MANUAL

DESIGN AND INSTALLATION OF TELEPHONE CABLING

DEP 32.71.00.16-Gen.

December 1997

DESIGN AND ENGINEERING PRACTICE

PREFACE

DEP (Design and Engineering Practice) publications reflect the views, at the time of publication, of:

Shell International Oil Products B.V. (SIOP)
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and
Shell International Chemicals B.V. (SIC)

The Hague, The Netherlands,

and other Service Companies.

They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Group Operating companies. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use DEPs they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will expect them to follow those design and engineering practices which will achieve the same level of integrity as reflected in the DEPs. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal or its technical advisor.

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2) Other parties who are authorized to use DEPs subject to appropriate contractual arrangements.

3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) or 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

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All administrative queries should be directed to the DEP Administrator in SIOP.

NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

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1. INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for the design and installation, outside office buildings, of telephone cables used by voice (PABX) systems. This DEP supplements DEP 32.71.00.10-Gen. and DEP 32.71.00.12-Gen., and is complementary to DEP 32.71.00.30-Gen. which deals with data and voice cabling inside office buildings.

For cabling within the battery limits of oil, gas or chemical plants, and for offshore installations, see DEP 32.37.20.10-Gen.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIOP and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors nominated by them (i.e. the distribution code is "C", as described in DEP 00.00.05.05.-Gen.).

This DEP is intended for use in oil refineries, gas plants, chemical plants, oil and gas production facilities, and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.4 ABBREVIATIONS

ALPA	Aluminium PVC Armoured
DP	Distribution Point
HDPE	High Density Poly Ethylene
MDF	Main Distribution Frame
PVC	Poly Vinyl Chloride

1.5 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced in this DEP are listed in (7).

2. DESIGNING THE TELEPHONE NETWORK

2.1 SERVICE ZONES

When a new network is designed or an existing network upgraded, the planned service area should be split into zones. A zone is an undivided geographic area where telephone service is needed. For small installations, there may be only two zones, one covering the plant / office complex and the other the Residential Area. For larger installations there will be more than two zones.

The cable plant in a zone will be planned on the basis of the ultimate number of subscribers. Care should be taken not to underestimate this number since it can be expensive to increase it at a later date.

2.2 NETWORK HIERARCHY

The telephone network follows a 'tree and branch' design starting from the telephone exchange, spreading into a zone through primary cables, secondary cables and finally the building distribution cables serving individual telephones.

Depending on the ultimate number of subscribers it will contain, a building will be supplied from a primary or secondary distribution cable.

2.3 SPARE PAIRS AND FLEXIBILITY POINTS

Because it is difficult to determine the exact locations of subscriber growth within a zone, the primary and secondary cables should have at least 30% spare pairs, or more, if significant subscriber growth can be foreseen.

The junction boxes between the primary, secondary, and distribution cables are called flexibility points since they provide the necessary flexibility to cater economically for growth in different areas within the service zone.

2.4 CHOICE OF INSTALLATION METHOD

There are three methods of installing telephone cable, viz. overhead, ducted or direct burial.

Overhead cabling requires special cable, equipment, techniques, and safety measures. This practice shall not be used in Shell locations since unprotected overhead cable in industrial areas is vulnerable to damage by cranes and heavy plant and in residential areas it looks unsightly.

NOTE: Within the battery limit of processing plants, telephone cable distribution should follow DEP 32.37.20.10-Gen.

Ducting involves laying plastic pipe or special 'phone-duct' in the ground, then pulling the cable through. This technique should be used in large installations when subscriber growth patterns are not known and the digging costs are high, for example in rocky areas. Once the duct is laid, additional cables can be pulled through at very low cost. However, specialist knowledge and equipment, such as a cable winch and pulling tackle is needed. Ducting should not be used:

- for small installations which are designed and installed without expert knowledge or equipment,
- if the ground is permanently wet since the duct will collect water and mud over the lifetime of the installation and it will be difficult to pull new cables,
- in locations where hydrocarbons are encountered (refineries, chemical plants and storage depots) since the duct could fill with 'heavier than air' vapours and become a zone 0 hazardous area.

Direct burial involves laying the cable in a trench and back-filling. This is the simplest way of installing telephone cable but the cable used shall be armoured which increases the cost.

Specifications for outdoor telephone cable suitable for laying in ducts or for direct burial are

given in (Appendix 1).

2.5 TERMINATION TECHNIQUE

Insulation Displacement Technique (where prongs of the connector pierce the insulation surrounding the conductor) shall be used throughout the network for all connections. This technique allows high productivity and provides integrity and consistency of the connections, even those made by unskilled technicians. Single conductor wire shall be used with a diameter not exceeding 0.63 mm.

Screwed or soldered connections shall not be used for new installations.

3. DETAILED NETWORK DESIGN

3.1 MAIN DISTRIBUTION FRAME (MDF)

The MDF is the interface between the telephone exchange and the cable network. The telephone exchange and MDF frame shall be sized as described in Section 3.2 of DEP 32.71.00.10-Gen. to cover all foreseeable growth in all zones. Since additional connector blocks can be added to the frame at a later date it is only necessary to insert sufficient connectors for the current number of subscriber lines. Pairs from the telephone exchange are connected to terminals arranged horizontally while the pairs to the distribution are connected to terminals arranged vertically. The horizontal and vertical terminals are linked by jumper wire. The vertical connections shall have built-in discharge tube protectors or fuses to protect the exchange against lightning surges.

3.2 PILLAR

When the ultimate number of subscribers in a zone has been decided, a self-standing junction box called a 'pillar' should be sited in the zone located at or near the 'geographic centre of gravity' of the subscribers. Small installations should use only one pillar per zone for simplicity. The pillar should be easily accessible, usually near the roadside, but with sufficient clearance to allow technicians to work on it safely without the risk of being hit by passing traffic. The pillar should be mounted on a concrete foundation or plinth with cable entry at the back and the whole installation should be protected from vehicles by means of steel pipe. The plinth may be extended with an apron at the front to provide dry standing for technicians working on the pillar.

The feeder cable from the MDF should have enough pairs so that there is not a shortage in the foreseeable future. It is not recommended to exceed 100 pairs per cable since this is a comfortable maximum to work with and to joint. If more than 100 pairs are needed, multiple 100-pair cables can be laid. In small installations, if more than 300 pairs are needed to a single pillar, it is recommended that the original zone be split into smaller zones, each with its own pillar.

The main cable(s) should be connected to the MDF and the pillar in matching pair sequence, i.e. pair 1 on the MDF is pair 1 in the pillar. This makes record keeping and fault tracing easier.

3.3 DISTRIBUTION POINT (DP)

DPs are used to extend the connections further towards the subscriber. The exercise described above should be repeated, but on a smaller scale. Ideally, the DP should be located at the 'centre of subscriber gravity' but it is more important that its position is selected for a convenient cable route to the subscribers. The DP will not normally be self-supporting but attached to a convenient building or other existing structure. It should be located in a dry place between 1 m and 1.5 m from the ground to allow easy access for technicians to test the pairs and to rearrange the jumpering.

If the DP is intended to serve offices in a block, it will usually be installed indoors in a utility room. It is very important to ensure easy access for maintenance. The DP (or pillar) should not be blocked by air-conditioning plant or switchgear or by possible extensions to them. It is also important to keep the telephone wiring as far away as possible from the power wiring to avoid inductive pick-up.

A cable (usually 25-pair) will be laid between the pillar and the DP and terminated at both ends. Matching pair sequence should be used.

For small installations the number of different sizes of cables used should be minimised since this will reduce the holding of spare lengths and jointing hardware.

3.4 JUMPERS

At each junction box, pillar or DP, all pairs of the incoming and outgoing cables shall be separately terminated. This allows individual pairs to be tested in isolation. Jumpers are required to link the incoming pair with the outgoing pair to extend the telephone service to

the subscribers.

When pillars are first installed, it is not known exactly where the growth in demand will occur within the zone and the pillar provides the flexibility to connect new subscribers. A certain number of spare pairs should be jumpered through each pillar to the DPs. This allows a quick and easy response to a new request or restoration of service by means of a change of pair.

3.5 SUBSCRIBER CONNECTION

The specification for the subscriber connection in offices is contained in DEP 32.71.00.30-Gen.

For residential distribution there shall be a direct feed from the last DP to the individual houses and 2-pair cable should be used for this purpose. A termination box shall be installed on the wall of the house as the interface between the underground cable and the indoor wiring. The location of this box should be chosen so that it is sheltered from the rain but still accessible for servicing without the repairman standing on ladders or requiring access to the house.

3.6 INTERNAL BUILDING WIRING

The specification for the internal wiring in offices is contained in DEP 32.71.00.30-Gen.

In residences, distribution sockets should be planned for all main rooms. For large living rooms, several sockets in different locations should be provided to allow different furniture layouts without recabling the telephone. All internal telephone outlets shall be provided from PVC concealed conduits at least 20 mm in diameter. Note that a conduit size of less than 20 mm makes cable pulling difficult. PVC cable with 2 mm x 2 mm x 0.5 mm solid annealed copper conductors plus earth wire shall be pre-installed in the conduit and cabled back to the termination box described above.

If conduit is installed in the roof space all the joints shall be sealed. This is particularly important in tropical areas since the rooms are air-conditioned while the roof space is not. If the conduit is left open, water condenses in the conduit and runs down into the telephone socket resulting in rapid corrosion of the metal parts and unsatisfactory service.

3.7 DISTRIBUTION SOCKETS

DEP 32.71.00.30-Gen. gives advice on distribution and termination inside office buildings.

For residences, the distribution wiring shall terminate in RJ11 sockets (ISO/IEC standard 4-pin modular connector) or RJ45 sockets (ISO/IEC 8877 8-pin modular connector), to be decided by the Principal.

3.8 SPECIFICATION FOR PILLARS, DPs AND PREMISES DISTRIBUTION

Specifications for Pillars, DPs and Premises Distribution are given in (Appendix 2).

4. INSTALLATION

4.1 CHOICE OF CABLE ROUTE

The cable route should be chosen with care, so as to be separate from power cables (see also ITU-T recommendation K8). It will usually run alongside permanent roads not subject to realignment. The aim is to provide easy access to the cable throughout its life without disrupting traffic. Cable should therefore not be routed under buildings, either present or future, or through areas which are subject to construction activities. Road crossings should be provided with a 100 mm or 150 mm diameter steel pipe to allow future cables to be pulled through without digging up the road a second time. A draw rope shall be installed with which to pull the initial cable through the pipe and a new draw rope should be installed every time a new cable is pulled. This will allow subsequent cables to be pulled easily.

When laying out duct routes:

- plan on a straight length of 100 m maximum;
- allow a turning chamber every time the route changes direction;
- hand holes may be used for turning chambers in duct routes containing less than 100 pairs.

4.2 DIGGING

When digging a trench for duct or direct burial the following points are important:

- follow the site excavation or 'digging' permit procedures;
- make sure that all existing services are located and marked before starting to dig;
- use only hand digging near existing services and take special care near high-tension electric cables;
- trenches shall be at least 600 mm deep;
- in soft ground or for deep excavations use shuttering to prevent the sides of the trench caving in;
- the bottom of the trench should be smooth with all large stones removed;
- a layer of sand should be spread evenly over the bottom of the trench to cover it completely;
- when using duct make sure that the draw rope is installed;
- for direct burial only armoured cable shall be used;
- make sure that the cable does not kink while it is being laid;
- the cable or duct should be laid in the centre of the trench;
- more sand should be poured on top of the cable or duct to cover it completely;
- the trench should be back-filled and consolidated;
- the original surface should be reinstated.

See also DEP 34.13.20.31-Gen. for cable trenches.

If the cable is laid for termination at a later date, do ensure that the ends of the cable are left sufficiently long for termination in the junction boxes and buildings and also that the ends are left protected.

4.3 UNDERGROUND TURNING CHAMBERS (MANHOLES)

Local safety procedures shall be followed when entering underground turning chambers. These include:

- cordoning off or marking of the work site to prevent vehicles or people falling down open manholes;
- checking for a sufficient supply of oxygen, preferably on a continuous basis, but at least before entering the manhole for the first time each day;
- checking for hydrocarbons (explosimeter test), preferably continuously, but certainly before carrying out any hot work.

NOTE: A portable gas detector should be used which is capable of continuously monitoring both oxygen and hydrocarbons.

5. AS-BUILT DOCUMENTATION

The following documents are required for a telephone distribution network and should be provided by the installation contractor. They are:

- marked-up map and plot plan showing the exact location of cables, manholes, flexibility points and final distribution points;
- diagram showing the main cables;
- primary connection point and cable diagram;
- MDF termination layout;
- typical cable burial details;
- typical DP installation.

Note that the original maps and plot plans will usually be provided by others.

The MDF records for small networks can be kept on cards, with the details written in pencil so that they can be easily changed. For larger networks a computer record system is preferable. This should be capable of registering spare pairs throughout the network.

6. MAINTENANCE

A properly installed network should give very little trouble, except in the case of accidental excavation of a cable. It is therefore vital to ensure that no machine excavation takes place in the vicinity of the cables. If not already in force, a system of excavation or 'digging' permits should be introduced to protect all services, not just the telephone cables. Accurate maps, either on paper or electronic, shall be kept up to date and all changes and additions registered.

7. REFERENCES

In this DEP reference is made to the following publications:

NOTE: Unless specifically designated by the date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Instrument signal lines	DEP 32.37.20.10-Gen.
Plant telecommunication	DEP 32.71.00.10-Gen.
Telecommunications for offshore platforms	DEP 32.71.00.12-Gen.
Structured cabling systems for telecommunications	DEP 32.71.00.30-Gen.
Roads, paving, surfacing, slope protection and fencing	DEP 34.13.20.31-Gen.

INTERNATIONAL STANDARDS

Information technology; telecommunications and information exchange between systems; interface connector and contact assignments for ISDN basic access interface located at reference points S and T — ISO/IEC 8877

Issued by:
International Organisation for Standardisation
1, Rue de Varembé
CH-1211 Geneva 20
Switzerland.

or:
Central Office of the IEC
3, Rue de Varembé
CH 1211 Geneva 20
Switzerland.

Copies can also be obtained from national standards organizations.

Separation in the soil between telecommunication cables and earthing system of power facilities — ITU-T Recommendation K8

Issued by:
International Telecommunications Union
General Secretariat - Sales Section
Place des Nations
1211-Geneva 20
Switzerland.

APPENDIX 1 SPECIFICATION OF OUTDOOR TELEPHONE CABLE

1. SUITABLE FOR LAYING IN UNDERGROUND DUCT

XXX pair (see NOTE 1) Telecommunication cable, 110 volt, polyethylene insulated, screened, ALPA sheath, HDPE sheathed, suitable for laying in underground duct.

- Conductors of high-conductivity solid plain annealed copper 0.63 mm diameter, covered with high density polyethylene insulation to withstand 110 V;
- inner polyethylene jacket with jelly fill or other water blocking agent;
- aluminium tape or extruded aluminium shield with drain wire;
- outer polyethylene jacket;
- extruded outer sheath of HDPE.

2. SUITABLE FOR DIRECT BURIAL

XXX pair (see NOTE 1) Telecommunication cable, 110 volt, polyethylene insulated, screened, ALPA sheath, steel wire armoured, HDPE sheathed, suitable for direct burial in the ground.

- Conductors of high-conductivity solid plain annealed copper 0.63 mm diameter, covered with high density polyethylene insulation to withstand 110 V;
- inner polyethylene jacket with jelly fill or other water blocking agent;
- aluminium tape or extruded aluminium shield with drain wire;
- outer polyethylene jacket;
- single armouring layer of galvanised steel wires;
- extruded outer sheath of HDPE.

3. ACCESSORIES

Jointing kit, in-line style, for 100-pair telecommunication cable with 0.63 mm conductors and drain wire, resin casting type, complete with conductor jointing clips, mould, resin and accessories.

NOTE 1: Suggested standard number of pairs for outdoor cable:

100 pair - Primary distribution cable MDF to Pillar.

25 pair - Secondary distribution cable from Pillar to DP.

(10 pair) - Optional secondary distribution cable. For smaller installations use 25 pair.

2 pair - Drop wire for connection of individual house wiring to DP.

APPENDIX 2 SPECIFICATION OF OUTDOOR TELEPHONE PILLARS, DPs, AND CUSTOMER PREMISES DISTRIBUTION BOXES

Pillars

Free standing, plinth mounted, weatherproof cabinet (polyester or similar) equipped with separate rows of insulation displacement connectors for incoming and outgoing cables of up to 0.63 mm diameter, and with ground bar. Cable entry underneath. The suggested size is:

- incoming 100 pair and 4 X 25 pair outgoing

DP's

Wall-mounted, weatherproof cabinet equipped with one or more rows of insulation displacement connectors for incoming and outgoing cables and with groundbar. Cable entry underneath. The suggested sizes are:

- 25 pairs incoming, 3 X 10 pairs outgoing (or 2 X 25 outgoing if local standard).

Premises distribution (outdoor)

Wall-mounted, weatherproof cabinet equipped with one or more rows of insulation displacement connectors, with groundbar and with the option of gas discharge tube protection. Suggested size is:

- 4 pairs incoming, 10 pairs outgoing.