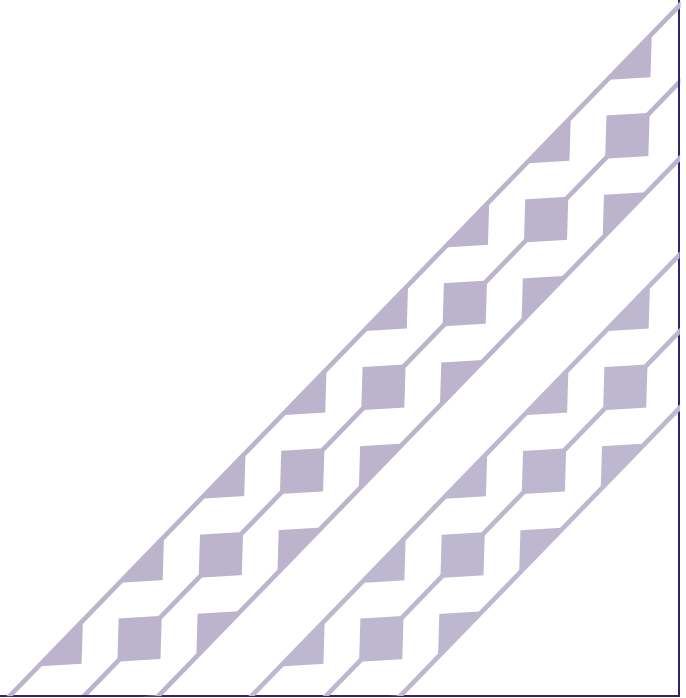




**Hawaiian
Electric**

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.



GUIDE FOR UNDERGROUND DUCT LINE DESIGN
FOR THE
HAWAIIAN ELECTRIC COMPANY

Plans of the roads and monuments which are needed to lay out the duct line can generally be obtained from the City & County Engineering Division or the State Transportation Department. If no plans are available, field data must be taken by surveyors so that the road can be laid out. Duct line plans are generally drawn to a scale of 1" = 20'.

All existing manhole covers, driveways, fire hydrants, poles, etc., along the route of the proposed duct line must be located with respect to the known road monuments. Existing grade along the proposed duct line should be taken every 50 feet.

Existing underground lines can generally be determined by checking the field locations of the manhole covers against the records of the various utilities such as gas, water, telephone, electricity, street lights, sewers and storm drains. Elevations may be checked wherever the utility passes through a manhole. However, this method is only approximate.

The City Planning Commission should be consulted for future plans, especially road changes and set-back lines which may affect the duct line. Future plans of the other utilities should also be considered. Should it be necessary to obtain a more accurated location of a water line, the Board of Water Supply can arrange to have metal pipes in the ground checked with their instruments.

The layout of an underground duct line depends on the location of the manholes involved. The problem of locating the manholes should, therefore, be considered first before the duct line is laid out.

The distance between manholes on a street run is limited only by the length of cable that can be pulled into the duct line. The tension required to pull the cable into the duct must not exceeded that recommended by the cable manufacturer. Cable handling equipment such as reels and reel supports also limit the length of cable that can be handled.

In working with the 3/c 46 Kv 600 MCM LPGF cable, the practice has been to limit the manhole spacing to 800 feet. When spacing manholes along a straight section of road, the distance between manholes should be made as nearly equal as possible.

Quite frequently, the manhole must be located at an intersection. The manhole opening should be so located that a winch truck or cable reel placed at the manhole opening does not cause excessive interference with vehicular traffic.

When a manhole is to be built in the sidewalk area, consideration must be given to future road widening plans, so that the manhole cover will not fall in the space which will be occupied by the future curb or gutter. Difficulty will be experienced in construction as well in future use if the manhole is built under an overhanging structure.

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| DRAWN | CT | DESIGNED | RM | APPD | TN | RDL | VEC | REDRAWN | |
| SUPERSEDES | | | | DUCT LINE DESIGN GUIDE UG DUCTS & STRUCTURES | | | | ORIGINAL | 9-14-70 |
| ENGINEERING STANDARD HAWAIIAN ELECTRIC CO. INC. | | | | | | | | 30-1006 | REV 2 |
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The manhole opening should be located outside of the parking lane, so that access to the manhole will not be blocked by parked cars. The manhole opening must be clear of the curb line and should be clear of the gutter.

Choose a location for the manhole free from underground obstructions. The site chosen should permit relocating of the manhole without major changes in case of the appearance of unrecorded underground structures such as old storm drains, sewers, or duct lines.

The duct line can now be laid out to connect the manholes. Layout of the duct line depends on different conditions. Some factors to consider in laying out the duct line are maintaining an adequate radius of curvature, avoiding underground obstructions, keeping the duct line square to the window face, and keeping out of the curb and gutter areas. Construction costs will be less if the curb and gutter need not be disturbed.

When planning the route of a duct line, it should be kept in mind that sewers, duct lines, and storm drains cannot be relocated except at prohibitive cost. Water and gas mains may be rerouted with the cost depending on the size of pipe involved. Service lines may be moved at relatively little expense.

Duct line curvature, both horizontal and vertical, should be designed to have at least 300 feet radius, but field conditions frequently require that a lesser radius be used. The minimum permissible radius for any duct line curve should be determined by the number of curves as well as the length of that section of duct line.

Where possible, the duct line should be laid out parallel to the center line of the road. Complete ties should be made to locate the duct line with respect to road monuments.

The Planning Division will determine the number and size of ducts to be used in the duct line. With a 1½" spacing between ducts and a 3" concrete envelope around the ducts, determine the height and width of the concrete duct line.

With the complete picture of underground obstructions plotted on a profile sheet, the profile of the duct line can be laid out. The profile drawing is most conveniently shown on a distorted scale such that 1" = 2' vertically while horizontally 1" = 20'.

Clearances between duct lines and other utilities shall meet all applicable requirements in the National Electric Safety Code (NESC). Any clearance conflicts shall be resolved by the appropriate authority, utility or agency having jurisdiction.

The duct line should have the required cover and should not go any deeper than necessary to avoid obstructions. As a general rule, a minimum slope of 3" per 100 feet of duct line is maintained for drainage of the ducts if feasible. If the location of underground structures make it difficult to provide drain, it may be left out.

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Where sharp vertical curves are indicated on the distorted scale, the profile scale should be expanded to obtain a true picture of the curve radii.

Not infrequently, a profile drawing of the tentative path of the duct line will indicate that there are too many underground obstructions to permit the full height of the duct line. This problem is generally solved by transposing the ducts into a flat configuration, thereby decreasing the required vertical space for the duct line. However, this solution requires a corresponding increase in the duct line width.

Sometimes, rerouting of the duct line plan will permit the duct line to cross the obstruction at a more convenient point, or sometimes even avoid the crossing altogether.

Where the duct line needs to be transposed into a special configuration, a 1/2" = 1' scale drawing of the roll, showing the plan and elevation of the center lines of each duct in the roll, will provide information for trench width and grades as well as for determining the length of duct line needed for the roll. Duct curves in the roll, as elsewhere, should be limited to a minimum radius of 300 feet.

Wherever the duct arrangement changes in the duct line, a cross section view of the duct line should be drawn. The ducts should be so numbered that in the manhole, the duct numbers are read from left to right, then top to bottom, as in reading a printed page. Where an odd duct is encountered, it shall have the last number of the series.

Oftentimes, reinforcing steel in the duct line will provide additional structural strength for special conditions such as poor soil support or crossing under railroad tracks. The Initiating Division should be consulted before designing any reinforced duct line sections.

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MINIMUM SEPARATION CLEARANCES TO EXISTING UNDERGROUND DUCTLINES
HORIZONTAL (PARALLEL)

| Utility Being Installed | Existing Direct Buried Cable | Existing Direct Buried in Conduit No Concrete Encasement | Existing 3" Concrete Encasement | Applicable Notes |
|-------------------------------|------------------------------|--|---------------------------------|------------------|
| HECO DB Conduit | 12" | 3" | 0" | |
| HECO 3" Encasement | 0" | 0" | 0" | |
| Telephone/ CATV DB | 12" | 12" | 6" | |
| Telephone/ CATV DB Ducts | 12" | 12" | 6" | |
| Telephone/ CATV 3" Encasement | 0" | 0" | 0" | 6 |
| Traffic Signal | 12" | 12" | 12" | |
| Water DB | 36" (96" HELCO) | 36" (96" HELCO) | 36" (96" HELCO) | 1, 5 |
| Water Service Lateral | 12" | 12" | 12" | |
| Water (Concrete Jacketed) | 36" (96" HELCO) | 36" (96" HELCO) | 36" (96" HELCO) | 1, 5 |
| Gas DB | 12" | 12" | 12" | 1 |
| Gas (Concrete Jacketed) | 12" | 12" | 12" | 1 |
| Sewer DB | 36" | 36" | 36" | 1, 2, 3 |
| Sewer (Concrete Jacketed) | 36" | 36" | 36" | 1, 2, 3 |
| Drain | 12" | 12" | 12" | 1 |
| Fuel Pipelines | | | | 4 |

Notes:

- Where space is available, parallel clearance to other utilities or foreign structures other than communication or traffic signal shall be 36".
- For MECO and HECO, if 36" clearance cannot be met:
Clear < 12" - Jacket sewerline with reinforced concrete per std 30-1030 for a distance of 5ft + pipe diameter. 12" < clear < 36" - Jacket sewerline with plain concrete
- For HELCO, if 36" clearance cannot be met:
Jacket sewer line and HELCO DB cable and conduit with reinforced concrete for a distance of 5 feet + pipe diameter.
- All fuel pipeline crossing shall be reviewed by the company that owns & maintains it.
- For Oahu only, 5 feet clear to water mains 16 inches and larger. For island of Hawaii only, 8 feet clear to all water main sizes.
- For situations with 0" minimum separation, a 6" separation is recommended.
- Clearances measured from outer edges or diameters of utilities.

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DUCT LINE DESIGN GUIDE
UG DUCTS & STRUCTURES

MINIMUM SEPARATION CLEARANCES TO EXISTING UNDERGROUND DUCTLINES
VERTICAL (CROSSING)

| Utility Being Installed | Existing Direct Buried | Existing Direct Buried in Conduit No Concrete Encasement | Existing 3" Concrete Encasement | Applicable Notes |
|-------------------------------|------------------------|--|---------------------------------|------------------|
| HECO DB Conduit | 6" | 3" | 0" | |
| HECO 3" Encasement | 0" | 0" | 0" | |
| Telephone/ CATV DB | 12" | 12" | 6" | |
| Telephone/ CATV DB Ducts | 12" | 12" | 6" | |
| Telephone/ CATV 3" Encasement | 0" | 0" | 0" | 6 |
| Traffic Signal | 12" | 12" | 6" | |
| Water DB | 6" | 6" | 6" | 4 |
| Water Service Laterals | 6" | 6" | 6" | |
| Water (Concrete Jacketed) | 6" | 6" | 6" | 1, 4 |
| Gas DB | 12" | 12" | 12" | |
| Gas (Concrete Jacketed) | 12" | 12" | 12" | |
| Sewer DB | 24" | 24" | 24" | 2, 3 |
| Sewer (Concrete Jacketed) | 24" | 24" | 24" | 2, 3 |
| Drain | 12" | 12" | 6" | |
| Fuel Pipelines | | | | 5 |

Notes:

- Meco Concrete Encase 5' feet on either side.
- For MECO and HECO, if clearance cannot be met:
Clear < 12" - Jacket sewerline with reinforced concrete per std 30-1030 for a distance of 5ft + pipe diameter. 12" < clear < 24" - Jacket sewerline with plain concrete.
- For HELCO, if clearance cannot be met:
Jacket sewer line and HELCO DB cable and conduit with reinforced concrete for a distance of 5 feet + pipe diameter.
- For MECO and HECO, 12" vertical clearance for pipe diameters > 16".
For HELCO, 16" vertical clearance shall be maintained for all water pipe diameters.
- All fuel pipeline crossing shall be reviewed & approved by the company that owns & maintains it.
- For situations with 0" minimum separation, a 6" separation is recommended.
- Clearances measured from outer edges or diameters of utilities.

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