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NATIONAL IRANIAN OIL REFINING & DISTRIBUTION COMPANY
NATIONAL IRANIAN OIL ENGINEERING
& CONSTRUCTION COMPANY

NIOEC SP

NIOEC SPECIFICATION FOR LOCAL AREA NETWORK (LAN)

FIRST EDITION

DECEMBER, 2017

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IN THE NAME OF GOD**FOREWORD**

By their very nature, technical Specifications are continuously subject to modifications and revisions. To strengthen their merit and usefulness, continuous improvements, addendum, deletion of disparate information and consequently provision of updated revisions are to be made in order to ascertain that such Specifications meet the current requirements, inclusive of Iranian Petroleum Standards (IPS) and the recognized and acceptable national and international Standards, as well as the optimal codes and practices based on the accumulated in-house know-how and plant knowledge and experiences.

However, in reality, due to several reasons, not to mention the complexity of the matter, the ultimate goal of continuous direct embedment of the required changes on the relevant Specifications may be far reaching. Therefore, in the interim periods between the officially issued revisions, the required changes will appear in other documents related to the engineering and design work of the ongoing projects.

In response to the initiative of the Design and Engineering Directorate, and considering that the task of the execution of several important and mega projects for the realization of the new oil refineries, pipelines and oil terminals as well as improvements of the existing facilities, has been assigned to NIOEC, it was decided to update the NIOEC Specifications and to issue new official revisions.

The Design and Engineering Directorate was itself entrusted to carry out this important task, and as such by forming several special technical committees, working in close co-operation and cohesion and sharing their expertise and knowledge, the updated and revised NIOEC Specifications were successfully prepared and complied.

These Specifications are intended to be used for Oil Refineries, Distribution Depots, Oil Terminals, Pipelines and Pump Stations within NIOEC's projects, and have been proven to be of high value for such purposes. It must however be appreciated that these Specifications represent the minimum requirements and should in no way be interpreted as a restriction on the use of better procedures, engineering and design practices or materials.

We encourage and highly appreciate the users and other clear sighted and experts to send their comments on the Specifications to the Design and Engineering Director of NIOEC for evaluation and approval.

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NOTES:

- 1) THIS SHEET IS A RECORD OF ALL REVISIONS TO THIS SPECIFICATION.
- 2) WHEN APPROVED EACH REVISION SHALL BE CONSIDERED AS A PART OF THE ORIGINAL DOCUMENT.
- 3) NUMBER OF PAGES EXCLUDES THIS SHEET AND THE COVER SHEET.

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INTRODUCTION

To satisfy the requirements of this NIOEC specification, Iranian Oil Pipelines and Telecommunication Company Instruction Manual of Designing and Installing LAN (IOPTC (Rev. 001)) with the modifications as specified hereinafter shall be strictly followed.

1. SCOPE

This specification defines NIOEC's minimum requirements for the design, material and construction of Local Area Network (LAN).

Deviations from this specification will only be permitted on obtaining written approval from NIOEC.

Resolution on cases not explicitly stipulated in this Specification, or on cases where conflicts may arise among the requirements of the referenced IOPTC (Iranian Oil Pipelines and Telecommunication Company) Instruction Manual and the international standards, shall be made through written consent and approval of NIOEC.

2. REFERENCES

The following standards, codes, and specifications, to the extent specified hereinafter, shall constitute a part of this NIOEC Specification. Latest edition of the undated referenced documents and the cited edition of the dated references shall apply. The applicability of changes made to the dated references, after the cited date shall be mutually agreed upon between NIOEC and the Vendor /Contractor.

IEC (INTERNATIONAL ELECTRO-TECHNICAL COMMISSION)

IEC 60051	"Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories"
IEC 62040	"Uninterruptible Power Systems (UPS)"
IEC 60228	"Conductors of Insulated Cables"
IEC 60947-1	"Low-Voltage Switchgear and Controlgear- Part 1: General Rules"
IEC 60947-2	"Low-Voltage Switchgear and Controlgear- Part 2: Circuit-Breakers"

IOPTC MAN (IRANIAN OIL PIPELINES AND TELECOMMUNICATION COMPANY INSTRUCTION MANUAL)

IOPTC (Rev. 001)	"Instruction Manual of Designing and Installing LAN"
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ISO (INTERNATIONAL STANDARD ORGANISATION)

ISO9001	"Quality Management Systems- Requirements"
ISO14001	"Environmental Management Systems- Requirements with Guidance for Use"

NIOEC SP (NIOEC SPECIFICATIONS)

NIOEC-SP-00-10

“Specification for Units”

TIA (TELECOMMUNICATIONS INDUSTRY ASSOCIATION)

ANSI/TIA/EIA-606-A

“Administration Standard for Commercial Telecommunications Infrastructure”

ANSI/TIA-607

“Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises”

TIA-TSB-155

“Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T”

3. UNITS

International System of Units (SI) shall be used in accordance with NIOEC-SP-00-10, unless otherwise specified.

4. ABBREVIATIONS**ABS:** American Bolt and Screw**DSL:** Digital Subscriber Line**FTP:** Foiled Twisted Pair**HDTRD:** High Definition Time Domain Xtalk (Crosstalk)**IP:** Ingress Protection**LAN:** Local Area Network**LC:** Lucent Connector**LSZH:** Low Smoke Zero Halogen**OTRD:** Optical Time Domain Reflector**PoE:** Power over Ethernet**PVC:** Poly Vinyl Chloride**RMS:** Root Mean Square**SC:** Subscriber Connector**SFTP:** Shielded and Foiled Twisted Pair**SM:** Single Mode**SNMP:** Simple Network Management Protocol**THD:** Total Harmonic Distortion**UPS:** Uninterruptible Power Supply**UTP:** Unshielded Twisted Pair**WAN:** Wide Area Network

5. ADDENDUM TO IOPTC INSTRUCTION MANUAL OF DESIGNING AND INSTALLING LAN

This addendum revises the below listed articles of the referenced document, other clauses remain without any change.

Article 10: FIBER OPTIC PATCH PANELS (Modification)

Substitute the first sentence of second paragraph with the following sentence.

“The accepted brands of patch cord, patch panel and optical fiber pigtail are as follows or compatible with the brand of other devices including cables.”

Article 16.9: Codes and Standards for Emergency Power Supply (Substitution)

Codes and standards for emergency power supply are listed in the following table:

Code	Description
IEC 60051	Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories
IEC 60947-1	Low-Voltage Switchgear and Controlgear- Part 1: General Rules
IEC 60947-2	Low-Voltage Switchgear and Controlgear- Part 2: Circuit- Breakers
IEC 60228	Conductors of Insulated Cables
IEC 62040	Uninterruptible Power Systems

Article 19.2: Fiber Optic Network Test (Modification)

Modify the first paragraph as follow:

- o According to the TIA TSB-155 (Technical Service Bulletin) standard, for a fiber optic test, it is necessary to use a device similar to the copper cable analyzer.



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Telecommunication Management

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1- IMPORTANCE OF THE BUILDINGS

The buildings are classified according to the importance of the use and availability of buildings as follows:

Type A: Buildings with high relevance and availability, in which the redundancy is reached as high as possible. The connection between these buildings and network center is through fiber optics, usually with two separate connections.

Moreover, the network center is usually located in administration/telecommunication buildings (where the telecommunications routers are installed). Core switches are installed in these buildings. In order to install the network servers, a separate location with the appropriate facilities (cooling system, UPS, fire fighting system, and etc.) shall be available.

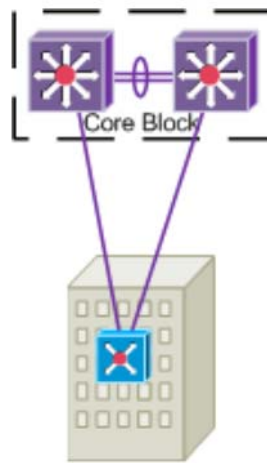


Figure 1- Type A Buildings

Type B: Buildings that take second place and in which no redundancy is considered. The connections between these buildings and the network are made via a fiber optic link.

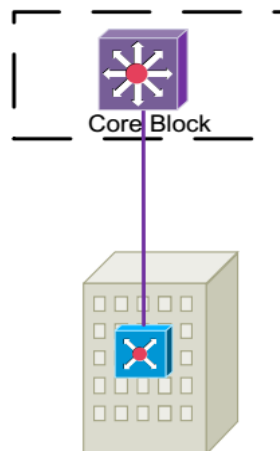


Figure 2- Type B Buildings



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Type C: Buildings which have telephone communications with the center and whose network communications are DSL connections.

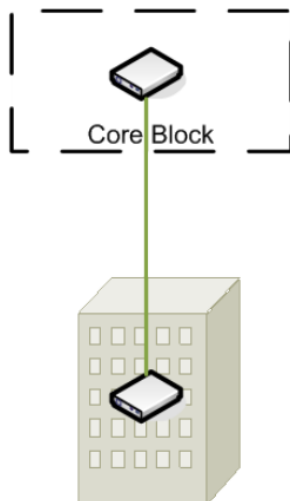


Figure 3- Type C Buildings

Type BW: Buildings whose connection to the network, such as type B, is via fiber optic and in which a wireless service also is required.

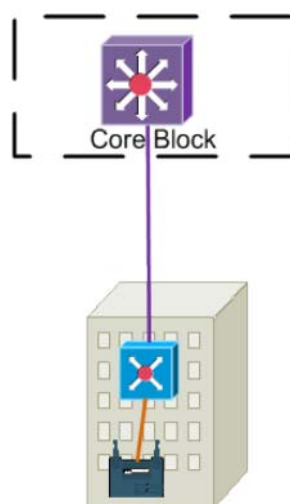


Figure 4- Type BW Buildings

Type CW: Buildings whose connection to the network is such as type C and in which a wireless service also is required.

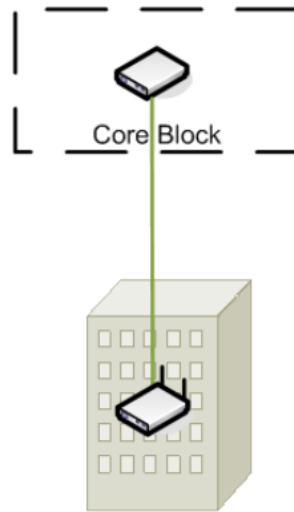


Figure 5- Type CW Buildings

It should be noted that the type of buildings will be determined by the district manager and telecommunication management experts. However, a Type A link shall be established between all buildings to connect buildings and network easily when the future use of the buildings is changed.

The following items shall be considered in projects:

- The design of the Active Network area shall be based on three layers: core, distribution and access.
- Network administrators and supervisors shall have enough information about structured cabling and Network design concepts.

2- WORK NODE

A network node in the pipelines and the telecommunications network of The Iranian Telecommunication Company from the perspective of the computer network is:

- Two network ports
- An UPS-powered power port Emergency power port supplied with UPS
- A public network electricity connection
- Two analogue telephone ports with the definition of telecommunication

A network outlet is displayed in Figure 6.



Figure 6- Two Ports Network Wall Outlet



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Moreover, industrial network outlets shall be used in the control buildings and near the control system equipment (Marshall Rack). In Figure 7, a sample of these network outlets is shown.



Figure 7- Industrial Network Outlet

Each of these outlets has 2 ports for network communication. Two complete outlets (four ports in total) shall be installed at each location. This means that four industrial ports per Marshall Rack shall be considered. These outlets shall be industrial type and IP67 and shall be installed according to manufacturer's instructions.

The following items shall be considered for each work node:

- All network outlets shall be "Cat.6 FTP" in office buildings and "Cat.6SFTP" in industrial buildings.
- The height of the installation of outlets from the ground shall be based on building standards.
- Standard symbols for data network shall be used in documents.
- The location of the network nodes shall be according to the space and user layout. It should be considered a network node per 4 square meters in work space according to the above definition.

3- COPPER NETWORK CABLE

As already mentioned, two types of copper network cables shall be used in the buildings.

3-1- FTP Network Cable

There is an aluminum foil layer under the PVC layer of this network cable. In addition, a metal wire is pulled along the cable to compensate environmental noise (Drain Wire). This wire is the shield-connection between two points and so the keystone in the enclosures shall be connected to the Shield keystone according to the instructions.

3-2- SFTP Network Cable

Under the PVC layer of this cable, there are two metal layers, an aluminum foil layer and screen of tinned copper braiding layer. In addition, a metal wire is pulled along the cable to compensate for environmental noise (Drain Wire). This wire is the shield-connection between two points and so the keystone in the enclosures must be connected to the Shield keystone according to the instructions. Cat.6 FTP and Cat.6 SFTP network cables shall be one of the following brands. Otherwise, the necessary tests shall be carried out before using cables.

- NEXANS
- R&M
- CONNECTIX



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- CAE
- AMP
- HUBBELL
- SIEMON
- Unicom

The following points shall be considered during installation of the copper network cable and Cat.6 keystones:

- Before termination the network cable, the additional cable for termination on the side of the outlet shall be about 30 centimeters.
- On the side of the rack, the cable shall be kept sufficiently in a metal box of 40 x 60 and 20 cm depth, which is called a service loop box.
- In order not to deteriorate the technical characteristics of the cables used, the load on the cables is very important during installation in the conduit and shall not exceed 111 Newton (about 11 Kg). In order to avoid the possibility of a stronger force on the cable, the following points shall be considered:
 - Conduits shall be straight as much as possible.
 - More than two 90° bends in paths up to 30 meters length shall be avoided.
- For more than two bends in the path, the following shall be noted:
 - The maximum length of the route shall be 10 meters.
 - Conduit diameter shall be enlarged one size.
 - One of the bends shall be installed 30 cm away from the cable inlet.
- The maximum conduit length without window should be 45 m.
- In order to pull several cables at the same time, a cable shall be considered as a guide cable. Connect the two cables at a distance of 75 mm from the cable end to the guide cable; and in the same manner and with the above spacing, all the cables divided into two categories will be connected to the guide cable.
- To install the copper network cable, the minimum cable bending radius of 8 times the outer diameter of the cable shall be considered.
- During the cabling, it is necessary to avoid falling cables under the feet.
- The keystone shall be sealed according to the Type-A standards.
- A PG29 Gland should be used to pass two cable strings and it is noteworthy that the PG13.5 Gland is too small to pass two cable strings
- A minimum distance between the network cable and the conduits which contain unshielded electrical cables shall be 10 cm.



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4- NETWORK PATCH CORDS

As mentioned in the standard, the connection between the network outlet and the network user and also between the patch panel and the switch shall be via the patch cords. If both patch cords are selected as a shielded type, a ground loop is generated in the system. For this reason, only one patch cord should be shielded and the other should be the UTP type. In this regard, the installed patch cord on the patch panel side shall be shielded and on the consumer side shall be UTP. The list of patch cords that are used is as follows:

- 1M SHIELDED CAT.6 PATCH CORD (FTP) LSZH (Using in Rack)
- 2M SHIELDED CAT.6 PATCH CORD (FTP) LSZH (Using in Rack)
- 2M UNSHIELDED CAT.6 PATCH CORD (UTP) LSZH (Using in Outlet)
- 3M UNSHIELDED CAT.6 PATCH CORD (UTP) LSZH (Using in Outlet)
- 5M UNSHIELDED CAT.6 PATCH CORD (UTP) LSZH (Using in Outlet)

5- NETWORK KEYSTONE JACK

Obviously the keystone shall be compatible with the flush mounted outlet frame installed on the wall during the construction phase. For this reason, one suggestion is that if the French style is to be taken into account, the keystone and the corresponding frame are selected to be able to be mounted within a framework of 45x45 mm French standard.

The keystone shall be CAT.6 shielded keystone jack for mounting in outlet or unloaded patch panels.

The approved brands for patch cord and keystone jack are either as follows or compatible with the brand of other devices including cables.

- NEXANS
- R&M
- CONNECTIX
- CAE
- AMP
- HUBBELL
- SIEMON
- UNICOM

To install the keystone, the following points shall be considered:

- The keystones termination shall be Type A standard.
- To install the keystone, the copper cable cover shall be removed up to 50 mm.
- It is noted that the cable metal foil shall be pulled one centimeter on the cable and then connected to the keystone metal part.
- The wires are individually inserted into the embedded junction box in the keystone and then punched.
- The appropriate punching tool, punch 110, should be used for punching.
- Do not untwist the wires as far as possible until they reach the punch.
- Pitch of twist shall not be larger than what is manufactured during pulling
- After installing the keystone, the maximum jacket distance to termination shall be 13 mm.
- The drain wire shall be connected to the keystone shield and locked by the related bonding.



6- NETWORK OUTLET

Network outlets shall be French style. The back box depth of network outlet shall be at least 5 centimeters.

7- FIBER OPTIC NETWORK CABLE

The following types of fiber optic network cables shall be used.

7-1- Outdoor Fiber Optic Cable

This type of cable has a corrugated steel armored layer that can be buried directly in the soil. However, in the plant area, this cable shall be passed through the polyethylene pipes inside the trench. The following items shall be considered for installation:

- The pulling tension shall not be greater than 350 Newton.
- The bending radius of this cable during the installation shall be at least 2 times the cable outer diameter and, after installation, shall be less than 15 times the cable outer diameter.
- The length of cable loops in each manhole is at least 5 meters on each side and they are arranged using the loop-cable tie hanger in the manholes.
- To install this type of cable, first a yarn shall be installed inside the conduit according to the **Error! Reference source not found..**

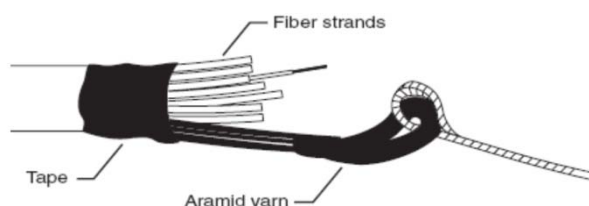


Figure 8- Installation of the outdoor fiber optic cable

- This type of cable is terminated in two ways in the entrance of the building.
 - o The fiber optic cable is connected to the indoor cable in a special box.
 - o The cable is inserted directly into the rack and is terminated in the fiber optic patch panel.
- All fiber optic cables shall be selected SM and armored type regardless of the distance between buildings. It is necessary to establish fiber-optic connection between the buildings and the telecommunication center of the site (the radio room). Experts have announced the number of strings which shall be minimum 6 strings and maximum 24 strings. The general specifications of the cables are as follows:
 - OUTDOOR SM, CENTRAL TUBE, GEL FILLED, FIBER OPTIC CABLE, 4000m PER REEL

7-2- Indoor Fiber Optic Cable

This type of cable has a LSZH cover that prevents smoke from burning during the fire. This type of cable is used inside the building. To avoid damage caused by non-standard installation, the followings shall be considered:

- The pulling force to install it inside the conduit shall not exceed 200 N (approximately 20 Kg).



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- The minimum bending angle for this type of cable at installation time is 15 and after installation 10 times the outer diameter of the cable.
- The yarn strings in the cable shall be used for pulling.
- The excess amount of fiber optic cable is kept in the service loop box alongside the rack.
- Use 6 to 12-strand fiber optic cables, depending on the requirements of each building.

The general specifications of the cables are as follows:

- INDOOR/OUTDOOR SM, LSZH, TB FIBER OPTIC CABLE, 2000m PER REEL

The approved brands of indoor and outdoor fiber optic cables are as follows; otherwise, the necessary tests on the fiber shall be carried out before procurement.

- NEXANS
- R&M
- CONNECTIX
- AMP
- CAE
- SIEMON
- HUBBELL
- UNICOM

8- FIBER OPTIC PATCH CORDS

Fiber optic patch cords are used to communicate between switches and fiber optic patch panels. In addition, the appropriate patch cord is used for communication between two switches. For this purpose, the following three types of patch cords are proposed for the above communications:

- SC-LC 1M DUPLEX SM OPTICAL FIBER PATCH CORD
- SC-LC 2M DUPLEX SM OPTICAL FIBER PATCH CORD
- LC-LC 2M DUPLEX SM OPTICAL FIBER PATCH CORD

9- PIGTAIL

For terminating fiber optic cables in patch panels, a pigtail with the following specifications is required:

- 1.5M, SC Simplex, SM, 900 Micron, Pigtail

10- FIBER OPTIC PATCH PANEL

All fiber optic cables are terminated in the fiber optic patch panels on both sides of line. Suitable cassette shall be used in the patch panels. Depending on the number of fiber optic strands terminated in the patch panel, this cassette can control the thermal crimp of 12 to 24 fiber optic strands. Fiber optic patch panel specifications are as follows:

- 6 SC PORTS (3 DUPLEX) SM FIBER OPTIC PATCH PANEL
- 12 SC PORTS (6 DUPLEX) SM FIBER OPTIC PATCH PANEL
- 24 SC PORTS (12 DUPLEX) SM FIBER OPTIC PATCH PANEL

The accepted brands of patch cord, patch panel and optical fiber pigtail are as follows:

- NEXANS



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- CONNECTIX
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- UNICOM

The following arrangements shall be considered in the fiber optic network of the sites:

- The fiber optic connection of all buildings shall be connected to the WAN center of the site. Obviously, this center can be a radio room, a control room or an office building. In any case, it is necessary to foreseen the fiber optic link to connect the buildings to the WAN center to connect the main switch and from there to the WAN.
- In order to connect the network between buildings, it is necessary to consider routes and execute drilling, piping and installing manholes at distances of 50 m. Also, SM fiber optic cables shall be used.

11- FIBER BOX

This box is installed at the entrance of the outdoor fiber optic cable to the building. In this box, the outdoor fiber optic cable connects to indoor fiber optic cable. A typical optical fiber box is shown in the Figure 9.

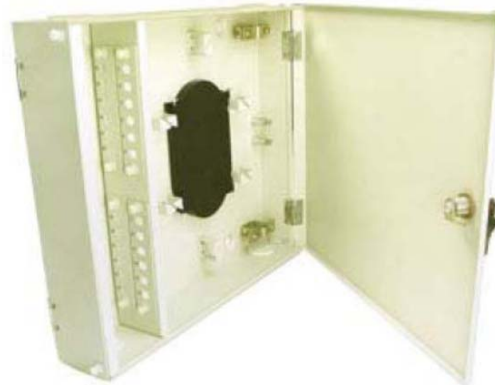


Figure 9- Fiber Box

These boxes are installed as follows:

- This box has two separate physical parts.
- At the entrance, the outdoor cables come into the box after they have passed the gland and after fixing at the entrance of the box, the cover is removed.
- After removing the cover, the tube containing the fibers is directed to the fiber optic cassette. This shall be done taking into account the minimum bending radius.
- The tubes are attached to a fusion cassette and, after retention; their tubes are removed at a distance of about 2 meters and prepared for the fusion process.
- This box will be installed on the wall with a suitable screw, washer and plug. The height of the bottom level of the box from the ground is about 130cm.



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12- GALVANIZED CONDUITS

Galvanized conduits (Intermediate Metal Conduit) which are available in 3 meter branches are connected to each other via coupling. A typical galvanized conduit is shown in Figure 10.



Figure 10- Galvanized Conduit

The following items shall be considered in installation of these conduits:

- To pull the cables, in every 20 meters of installed conduit, a metal junction box shall be installed. It shall be noted that for the connection of the conduit with this box, the corresponding glands shall be used so that there is no gap between the conduit head and the box.
- If the installer is forced to make the conduit short during installation, the end of conduit shall be threaded. Therefore, new threads shall be created as standard when connecting the two conduits.
- For the installation of these conduits on the wall, double base brackets which used to attach gas pipes to the wall with screw and plug shall be used.
- In situations where a part of the wall that comes into the path, makes the installation of conduits difficult, the conduits can be bent very precisely.
- Where the conduit route is changed, bends with door shall be used.
- Where several conduits are installed close together, they shall be installed in a straight line and parallel to each other.
- The number of cables per conduit shall be according to the following Table.

Inside Diameter (mm)	Trade Size	Cable Outside Diameter mm (in)							
16	1/2	1	1	0	0	0	0	0	0
21	3/4	6	5	4	3	2	2	1	0
27	1	8	8	7	6	3	3	2	1
35	1-1/4	16	14	12	10	6	4	3	1
41	1-1/2	20	18	16	15	7	6	4	2
53	2	30	26	22	20	14	12	7	4
63	2-1/2	45	40	36	30	17	14	12	6
78	3	70	60	50	40	20	20	17	7
91	3-1/2	-	-	-	-	-	-	22	12
103	4	-	-	-	-	-	-	30	14

- The following table shows the minimum bending radius for conduits.

If The Conduit Has An Internal Diameter of	The Bend Radius Must Be At Least
50 mm (2 in) or less	6 times the internal conduit diameter.
More than 50 mm (2 in)	10 times the internal conduit diameter.