Construction of Main Electrical Power Supply line
For the
Construction of Khan Younis Waste Water Treatment Plant Project
(KY WWTP)

Executing Entity: UNDP/PAPP

Employer: UNDP/PAPP

June 2018

Consultant

VOLUME 4 – ADDITIONAL DOCUMENTS, PROVIDED BY THE EMPLOYER

PART 1 – ADDITIONAL DOCUMENTS PROVIDED BY GEDCO

PART 2 – SAFETY GUIDELINES:

SAFETY AND HEALTH IN CONSTRUCTION: AN ILO CODE OF PRACTICE

SAFETY, HEALTH AND WELFARE ON CONSTRUCTION SITES: A TRAINING MANUAL

PART 1 – ADDITIONAL DOCUMENTS PROVIDED BY GEDCO

شـركة تـــــوزيع كهـرباء محافظــــــات غـزة

Gaza Electricity Distribution Corporation

General Specifications

For

Distribution Materials and Equipments

March 2013

1 GENERAL SPECIFICATIONS

1.1 Completeness of Contract

1.1.1 All apparatus, accessories or fittings which may not have been specifically mentioned, but which are usual or necessary in the respective equipment for the completeness of the finished work in an operable status, shall be deemed to be included in the Contract and shall be provided by the Contractor without any extra charge. All equipment shall be complete in all details, whether or not such details are mentioned in the Specifications. This includes fixation details and connection clamps and/or terminals.

1.1.2 Any reference in the quantity and price schedules, the delivery period schedule or in the various clauses and schedules of the text of either the Specification or the Bid, to any equipment shall imply that the equipment is complete with all accessories, apparatus and fittings as outlined in sub-clause 1.1.1 above.

1.1.3 The Bidder shall be responsible for ensuring that the equipment supplied is fit for the purpose intended. Available information on the characteristics of the system to which the works will be connected and associated will be supplied on request to the Bidder who shall be responsible for obtaining and determining all applicable knowledge relevant to the works.

1.2 Drawings and Documentation

The Contractor shall prepare and submit to the Engineer/GEDCO for approval dimensioned general and detailed design drawings and other pertinent information of all the Equipment specified in the Specifications.

The Contractor shall supply detailed instructions for erection, operation and maintenance of all equipment and components in English and preferably Arabic language.

In the event of any difference between the drawings and the Specifications, the latter shall prevail.

Approval of drawings shall not relieve the Contractor of his obligations to supply the Plant in accordance with the Specifications. In the event of any difference between scaled dimensions and figures on the drawings, the figures shall prevail

All text on drawings provided by the Contractor shall be in the English language in addition, if necessary, to that of the country of origin.

All drawings shall be dimensioned in millimeters.

1.3 Time of Delivery and Completion

The guaranteed delivery times shall be stated in the appropriate schedule in this document.

1.4 Quality of Materials

All materials supplied under this Contract shall be new and of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions arising under working conditions without distortion or deterioration in the setting up of undue stresses in any parts and also without affecting the suitability of the various parts of the Works for which they were designed. No toxic material (such as Halon, PCB, and Asbestos) shall be utilized.

1.5 Contractor's Quality Assurance Procedures

The Bidder shall have established a quality assurance system based on ISO 9001 or 9002. The Contractor shall include a documentation of the system with a list of current procedures, an organogram of the quality organization and the name of the quality manager. He shall also submit a list of quality revisions performed the last twelve months with a list of closed and unclosed findings as well planned revisions the coming twelve months.

The Contractor shall submit for approval a program of quality control and inspection procedures to assure that the product during manufacture and on completion complies with the specified requirements. The program shall relate the quality control and inspection activities to the production cycle. In support of the quality control and inspection program the Contractor shall provide details of quality control and inspection procedures available for use in the execution of the Contract. The Contractor shall retain responsibility for quality control and inspection activities made by his sub-contractors and shall indicate on the program, which items are to be sub-contracted.

1.6 Guarantees and Particulars

The Works shall comply with the technical guarantee data stated in the Bid. The Contractor shall be responsible for any discrepancies, errors and omissions in the particulars and guarantees, whether the Engineer/GEDCO has approved such particulars and guarantees or not.

1.7 Places of Manufacture and Sub-Contractors

The manufacturer's identity and places of manufacture, testing and inspection before shipment for the various portions of the Contract Works shall be specified in the Technical Schedules and shall not be departed from without the agreement of the Engineer/GEDCO.

All Sub-contractors and Sub-suppliers of components and materials shall be subject to the approval of the Engineer/GEDCO. Information shall be given on each Sub-order sufficient to identify the material or equipment, to which the sub-order relates, stating that the material is subject to inspection by the Engineer/GEDCO before dispatch.

All equipment offered shall be the product of recognized and experienced manufacturers and shall be proven equipment of the same basic design and size similar to that which has been in successful continuous operation for at least three years preferably under similar climatic conditions. Proven plant reliability and high availability are of prime importance and the attention of the Bidder is drawn to these particular requirements.

1.8 Inspection and Testing

All materials used in the Contract Works may be to inspection by the Engineer/GEDCO and it is the Contractor's responsibility to advise the Engineer/GEDCO when equipment and materials are available for inspection, at least 1 month in advance.

Factory tests on equipment shall be made according to the applicable IEC Standards, or as specifically specified or according to standards approved by the Engineer/GEDCO.

Routine tests shall be made on each unit of all equipment.

Type tests shall be made on one unit of each type of different equipment. Instead of carrying out the type tests the Contractor may submit suitable certificates of tests made on equipment of the same type; however, the Employer reserves the right of accepting these certificates or to reject them partially or totally.

The Engineer/GEDCO shall be at liberty to demand any additional testing at the manufacturer's works, at site or elsewhere in order to verify that the equipment complies with the conditions of the Specifications.

A test program shall be submitted to the Engineer/GEDCO for approval at least 1 month ahead of the commencement of testing.

Measuring apparatus shall be approved by the Engineer/GEDCO and if required shall be calibrated at the expense of the Contractor at an approved laboratory.

1.9 Packing, Transportation and Storage

Packing shall give adequate protection to the enclosed materials against mechanical damage during transport to its final destination, including rough handling during sea, rail and road transport and transition from one mode of transport to another.

Packing should be stout close-boarded wooden cases of adequate thickness, suitably braced and banded and lined internally with water-resistant material or equally solid enclosures.

Steelworks sections and similar items may be bundled provided that the ends are adequately protected and the enclosing bands or wires are robust.

Indoor electrical equipment must be enclosed in welded polythene envelopes inside packing cases and the envelopes shall be evacuated or have a desiccant inside.

All items in cases or crates shall be secured so that they are not free to move and cannot work loose in transport. If rotating parts are shipped within their bearings or mountings, they must be adequately braced and restrained to prevent relative movement. Loose items shall be placed in bags in a case, each bag having stitched onto it a label indicating the number and nature of its contents. Where a filler material is used in a case to restrict movement or provide additional protection, it must be inorganic and non-hygroscopic.

All surfaces liable to corrosion shall be thoroughly cleaned and special steps adapted to the nature of the materials and the time interval between packing and unpacking shall be taken to prevent corrosion. These steps may constitute the greasing on surfaces, the application of a protective coat, enclosure of the items in a hermetically sealed container, the addition of vapour phase inhibitor paper to the package or other approved means.

Steps shall be taken to ensure that moisture, moulds, insects or rodents cannot damage insulated materials. Items that include materials liable to be damaged by moisture shall be packed in hermetically sealed containers in which silica gel, or some other approved desiccant has been inserted.

Cases shall be marked with large lettering to show which side of the case is to be up, and if the contents are fragile, marked “FRAGILE” in large letters with the international wineglass symbol. Packages shall be marked with their place of destination in such a way that rough handling or the effect of weather cannot remove or obliterate the marking. Each item shall be marked with its gross weight and, for all lifts over two tonnes, marks on the cases shall show the correct positions for the slings.

Special steps shall be taken to guard against theft during transport. No small items such as padlocks nameplates and so forth that could be torn off or unscrewed shall be accessible.

Cases, crates, barrels and drums shall be banded in such a manner as to obstruct the theft of any of the timber used for packaging and the bands shall be so secured that they are not rendered ineffective by shrinkage of the wood.

A descriptive and fully itemized list shall be prepared of the contents of each packing case. A copy of this list shall be placed in a waterproof envelope under a metal or other suitable plate securely fastened to the outside of one end of the case, and its position indicated by stenciling on the case. Where appropriate, drawings showing the erection markings of the items concerned shall be placed inside the case.

All stenciled markings on cases and crates, or other markings on descriptive metal tabs fixed to cable drums, bundles of structural steel works and so forth, shall be applied in two places with a material which cannot wash off and shall be additional to any erection or other marks or impressions which may be specified elsewhere.

Shipping marks are to be stenciled in oil based paint in block letters and symbols. When unobstructed flat smooth surfaces of sufficient size are not available on the case for the shipping marks they are to be stenciled on marine-ply notice boards of adequate size and of at least 6 mm thickness securely fastened to the packing case.

All packing cases, though not steel containers, shall remain the property of the Employer.

1.10 Tools

The Supplier shall supply in lockable boxes, for the Employer's use, any special tools that may be required for assembly, dismantling and adjustments to the equipment. The tools shall be unused and in new condition at the time of hand over. Suitable special spanners shall be provided for bolts and nuts which are not properly accessible by means of an ordinary spanner.

1.11 Spare Parts

Particulars of spare parts, which may or not from part of the contract at the Purchaser's discretion, shall be agreed. Bidders giving their recommendations should complete the relevant Schedules and prices for spares that they believe should be purchased by Purchaser

2 TECHNICAL SPECIFICATION

2.1 General

This Chapter contains a general technical specification of electrical distribution equipment and may cover equipment not to be procured under this contract. For details about each type of equipment to be procured reference is made to **Particular Technical Specifications.**

The design shall incorporate every reasonable precaution and provision for the safety of the general public as well as for all those engaged in the operation and maintenance of the Contract Equipment and of associated works supplied under other Contracts.

2.2 Drawings

The Bidder shall in his Bid enclose overall drawings showing dimensions, main working principles, and internal components and fixing methods to a detail level allowing the Employer to evaluate the functionality and completeness of the equipment.

2.3 Standards

Ratings, characteristics, tests and test procedures, etc. for the electrical equipment encompassed by this specification shall comply with the relevant provisions and requirements of the Recommendations of the International Electrotechnical Commission (IEC), unless otherwise expressly stated in Particular Technical Specifications. This applies even where the specific standards are not referred to in the Particular Specifications. Where the IEC Recommendations do not fully cover all provisions and requirements for the design, construction, testing, etc. and for equipment and components that are not covered by IEC Recommendations recognized national standards shall be applied. The rules of CEE (International Commission for the approval of electrical equipment) and the standards of CENELEC (the European Committee for Electrotechnical Standardization) may also be applied.

Can be adopted British Standards Institution (BSI) or German Institute for Standardization (DIN) or French Standards (NF) for specific items of electrical materials.

The latest revision or edition in effect at the time of Bid Invitation shall apply. Where references are given to numbers in the old numbering system from IEC it shall be taken as to be the equivalent number in the new five digit number series.

The Precise Standard, complete with identification number, to which the various equipment and materials are manufactured shall be specifically stated by the Bidder.

In case of conflict or disagreement between the particulars of the Standard adopted by the Bidder and the particulars of this Specification, this Specification shall prevail over the Standard. All conflicts or disagreements, mentioned above, must be clearly stated, failing which the materials and equipment offered shall be deemed to comply in every respect with this Specification both in manufacture and in performance, and compliance thereof be insisted upon without additional cost to the Employer.

2.4 Units

The SI-system (meter, Newton, second) shall be used throughout the works covered by this Specification.

2.5 Definitions

Whenever the following terms or words are found in the specifications and/or other documents, they shall have the following meaning:

"High Voltage Equipment" (HV):

Mostly used for equipment provided for a maximum operating voltage higher than 36 kV

"Medium Voltage Equipment" (MV):

Equipment provided for a maximum operating voltage higher than 1000 V and up to 36 kV.

"Low Voltage Equipment" (LV):

Equipment provided for operation at 1000 V or below. (For transformers the term Low Voltage Winding is used for the side with lowest rated voltage regardless of value, IEC 60076)

Reference to degree of protection (IP) is according to the classification in IEC 60529

2.6 System Characteristics

The basic characteristics of the electrical systems and equipment shall be as follows (not all voltages are applicable to this contract):

MV Equipment 33 kV

Maximum operating voltage 36 kV, 3-phase, 50 Hz, delta connected system with neutral solidly earthed via zigzag-star connected Earthing transformer.

MV Equipment 22 kV

Maximum operating voltage 24 kV, 3-phase, 50 Hz, delta connected system with neutral solidly earthed via zigzag-star connected Earthing transformer.

LV Equipment, 0.4 kV

Maximum operating voltage 420 V, 3-phase, 50 Hz, loaded and effectively earthed neutral TN-C system.

2.7 Phase Relationship

The standard phase colours are Red (L1), Yellow (L2), and Blue (L3) (RYB).

2.8 Design Criteria

The equipment shall be designed to withstand the design stresses given below without damage and disruption of service. All tests shall as a minimum is based on these design parameters.

Item	Description	Unit	Nominal voltage level		
			33	22	0.4
1	Nominal system voltage phase to phase	kV	33	22	0.4
2	Highest system voltage phase - phase [1)]	kV	36	24	0.42
3	System Frequency	Hz	50	50	50
4	System earth(see above)	----	Solid	solid	Solid
5	Minimum Design Short circuit Current (1 sec. arch test) [2)]	kA	25	25	25
6	Impulse withstand voltage (1.2/50 μ sec wave) [3)]	kV peak	170	125	12
7	Power frequency withstand voltage (1 min.) [3)]	kV	70	50	2.5
	Min Creepage distance over outdoor insulators (Pollution class 3- severe, IEC 60815/85 - 2.5cm/kV)	cm	90	60	7.5

Note 1)

Ref. IEC 60038

Note 2)

For all current carrying parts the permissible short circuit duration shall be at least 1 second. Indoor equipment shall be arc tested in accordance with IEC 60298 amendments 2. The dynamic or momentary short circuit current on which the equipment design shall be based shall be computed by multiplying the r.m.s. value of the symmetrical short circuit current by the factor 1.8 x $\sqrt{2}$.

Note 3)

Ref. IEC 60071

2.9 Ambient Temperatures, Relative Humidity, Wind Pressure

Unless otherwise specifically stated in Particular Technical Specification, any equipment, component and assembly shall be designed for the following service conditions:

Item	Description	Unit	Value
1	Altitude of site above sea level	m	- 50 to + 200
2	Ambient Temps:- Maximum / Minimum	°C	+45 / - 5
3	Wind Speed	m/s	15
4	Isokeraunic Level		15
5	Pollution Type		Dust
6	Relative Humidity Maximum/ Minimum	%	100 / 50
7	Rainfall Average annual	mm	600
8	Hail		Yes
9	Fog		Yes
10	Sand Storms		Occasional

Wherever any of these maximum or 24 hour average temperatures exceed the normal service condition temperatures of the IEC Recommendations for the relevant equipment, or of such other standard which is approved to be applied, the permissible temperature rises of the recommendations or the standard shall be reduced by the same amount as the difference between the above figures and the normal service condition temperatures.

The Contractor shall guarantee these reduced temperature rises.

شركة تـــوزيع كهرباء محافظـــات غزة

Gaza Electricity Distribution Corporation

TECHNICAL SPECIFICATIONS FOR 24 kV RING MAIN UNIT

March 2012

1 GENERAL SPECIFICATIONS

1.1 Completeness of Contract

1.1.1 All apparatus, accessories or fittings which may not have been specifically mentioned, but which are usual or necessary in the respective equipment for the completeness of the finished work in an operable status, shall be deemed to be included in the Contract and shall be provided by the Contractor without any extra charge. All equipment shall be complete in all details, whether or not such details are mentioned in the Specifications. This includes fixation details and connection clamps and/or terminals.

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2.4 Units

The SI-system (meter, Newton, second) shall be used throughout the works covered by this Specification.

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Whenever the following terms or words are found in the specifications and/or other documents, they shall have the following meaning:

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Mostly used for equipment provided for a maximum operating voltage higher than 36 kV

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Equipment provided for a maximum operating voltage higher than 1000 V and up to 36 kV.

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Equipment provided for operation at 1000 V or below. (For transformers the term Low Voltage Winding is used for the side with lowest rated voltage regardless of value, IEC 60076)

Reference to degree of protection (IP) is according to the classification in IEC 60529

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The basic characteristics of the electrical systems and equipment shall be as follows (not all voltages are applicable to this contract):

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3	System Frequency	Hz	50	50	50
4	System earth(see above)	----	Solid	solid	Solid
5	Minimum Design Short circuit Current (1 sec. arch test) [2)]	kA	25	25	25
6	Impulse withstand voltage (1.2/50 µ sec wave) [3)]	kV peak	170	125	12
7	Power frequency withstand voltage (1 min.) [3)]	kV	70	50	2.5
	Min Creepage distance over outdoor insulators (Pollution class 3- severe, IEC 60815/85 - 2.5cm/kV)	cm	90	60	7.5

Note 1)

Ref. IEC 60038

Note 2)

For all current carrying parts the permissible short circuit duration shall be at least 1 second. Indoor equipment shall be arc tested in accordance with IEC 60298 amendments 2. The dynamic or momentary short circuit current on which the equipment design shall be based shall be computed by multiplying the r.m.s. value of the symmetrical short circuit current by the factor $1.8 \times \sqrt{2}$.

Note 3)

Ref. IEC 60071

2.9 Ambient Temperatures, Relative Humidity, Wind Pressure

Unless otherwise specifically stated in Particular Technical Specification, any equipment, component and assembly shall be designed for the following service conditions:

Item	Description	Unit	Value
1	Altitude of site above sea level	m	- 50 to + 200
2	Ambient Temps:- Maximum / Minimum	^{o}C	+55 / - 5
3	Wind Speed	m/s	15
4	Isokeraunic Level		15
5	Pollution Type		Dust
6	Relative Humidity Maximum/ Minimum	%	100 / 50
7	Rainfall Average annual	mm	600
8	Hail		Yes
9	Fog		Yes
10	Sand Storms		Occasional

Wherever any of these maximum or 24 hour average temperatures exceed the normal service condition temperatures of the IEC Recommendations for the relevant equipment, or of such other standard which is approved to be applied, the permissible temperature rises of the recommendations or the standard shall be reduced by the same amount as the difference between the above figures and the normal service condition temperatures.

The Contractor shall guarantee these reduced temperature rises.

3 PARTICULAR TECHNICAL SPECIFICATIONS FOR 24 kV RING MAIN UNIT

This chapter covers the particular technical requirements of the medium 22 kV voltage equipment to be procured under this contract. By conflict between the general specification and the particular specifications below the particular specifications shall prevail.

Scope

This Section covers the manufacture and supply of indoor Ring Main Units, associated equipment and spares.

3.1 Design

- This specification applies to SF_6 insulated switchgear for maximum system voltage 24 kV.
- The switchgear shall be suitable for indoor mounting conditions with natural ventilation.
- Temperature independent gas pressure gauge marked with green (safe) and red (not safe) zones shall be provided. The safe operating zone shall correspond to a temperature range of -10^{o}C to $+55^{o}$C.The unit shall continue to work safely even if the gas pressure inside the tank goes down to the atmospheric pressure.Refilling /re-pressurizing inlet valve, if provided, shall be easily accessible for field refilling.
- The switchgear shall be maintenance-free and all the electrical parts including the arcing chamber and the main contacts of the switchgear, as well as the connection busbars are to be mounted in a metal enclosure, hermetically sealed.
- All the external parts of the switchgear shall be protected against corrosion. The switchgear shall be of a self-supporting construction type.
- The cubicles shall be short circuit type tested by an internationally recognized test institution; the switchgear shall consist of cubicles of tropical design. The cubicles shall be metal enclosed, each cubicle shall be provided with test points for capacitive voltage tester.
- Bus-bars shall be of electrolytic high grade copper. It shall withstand the mechanical stresses of the rated short circuit current.
- The surface treatment of the sheet steel is carried out according to the powder coating principle, whereby a thermosetting powder is applied to the sheet steel, electrostatically with an average layer of minimum fifty micrometers. The powder shall be a combination of epoxy and polyester resin, before the powder coating is applied, the sheet steel parts shall be degreased in a spray tunnel and phosphated with 0.4 to 0.8 g/m2 iron phosphate.

3.2 Products

3.2.1 Components:

Components are to include metal enclosed ring main SF6 switchgear unit, comprising two incoming switch disconnectors for ring main network feeders, one transformer protection fuse-switch combination, cable terminal fittings behind dead front panels and front mounted switch gear operating handles, control, indication

3.2.2 Characteristics:

Rated Voltage	24 kV
Normal system voltage	22 kV
Rated impulse withstand voltage (Peak)	125 kV
Rated power frequency withstand voltage (r.m.s)	50kV for I min
Continuous Current	630 Amps
Rated Short Time with stand Current 1s.	16 kA
Rated Short Time with stand Current 3s.	20 kA
Close and Latch Capability	68 kA (Momentary)
Rated Interrupting Time	Five cycles
Rated frequency	50 Hz
Busbar current rating	630 A
Rated peak withstand current	50 kA

3.2.1 Switch-Disconnector: General purpose, 3-pole, load-break, Short-circuit make, category B to IEC 265

3.2.2 Switch-Disconnector Ratings:

Rated nominal current	630 A
Rated short-circuit making Capacity (peak)	50kA

3.2.3 Ring switches shall be full load break and fault-making type. Ring switches shall be designed for interrupting full rated current as stated in above, small inductive or capacitive currents involved in disconnecting of unloaded transformers, cables or overhead lines. It shall be suitable for full fault-making current.

3.2.4 Ring switch shall consist of a moving contact assembly with three positions; 'ON,' OFF' and 'Earth'. Two independent manual operating mechanisms for ring and earth switches are also acceptable. The design shall prevent simultaneous closing of the main switch contacts and the earth switch contacts. The earth switch contacts shall be designed to close into a fault and shall have the same short circuit capacity as the main contacts.

3.2.5 Switch-Disconnector Operation: By removable handles at front of unit Switching mechanism is to be manual, spring charge, quick-make, quick-break, with speed of switching independent of operator: Main switch and earth switch operations are to be separated and safety interlocked with the manual handle Inserted in separate access holes for on/off operation of main switch and earth on/earth off operation of earth switch Handle design IS to ensure delay between closing and re-opening of main Switch or Earthing switch, to provide an anti-reflex operation. It is to be Impossible to move earth switch inadvertently into or from earth position except when main switch is in the open position .Indication of switch position is to be mechanical, directly connected to moving contacts each switch IS to have padlocking device in the open, closed and earth positions.

3.2.6 Fuse-Switch Combination: To consist trip-free, load-break, short-circuit make fuse-switch combination, with operational requirements as for switch-disconnector. Fuse is to be separately located in fuse chamber with interlocked earthing switches providing upstream and downstream earthing of the fuse assembly, Automatic trip switching is to be actuated by fuse striker pins which actuate common trip bar in switch mechanism. Once operated, striker pins remain in ejected position, preventing closure of switch until fuses has been replaced. Single phasing is not to be possible. Fuses are to be totally enclosed, current limiting, cartridge type, high-breaking capacity, with striker pins, and with draw able from front of unit

3.2.7 Fuse-Switch Combination Ratings:

Rated normal current	200 A
Rated prospective short circuit breaking current	25 kA to IEC
Rated prospective short circuit making current	63 kA
Rated current of fuse link (to suit)	100 A, 80A, 63A

3.2.8 Incoming/Outgoing Cables: up to 630 mm2 XLPE

3.2.9 Cable Terminal Connectors: Stress-relieving, epoxy sealed end, bolted type, complete with all accessories. Alternative arrangement may be proposed by manufacturer.

Cable Connections in Ring Main Unit Feeders shall be Suitable for RSTI Screened, separable connection system 630 A up to 630 mm2 as EN 50180 and DIN47636

Cable Connections in Transformer Feeders shall be Suitable for Screened Separable Elbow Termination Kit 250A

3.2.10 Accessories: Include the following:

a. Two N. C and two N. O. auxiliary contact on each switch:

b. Shunt trip release on fuse-switch combination;

c. Earth fault indicator, operated by core-balance type current transformer, located near and outside cable box/termination's with indicator visible from front and with automatic reset.

d. Padlocking Arrangements: Arrangements shall be provided for locking up with padlocks of size 1" for each of the following:

- Each of the access doors and covers.
- Each of the operating handle to the frame work.
- Each control position to prevent moving from "OFF" position to the "ON" position and vice versa.
- Each control position to prevent moving from "OFF" position to the "EARTH-ON" position and vice versa.

3.3 QUALITY ASSURANCE

Quality Assurance System conforming to ISO 9001 shall be followed in the manufacture of Ring Main Unit and the manufacturer shall furnish ISO 9001 Quality Assurance Certification Document with the offer.

3.4 Rating Plate markings

Rating plate shall provide the data of the switches and be weather-proof and corrosion-proof. The plate shall be positioned in the front of the unit and be clearly visible from the normal operating location of the device.

Information to appear on the name plate is:-

- Number and year of the standard adapted.
- Manufacturer's identification (Name, country of manufacture etc.)
- Designation of type.
- Class and category.
- Serial number and year of manufacture.
- Rated voltage and frequency.
- Class of insulation.
- Rated pressure of compressed gas for operation, if applicable.
- Rated pressure of compressed gas for interruption, if applicable.
- Weight of equipment without insulating medium and cable terminations.
- Weight and volume of insulating medium.
- Characteristic of switches.

3.5 Applicable Standards

The equipment and the components supplied shall be in accordance with the latest edition of the standards specified below and amendments thereof. However the GEDCo Specification shall supersede these Standards in the event there is a discrepancy

IEC 60694 - Common Specifications for High-Voltage Switchgear and Controlgear Standards

IEC 62271-105 - High-voltage switchgear and controlgear - Part 105: Alternating current switch-fuse combinations

IEC 60265-1 - High-voltage switches - Part 1: Switches for rated voltages above 1 kV and less than 52 kV

IEC 60129 - Alternating current (isolators) and earthing switches

IEC 62271-102 - High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches

IEC 60298 - A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV

IEC 62271-200 - High-voltage switchgear and controlgear - Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV

IEC 60640 - CAMAC - Serial Highway Interface System

IEC 60529 - Degrees of protection provided by enclosures (IP Code)

ISO 2063 - Metallic coatings – protection of iron and steel against corrosion – metal spraying of Zinc and Aluminum

3.6 INFORMATION TO BE SUPPLIED WITH THE OFFER

3.6.1 The following shall be furnished with the offer.

a) Catalogues describing the equipment and indicating the model.

b) Literature describing the operational feature of the equipment.

c) Rated values and characteristics of all switches, busbars, fuses, insulating medium etc.

d) Constructional features, materials used for components and relevant technical literature and dimensioned drawings.

e) Operating mechanism of the switches and associated equipment/ interlocks/access covers and doors including sequence of operation.

f) Mechanical characteristic incorporating overall dimensions in open and closed positions, weight with and without insulating medium, foundation layout dimensions, weather shield particulars, anticorrosive preventive measures, padlocking arrangements.

g) Drawing of name plate to scale incorporating the particulars called for.

h) Details of earthing, earth conductor/strap bonding and termination.

i) ISO 9001 Certification.

j) Certificate of type tests for the following carried out in accordance to the specified standard.

- **Dielectric Tests**
- **Temperature - rise Tests**
- **Making and Breaking Tests**
- **Short-Circuit Current carrying capability**
- **Operation and Mechanical endurance**

3.6.2 Test certificates, performance curves etc. Furnished shall be based on the type tests confirming to the relevant British Standard. The tests certificates should clearly identify the equipment's concerned, showing the Manufacturer's identity, type number and basic technical parameters.The test certificates referred to shall be issued from an internationally recognized independent testing authority.

3.6.3 Failure to furnish the particulars requested in Clause 6.5.1 will result in the offer being rejected.

3.7 TECHNICAL LITERATURE & DRAWINGS

The selected tenderer along with the equipment should supply relevant drawings, technical literatures, hand-books etc. in order to facilitate installation, operation and maintenance.

3.8 INSPECTION AND TESTING

6.8.1 Inspection

The selected Bidder shall make necessary arrangements for inspection by a Representative of the Purchaser and also to carry out in his presence necessary Routine or Sample Tests of the materials, equipment offered.

3.8.2 Testing (routine / Sample)

(i) Dielectric withstand tests

(ii) Mechanical operation (including interlocks) checks.

(iii) Leakage test.

(iv) Power frequency voltage withstand tests

(v) Measurement of resistance

3.8.3 Routine / Sample Test Certificates

These Test certificates will form a part of the shipping documents. Extra copies of these test certificates shall also be supplied with the equipment.

3.9 PACKING AND SHIPMENT

The switchgear shall be delivered ready for installation.

Switchgear shall be individually packed in non-returnable cases

For container shipment, switchgear bolted on wood pallet is acceptable.

Units shall be supplied complete with all operation and installation accessories.

Technical Guarantees No. RMU_2T2C

24 kV , 630 A Switchgear, and 16 kA Short Circuit Current Ring Main Unit SF6 , Two Incoming Switch Disconnectors, Two Transformer Protection Fuse Switch combination (CTTC)

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	**Reference Manufacturing Standards**					
	a) Service Condition		IEC60694			
	b) Switch Fuse Combination		IEC62271-105			
	c) Switch endurance & Short time & Peak withstand for Switch		IEC60265-1			
	d) Short time & Peak withstand for Earth Switch /Disconnector		IEC60129 / IEC62271-102			
	e) Temperature Rise Test & Dielectric Test & Internal Arc Test		IEC60298 / IEC62271-200			
	f) Safety Interlocking		IEC60298/ IEC60640			
	g)Enclosure Degree of Protection		IEC60529			
4	Insulation Medium , Interruption medium		SF6 Gas			
5	Design		Metal-Enclosed			
6	Type		Indoor			
7	Component		Two Incoming Switch Disconnectors, Two Transformer Protection Fuse Switch combination (CTTC)			
8	Rated voltage	kV	24			

Technical Guarantees No. RMU_2T2C

24 kV , 630 A Switchgear, and 16 kA Short Circuit Current Ring Main Unit SF6 , Two Incoming Switch Disconnectors, Two Transformer Protection Fuse Switch combination (CTTC)

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
9	Rated Frequency	Hz	50			
10	Safe Operating Zone Temperature	^{o}C	-10 to +55			
11	**Rated insulation level**					
	a) Rated short-duration power-frequency withstand voltage	KV	50			
	b) Rated lightning impulse withstand voltage	KV	125			
12	**Rated Normal Current**					
	a) for ring-main feeders	A	630			
	b) for transformer feeders depending on the HV HRC fuse link	A	200			
	c) for Busbar	A	630			
13	**Rated short-time withstand current**					
	a) for 1 sec	kA	20			
	Rated short-time withstand current for 3 sec	kA	16			
14	**Rated short-circuit making current**					
	a) for ring-main feeder	kA	50			
	b) for transformer feeder	kA	25			
15	Rated Peak withstand Current	kA	50			
16	Pressure values for insulation (Rated filling pressure)	hPa (absolute)	1500			
	Panel configuration					

Technical Guarantees No. RMU_2T2C

24 kV , 630 A Switchgear, and 16 kA Short Circuit Current Ring Main Unit SF6 , Two Incoming Switch Disconnectors, Two Transformer Protection Fuse Switch combination (CTTC)

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
17	Switchgear container Design		hermetically tight welded, without any sealings			
	Degree of protection for all high-voltage sections		IP65			
	Degree of protection for switchgear enclosure		IP3XD			
	Position for isolating/grounding via the Switch Disconnector		three Position			
	Position of switch-disconnector		three Position			
18	Bolted Electrical Joints Design		secured by fasteners of corrosion-proof materials			
19	Clearance between clamp and bushing		Suitable for all type of terminations			
20	Cable Connections in Ring Main Unit Feeders		Interface C , Screw Type , Suitable for RSTI Screened, separable connection system 630 A up to 630 mm2			
21	Cable Connections in Transformer Feeders		24kv interface A, Pin Type , Suitable for Screened Separable Elbow Termination Kit 250A			

Technical Guarantees No. RMU_2T2C

24 kV , 630 A Switchgear, and 16 kA Short Circuit Current Ring Main Unit SF6 , Two Incoming Switch Disconnectors, Two Transformer Protection Fuse Switch combination (CTTC)

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
22	**Operating Manually Indicate the Following Positions**					
	a) Switch Disconnector		ON and OFF			
	b) Off-Load Isolator		ON and OFF			
	c) Earthing		ON and OFF			
23	**Accessories**					
	a) Voltage indicator lamps		Required			
	b) Gas Pressure Indicator		Required			
	c) M.V Porcelain Fuses		Required			
	d) Operating Lever		Required			
24	Width	mm	Shall be filled by manufacturer			
25	Height	mm	Shall be filled by manufacturer			
26	Depth	mm	Shall be filled by manufacturer			
27	Total Weight	kg	Shall be filled by manufacturer			
28	Type Test Certificates /Reports from internationally reputed testing agency		Required			
29	Acceptance & Routine tests witnessed by Beneficiary		Required			

Tenderer's Signature : ………………………..… Date: ………………………………

Technical Guarantees No. Rec_24V

24KV Pole Mounted Three Phase Vacuum interruption Auto-Recloser with control unit

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer		Tavrida or Equivalent			
2	Country of Origin					
3	Reference Manufacturing Standards		IEC 62271-100, ANSI C37.60 2003, IEC 60694, IEC 60255 and IEC 61000			
4	Safe Operating Zone Temperature	^{o}C	-20 to +50			
5	Nominal System Voltage	KV	22			
6	Maximum Operating Voltage	KV	24			
7	Existing Distribution Networks Connection		Delta Connection			
8	Rated Frequency	Hz	50			
9	Existing Continuous Max. Current	A	450			
10	Impulse Withstand Phase to Earth & Phase to Phase	KV	125			
11	Impulse Across the Interrupter	KV	125			
12	Rated power frequency withstand voltage	KV	60			
13	Recloser proposed Continuous Current	A	630			
14	Phase Spacing	mm	shall be filled by the manufacturer			
15	Short Circuit Current, Symmetrical	KA	12.5			
16	Making Current, Asymmetrical Peak	KA	31.5			
17	Minimum Mechanical/Electrical Operations	C-O	30,000			
18	Minimum Allowable Operations Under Full load	C-O	30,000			
19	Minimum Allowable Operations Due to Short Circuit Fault (12.5KA)	C-O	Not less than 70			
20	Interrupting Medium		Vacuum			
21	Type of insulation method		shall be filled by the manufacturer			

Technical Guarantees No. Rec_24V

24KV Pole Mounted Three Phase Vacuum interruption Auto-Recloser with control unit

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
22	Enclosure Material		corrosion-free Aluminum or 316 Grade Stainless Steel			
23	Bushings Type		silicon rubber or Epoxy Resin			
24	Fully insulated bushing arrangements		Required			
25	Lower terminal to ground/earth Creepage Distance	mm	900			
26	Maximum interrupting time	Sec.	0.06			
27	Maximum closing time	Sec.	0.08			
28	Internal Voltage Sensors for Measurements		Required			
29	Internal Current Sensors		Required			
30	CVTs Current Sensors ratio		shall be filled by the manufacturer			
31	Two pole Single Phase 22kv/240v Outdoor voltage transformer to charging Batteries		Required			
32	Manual tripping Handle		Required			
33	Light weight Hook stick isolating rod		Total 6 each for all quantities			
34	Lattice steel Pole Mounting Frame		Required			
35	On Bottom Large and easy to view Position Indicator		Required			
36	Visible indication of OPEN/CLOSE		Required			
37	Degree of protection for the Recloser tank		IP65			
38	**Connection Cables and Accessories**					
38.1	Power Cable with all accessories to connect VT with Control Unit		12m Long			
38.2	Cables to be connected to the existing M.V Network		Required suitable for minimum 500A (CU 150mm2-5mt. For each)			

Technical Guarantees No. Rec_24V

24KV Pole Mounted Three Phase Vacuum interruption Auto-Recloser with control unit

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
38.3	Connectors to be mounted on insulators to connect the cables		Required			
38.4	Copper two Hole Cable Lugs to connect Cables with Recloser		6 Lugs with Suitable holes			
38.5	Bolts including washer for Lugs		Required			
39	Lifting Eyes		Required			
40	Grounding Terminal		Required			
41	**Six (6) Each Surge arrestors (including Brackets)**					
41.1	Standards		ANSI C62.1 / IEC60099_4			
41.2	Surge arrester Type		10kA Heavy Zinc Oxide Duty Polymer Gap-Less			
41.3	Type of installation		Phase to earth			
41.4	Maximum continues operating voltage (M.C.O.V)	kV	19.5			
41.5	Temporary overvoltages: Utov For 1 sec.	kV	shall be filled by the manufacturer			
41.6	Temporary overvoltages: Utov For 10 sec.	kV	shall be filled by the manufacturer			
41.7	Nominal discharge current (8/20µs) In	kA peak	10			
41.8	Partial discharge at 1.05 Uc		shall be filled by the manufacturer			
41.9	Arrester housing Material		High quality Silicon-Polymeric			
41.10	Creepage Distance	mm	910			
41.11	Equivalent Front-of-Wave (maximum discharge voltage for a 10 kA impulse current wave which produces a voltage wave cresting in 0.5 µs.)	kV Crest	≤88			

Technical Guarantees No. Rec_24V

24KV Pole Mounted Three Phase Vacuum interruption Auto-Recloser with control unit

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
41.12	Max. Discharge Voltage Using an 8/20 µs Current Impulse at 2.5 KA	kV	≤65			
41.13	Max. Discharge Voltage Using an 8/20 µs Current Impulse at 5 KA	kV	≤70			
41.14	Max. Discharge Voltage Using an 8/20 µs Current Impulse at 10 KA	kV	≤75			
42	Multi stranded Cables and accessories for surge arrestors connection (lugs, bolts, washers…etc.)		Required			
43	Recloser total Mass (Weight)	Kg	shall be filled by the manufacturer			
44	**Recloser Control Unit**					
44.1	Main Required Equipment		Control Unit , Control Device , RTU , GPRS and Batteries			
44.2	Cabinet Material		corrosion-free Aluminum or 316 Grade Stainless Steel			
44.3	Locking		Three-point latching with padlockable handle			
44.4	Cabinet Protection		IP65			
44.5	Power Control Device		Required			
44.6	Power Control Device Front Panel Display		LCD Display			
44.7	Pushbuttons for closing and opening		Required			
44.8	Hot line tagging		Required			
44.9	Ground blocked, remote blocked, and reclose blocked pushbuttons		Required			
44.10	Three-Pin Input Power Receptacles		Required			
44.11	BCT shorting-type terminal block for bushings		Required			
44.12	Earthing Connection		Required			
44.13	Lattice steel Pole Mounting Frame		Required			
44.14	Cable Locking Sleeves		Required			

Technical Guarantees No. Rec_24V

24KV Pole Mounted Three Phase Vacuum interruption Auto-Recloser with control unit

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
44.15	Control Cable Length	m	12			
44.16	Instruction Manual and all Drawings for internal wiring		Required			
45	**Communication Protocols**					
45.1	Modbus , DNP3 and IEC60870-5 VIA Ethernet		Required			
45.2	SCADA Capability		Required			
46	**Communication Interfaces**					
46.1	RS-232 Port and Cable		Required			
46.2	Isolated RS-485 Port		Required			
46.3	Ethernet Connector		Required			
46.4	Connection port for Laptop- USB		Required			
47	Necessary Connection and Configuration Between RTU and All parts and Connection between RTU and Wireless Communication Terminal		Required			
48	**Battery**					
48.1	Battery Operation		for control unit and proposed GPRS Modem			
48.2	Battery Type		Chargeable lead acid			
48.3	Capacitor backup for battery assistance		Required			
48.4	Battery Hold Up Time	hour	44			
48.5	Battery life expectancy	years	5			
48.6	Battery Charger		Required			
48.7	Battery charge Indicator		Display on LCD			
49	**Metering**					
49.1	CT Accuracy	± %	0.5			
49.2	CVT Accuracy	± %	2			

Technical Guarantees No. Rec_24V

24KV Pole Mounted Three Phase Vacuum interruption Auto-Recloser with control unit

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
49.3	Active and reactive Energy (KWH , KVARH) single and three-phase		Required with max. ±2% accuracy			
49.4	Real and reactive power for each phase and total, including directional, on an individual phase basis		Required with max. ±2% accuracy			
49.5	Demand currents on a per phase basis		Required			
49.6	Instantaneous currents, including ground current		Required			
49.7	Instantaneous voltage on a per phase basis		Required			
49.8	Instantaneous frequency		Required			
49.9	Positive, negative, and zero sequence voltages		Required			
49.10	Instantaneous power factor on a per phase basis		Required with max. ±0.2% accuracy			
49.11	Metering settings to include demand interval for current, single-phase kW, three-phase kW, single-phase kVAr, and three-phase kVAr		Required			
50	**Recording**					
50.1	Energy (KWH , KVARH) in a specific time		Required			
50.2	Demand Current & Power, Maximum Current & Power		Required			
50.3	Operation Recording		Required			
50.4	Fault recording		Required			
50.5	All Records Shall be Saved on non-volatile Memory which not erased in the case of battery discharge (10,000 event logs/records)		Required			
51	**Protection Characteristics**					
51.1	Phase time overcurrent protection		Required			
51.2	Phase instantaneous overcurrent protection		Required			
51.3	Two definite time overcurrent settings		Required			

Technical Guarantees No. Rec_24V

24KV Pole Mounted Three Phase Vacuum interruption Auto-Recloser with control unit

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
51.4	Ground overcurrent protection		Required			
51.5	Ground instantaneous overcurrent protection		Required			
51.6	Two definite time ground overcurrent settings		Required			
51.7	Negative sequence overcurrent protection		Required			
51.8	Phase and ground directional overcurrent protection		Required			
51.9	Over-frequency		Required			
51.10	Undervoltage and overvoltage control and alarm		Required			
51.11	Up to four reclose cycles		Required			
51.12	Adaptive reclosing shots: each reclose sequence allows independent programming of protective functions		Required			
51.13	Sensitive Earth Fault protection with directional features		Required			
52	**Program**					
52.1	free of charges Software Application Program Available for Remote and Monitoring Operations		Required			
54	**Tests**					
54.1	Type Test Certificates/Reports from internationally reputed testing agency according to the General technical specifications item 1.3		Required			
54.2	Acceptance & Routine tests witnessed by Beneficiary two Engineers or third Party		Required			

Tenderer's Signature : ………… Date: ………………………………

شركة تـــــوزيع كهرباء محافظـــــات غزة

Gaza Electricity Distribution Corporation

Technical Specifications

For

Medium Voltage XLPE Cables Fittings

March 2012

1. Medium Voltage XLPE Cables Fittings

1.1 Heat Shrinkable Outdoor Termination Kit for XLPE Cable

SCOPE:

These specifications cover the minimum technical requirements for the design manufacture. Supply and transportation to the site(s) and testing of 24 kV and 36 kV Heat Shrinkable Outdoor Termination Kit for XLPE Cables

1.1.1 System Details and Service Conditions

The performance of the Outdoor Terminations shall be guaranteed for the proposed operating, installation and environmental conditions as specified in general specifications

1.1.2 STANDARDS

IEC-60502 Power cables with extruded insulation and their accessories for rated voltages from 1 KV (Um = 1.2 kV) up to 30 KV (Um= 36 KV).

CENELEC HD629.1 S1:- Test requirements on accessories for use on power cables of rated voltage from 3,6/6 (7,2) kV up to 20,8/36 (42) kV - part 1: Cables with extruded insulation.

VDE-0278 Load cycling test.

IEEE-48 Test procedures and requirements for high voltage alternating current cable terminations.

IEC-60466 Continuous condensation test.

IEC-60507 Salt fog test.

IEEE-404 Test procedures and requirements for high voltage alternating current cable Splices

1.1.3 Design & Construction

The insulation tubing shall be generally suitable for outdoor installation, ultra-violet and chemical resistant and without adhesive coatings and shall be capable of being stored without damage at temperatures up to 50ºC.

Terminations for all MV cables shall be of an appropriate heat shrink design incorporating a suitable arrangement of stress control, and rain-sheds for outdoor use

Termination kits shall include suitable heat shrink tubing to effectively shroud, seal and insulate the exposed cable conductor and connector, and shall include a heat shrink glove to effectively seal the crutch of the cable to prevent ingress of moisture into the interstices of the cable. Suitable arrangements shall be provided to earth the cable screen and armour (if specified).

Terminations shall include Bimetallic Terminal Mechanical lug with 13 mm Hole and 3 each Shear Head Bolts (for Aluminium or Copper Conductors)

As soon as possible after the commencement of a contract and before materials are despatched, copies of the termination instructions.

Terminations to be supplied shall be submitted in English to the Engineer/GEDCO for approval, together with details of the physical and electrical characteristics of the filling medium proposed.

Higher thickness of heat shrinkable sleeves shall be preferable to counter erosion due to pollution.

The stress cone must; be of proven design of stress control. The suitable provision for covering the cable cores with re-useable protective system from the crotch seal to the bottom of stress cone should be made.

Proper stress control, stress grading and non-tracking arrangement in the terminations shall be offered by means of proven methods, details of which shall be elaborated in the offer. Detailed sectional view of assemblies shall be submitted along with the offer.

Suitable creepage extension/rain protection sheds for outdoor termination shall be provided.

The; terminations shall be supplied in kit forms. All insulating and sealing materials, consumable items, conductor fittings, earthing arrangements and lugs etc. shall be included in the individual kit.

1.1.4 Heat Shrink Materials

Heat shrink tubing and moulded parts shall be flexible, flame retardant, made from Specially Formulated Cross-Lined Polymeric of electrical insulating quality, and shall be obtained from an approved manufacturer. They shall be suitable for outdoor use in the conditions prevailing on site.

Each part shall bear the manufacturer's mark, part number and any other necessary markings to ensure correct identification for use on the correct size and type of cable. Each set of parts shall be packed as one unit with full and complete installation instructions and clearly marked to show the application.

The material shall reduce to the predetermined size and shape when heated above 120^{o}C. The components shall also be provided with an internal coating of hot melt adhesive compound that shall not flow or exude at temperature below 85^{o}C. All parts and materials shall be tested to a programme of tests to be agreed with the manufacturer.

1.1.5 Marking:

All components shall be clearly marked with the manufacturer's name and reference numbers. The marking shall be done before coating the adhesive onto the component.

Electrically conducting components shall be marked 'conducting' clearly and permanently.

All components shall be capable of being stored without deterioration within the temperature range of -10ºC to +55ºC. Components or materials, if subjected to a shelf life limitation, shall have the final date of use prominently and permanently shown on all packages.

Each hard box shall be printed with the following information:

a) Termination/accessories catalogue number

b) Purchase order number/tender

c) Manufacturer's name

d) Year of manufacture

e) Date of expiry

Each wooden box shall be fixed with an Aluminium plate bearing the following information:

a) Purchase order number/tender

b) Manufacturer's name

c) Year of manufacture

d) Date of expiry

e) Termination catalogue number

f) Gross weight

g) Position of slinging points and other relevant handling instructions.

1.1.6 Diagrams and Drawings

The drawings shall be submitted with the tender as a part of the tender documents.

Actual drawings showing the terminations, and accessories including terminations into equipment in respect of which the independent test reports have been obtained.

Typical drawings are not acceptable.

Catalogue for all the components used. Catalogue numbers for the offered items shall be high-lighted.

Duly completed attached technical data schedule for each offered item.

1.1.7 Testing

All Routine Tests and Type Tests of The terminations and accessories shall be tested in accordance with the latest standards.

Type Tests:

The termination kits of offered design should have been got tested from accredited laboratory as per relevant standards with latest version.

Acceptance Tests:

Initially the following tests shall constitute as acceptance tests-:

i) Dimensional checking as per approved drawings.

ii) Volume resistivity test for various components.

iii) AC High voltage test after installation of terminations

iv) Dielectric strength of major components.

v) D.C. High voltage test.

vi) Tracking resistance.

vii) Ultimatic Elongation.

Routine Tests:-

The following tests shall constitute routine test:

i) Dielectric strength.

ii) Density.

iii) Heat shock.

iv) Shrinkage ratio.

The tenderer must specify the details of routine tests (being conducted at their works) along with the standard applicable, in their offer.

The routine test certificates shall be furnished along with the inspection call for each offered lot.

1.1.8 Packing and shipment

Each kit of termination with appropriate Installation instructions shall be packed separately in hard board box Palletized non-returnable wooden boxes.

Packing notes shall be included in each hard board box giving a description of the goods packed.

Packing shall be designed to protect against ingress of moisture and mechanical damage.

The kits shall not be packed in any organic material.

1.2 24 kv Heat Shrinkable Straight Joint for Single Core XLPE Cables

SCOPE:

These specifications cover the minimum technical requirements for the design manufacture. Supply and transportation to the site(s) and testing of 24 kv Heat Shrinkable Straight Joint

1.2.1 System Details and Service Conditions

The performance of the Straight Joint shall be guaranteed for the proposed operating, installation and environmental conditions as specified in general specifications

1.2.2 STANDARDS

IEC-60502 Power cables with extruded insulation and their accessories for rated voltages from 1 KV (Um = 1.2 kV) up to 30 KV (Um= 36 KV.(

CENELEC HD629.1 S1 Test requirements on accessories for use on power cables of rated voltage from 3,6/6 (7,2) kV up to 20,8/36 (42) kV - part 1: Cables with extruded insulation.

IEEE-404 Test procedures and requirements for high voltage alternating current cable Splices

ASTM-E28 Test method for softening point by ring-and-bell apparatus.

1.2.3 Design & Construction

The Tenderer shall submit with his Tender drawings showing the types of joints proposed for each of the cables included in the Contract.

The joints shall be of a watertight, pull-over heat shrink type (Raychem or similar) without moulding, free from sharp points or ridges, thoroughly clean internally and externally. The sleeves shall be of sufficient diameter and length to permit colour-to-colour jointing without undue bending, handling or deformation of the cores.

The cable joints shall meet all requirements of IEEE-404, and shall be designed such that no insulating or semi-conducting tapes shall be required, except void filler tape and sealing mastic.

The cable joints shall provide water-proofing, mechanical and electrical protection and be completely sealed from cable jacket to cable jacket.

The diameter of heat shrinkable materials shall reduce to a pre-determined size upon application of heat in excess of 120ºC yielding a minimum shrink ratio of 3 to 1 and a maximum longitudinal shrinkage of 5%.

The recovered wall thickness of insulation tubing over the connector shall be uniform and equal to or greater than the cable insulation thickness as given in IEC-60502

The adhesive shall have a softening temperature not less than 90ºC, in accordance with ASTM-E28, be compatible with other components of joints and cables, and after curing shall not flow at temperatures of normal service.

The cable joints shall meet all the test requirements mentioned the Specifications.

The Joint shall include 24 kV Mechanical Connector with Shear-Head Bolts and Central Barrier for AL or CU Conductors for phases and Mechanical Connector with Shear-Head Bolts and Central Barrier for Copper Shield.

1.2.4 Design

At the screen end yellow void filling mastic is applied and the cable end is covered with a heat-shrinkable stress control tubing, the conductors are jointed with mechanical connector supplied with the joint, the connection area is covered with a stress control patch, heat shrinkable triple-extruded elastomeric joint body provides the correct thickness of insulation and the screening over the insulation, copper mesh wrapped around the joint area rebuilds the metallic screen , earth connection system must supplied with the kit the outer sealing and protection is performed by an adhesive coated , thick-wall, heat-shrinkable tubing

1.2.5 Instructions

As soon as possible after the commencement of a contract and before materials are despatched, copies of the jointing and termination instructions applicable to the joints, sealing ends and terminations to be supplied shall be submitted in English to the Engineer/GEDCO for approval, together with details of the physical and electrical characteristics of the filling medium proposed.

1.2.6 Heat Shrink Materials

Heat shrink tubing and moulded parts shall be flexible, flame retardant, polyolefin-based material of electrical insulating quality, and shall be obtained from an approved manufacturer. They shall be suitable for use indoors or outdoors in the conditions prevailing on site.

Each part shall bear the manufacturer's mark, part number and any other necessary markings to ensure correct identification for use on the correct size and type of cable.

Each set of parts shall be packed as one unit with full and complete installation instructions and clearly marked to show the application.

The material shall reduce to the predetermined size and shape when heated above 120oC. The components shall also be provided with an internal coating of hot melt adhesive compound that shall not flow or exude at temperature below 85oC. All parts and materials shall be tested to a programme of tests to be agreed with the manufacturer.

1.2.7 Fabrication

Cable joints shall be supplied in complete kit form with all materials and components required to complete the installation. Connectors shall be included in the kits. The cable joints shall be suitable for cables specified in the tender/inquiry.

Components shall not be adversely affected in any manner by contact with other materials normally used in the construction of cable joints and shall not increase the rate of corrosion of any metal with which they may come into contact.

All components of a Joint shall perform without distress under the normal conditions, cyclic loading and fault conditions.

Components supplied with adhesive coatings shall have means to prevent the coated surfaces from adhering to each other.

1.2.8 Marking

All components shall be clearly marked with the manufacturer's name and reference numbers. The marking shall be done before coating the adhesive onto the component.

Electrically conducting components shall be marked 'conducting' clearly and permanently.

All components shall be capable of being stored without deterioration within the temperature range of -10ºC to +55ºC. Components or materials, if subjected to a shelf life limitation, shall have the final date of use prominently and permanently shown on all packages.

Each hard box shall be printed with the following information:

a) Joint/accessories catalogue number

b) Purchase order number/tender

c) Manufacturer's name

d) Year of manufacture

e) Date of expiry

Each wooden box shall be fixed with an Aluminium plate bearing the following information:

a) Purchase order number/tender

b) Manufacturer's name

c) Year of manufacture

d) Date of expiry

e) Joint/accessories catalogue number

f) Gross weight in kilograms

g) Position of slinging points and other relevant handling instructions.

1.2.9 DIAGRAMS AND DRAWINGS

The drawings shall be submitted with the tender as a part of the tender documents.

Actual drawings showing the terminations, and accessories including terminations into equipment in respect of which the independent test reports have been obtained.

Typical drawings are not acceptable.

Catalogue for all the components used. Catalogue numbers for the offered items shall be

high-lighted.

Duly completed attached technical data schedule for each offered item.

1.2.10 TESTING

All Routine Tests and Type Tests of The terminations and accessories shall be tested in accordance with the latest standards.

Below Type tests reports by qualified laboratory:

AC Voltage Withstand

Partial Discharge

Impulse Voltage Withstand

Short Time Current

Cyclic Aging

DC Voltage Withstand

High Voltage Time

Shielding

1.2.11 PACKING AND SHIPMENT:

Installation instructions shall be packed separately in hard board box
Packing notes shall be included in each hard board box giving a description of the goods packed.
Packing shall be designed to protect against ingress of moisture and mechanical damage.
The kits shall not be packed in any organic material.

Technical Guarantees No. IT24_240

630A , 24 kv Indoor Screened Separable Termination Kit for 12/20 kv XLPE Cable 1x240/25 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		CENELEC HD629.1 S2, HD506 S1 , DIN47636, EN50180 and EN50181			
4	Max. Service Voltage (Um)	kV	24			
5	Design		Separable Tee Shape Connector			
6	Material		Cross linked EPDM			
7	Cable and Conductor Type		Single Core Cable with Copper Wire Shield			
8	Cable Insulation Type / Thickness		XLPE/5.5mm			
9	Conductor Cross Sectional Area	mm^2	240			
10	Current Carrying Capacity	A	630			
11	Basic Impulse Level	kV	125			
12	Partial discharge at 2 U0		< 6 Pc			

Technical Guarantees No. IT24_240

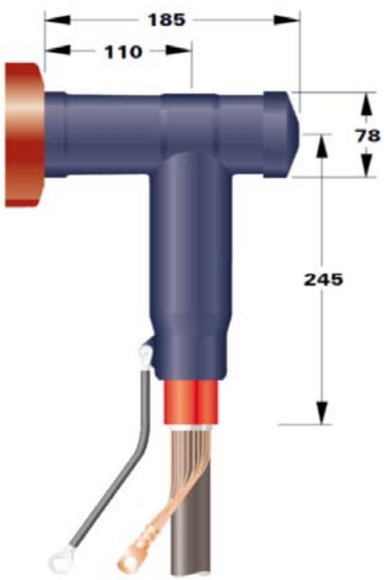
630A , 24 kv Indoor Screened Separable Termination Kit for 12/20 kv XLPE Cable 1x240/25 mm^2

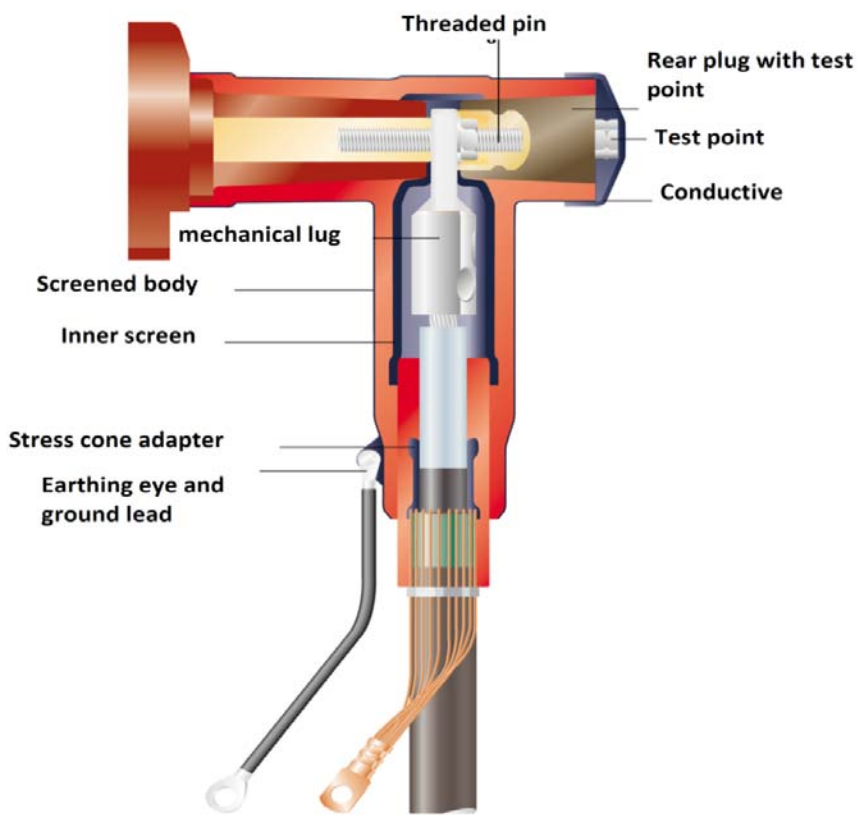
No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
13	AC Dry withstand Voltage Test (1 minute without Flashover and No Breakdown)	Kv	57			
14	DC withstand Voltage Test (15 minute without Flashover and No Breakdown)	Kv	76			
15	Thermal Short Circuit (1 second)	KA	33			
16	Dynamic short circuit	KA	84			
17	**Termination Kit Parts**					
	a) Screened Body		Required			
	b) Inner Screen		Required			
	c) Mechanical Lug with Shear-Head Bolts and Central Barrier for AL or CU Conductors (240 mm2)		Required			
	d) Stress Cone Adaptor		Required			
	e) Earthing eye and Ground Lead		Required			
	f) Threaded Pin Together with a Spring Washer and Hex Nut		Required			
	g) Removable Rear Plug with Capacitive Test Point		Required			
	h) Test Point		Required			
	i) Conductive End cap		Required			

Technical Guarantees No. IT24_240

630A , 24 kv Indoor Screened Separable Termination Kit for 12/20 kv XLPE Cable 1x240/25 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
18	Type Tests and Routine Tests reports by qualified laboratory according to the international specifications		Required			





Tenderer's Signature : ……………………..…   Date: ……………………………….

Technical Guarantees No. IT24_50

250A , 24 kv Indoor Screened Separable Elbow Termination Kit for 12/20 kv XLPE Cable 1x50/16 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Standards		ANSI/IEEE386 , IEC540, VDE0278 , VDE0220			
4	Max. Service Voltage (Um)	kV	24			
5	Termination Design		Separable Elbow Connector			
6	Termination Material		Cross linked EPDM			
7	Cable and Conductor Type		Single Core Cable with Copper Wire Shield			
8	Cable Insulation Type / Thickness		XLPE / 5.5mm			
9	Conductor Cross Sectional Area	mm^2	50			
10	Application		to Connect with SF6 Switchgear Transformer Side and Transformer H.V Side			
11	Current Carrying Capacity	A	250			
12	Basic Impulse Level	kV	125			
13	AC Dry withstand Voltage Test (1 minute without Flashover and No Breakdown)	Kv	57			

Technical Guarantees No. IT24_50

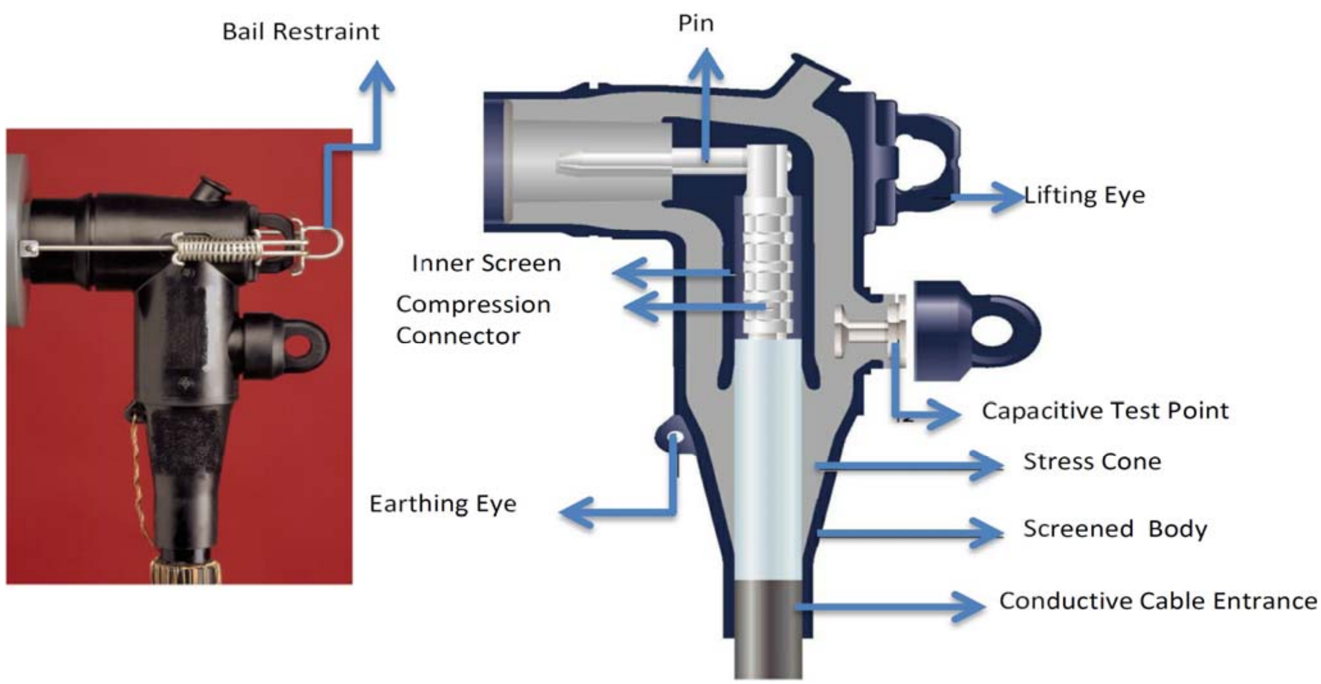
250A , 24 kv Indoor Screened Separable Elbow Termination Kit for 12/20 kv XLPE Cable 1x50/16 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
14	DC withstand Voltage Test (30 minute without Flashover and No Breakdown)	Kv	96			
15	**Termination Kit Parts**					
	a) Screened Body		Required			
	b) Capacitive Test Point		Required			
	c) Stress Cone		Required			
	d) Conductive Cable Entrance		Required			
	e) Earthing eye and Ground Lead		Required			
	f) Inner Screen		Required			
	g) Lifting Eye		Required			
	h) Pin (Tin Plated Copper Electrode , Tested to carry 250 A Continuous Current)		Required			
	i) Bimetallic Compression Pin-Connector Designed with Locking Ring, to Connect Both Aluminium and Copper Conductor Cables		Required			
	j) Bail Restraint		Required			
16	Type Tests and Routine Tests reports by qualified laboratory according to the international specifications (e.g. ANSI/IEEE 386, IEC 540, VDE 0278,VDE 0220)		Required			

Technical Guarantees No. IT24_50

250A , 24 kv Indoor Screened Separable Elbow Termination Kit for 12/20 kv XLPE Cable 1x50/16 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments



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Technical Guarantees No. SJ24_630

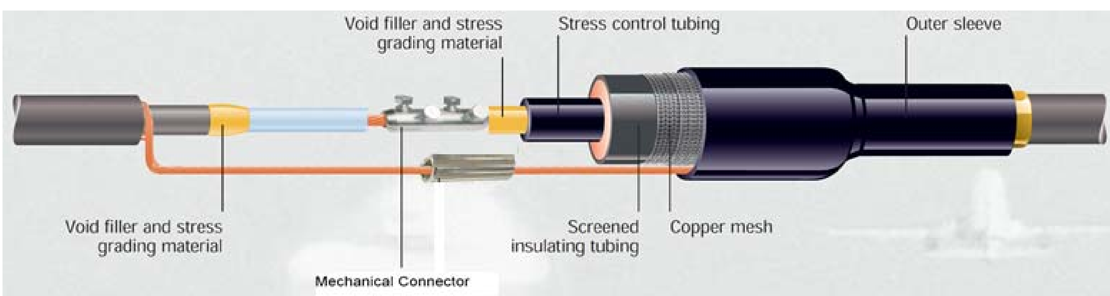
24 kv Heat Shrinkable Straight Joint for Single Core XLPE Cable 1x630/35 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Standards		HD 629.1 S1 , VDE0276 , VDE0620			
4	Max. Service Voltage (Um)	kV	24			
5	Cable and Conductor Type		12/20 kv Single Core Cable with Copper Wire Shield			
6	Cable Insulation Type		XLPE			
7	Conductor Cross Sectional Area	mm^2	630			
8	Copper Shield Cross Sectional Area	mm^2	35			
9- Test :						
9.1	Below Type tests reports by qualified laboratory according to CENELEC HD 629.1 S1 or IEC 60502-4 :- AC Voltage Withstand Partial Discharge Impulse Voltage Withstand Short Time Current Cyclic Aging DC Voltage Withstand High Voltage Time Shielding		Required			
9.2	Mechanical connectors Test used in joints should pass the requirements in accordance with IEC 61238-1 class A.		Required			
10	Routine test report		Required			
11	Installation Instruction Documents		Required			
	Heat Shrinkable Straight Joint Parts					

Technical Guarantees No. SJ24_630

24 kv Heat Shrinkable Straight Joint for Single Core XLPE Cable 1x630/35 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
12	Stress Control Tubing		Required			
	Screened insulating Sleeve		Required			
	Outer Sleeve (Heat Shrink able Conductive Material)		Required			
	Screened Insulating Tubing		Required			
	Filling Mastic		Required			
	24kv Mechanical Connector with Shear-Head Bolts and Central Barrier for AL or CU Conductors (630 mm2)		Required			
	Compression Connector for Copper Shield (35 mm2)		Required			
	Mastic Wrap		Required			
	Copper Mesh		Required			



Tenderer's Signature : ……………………..…   Date: ………………………………

Technical Guarantees No. SJ24_240

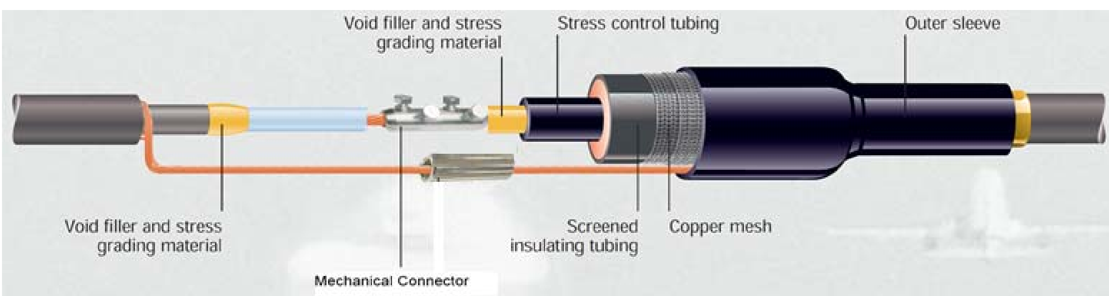
24 kv Heat Shrinkable Straight Joint for Single Core XLPE Cable 1x240/25 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Standards		HD 629.1 S1 , VDE0276 , VDE0620			
4	Max. Service Voltage (Um)	kV	24			
5	Cable and Conductor Type		12/20 kv Single Core Cable with Copper Wire			
6	Cable Insulation Type		XLPE			
7	Conductor Cross Sectional Area	mm^2	240			
8	Copper Shield Cross Sectional Area	mm^2	25			
9- Test :						
9.1	Below Type tests reports by qualified laboratory according to CENELEC HD 629.1 S1 or IEC 60502-4 :- AC Voltage Withstand Partial Discharge Impulse Voltage Withstand Short Time Current Cyclic Aging DC Voltage Withstand High Voltage Time Shielding		Required			
9.2	Mechanical connectors Test used in joints should pass the requirements in accordance with IEC 61238-1 class A.		Required			
10	Routine test report		Required			
11	Installation Instruction Documents		Required			
	Heat Shrinkable Straight Joint Parts					
	Stress Control Tubing		Required			
	Screened insulating Sleeve		Required			

Technical Guarantees No. SJ24_240

24 kv Heat Shrinkable Straight Joint for Single Core XLPE Cable 1x240/25 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
12	Outer Sleeve (Heat Shrink able Conductive Material)		Required			
	Screened Insulating Tubing		Required			
	Filling Mastic		Required			
	24kv Mechanical Connector with Shear-Head Bolts and Central Barrier for AL or CU Conductors (240 mm2)		Required			
	Compression Connector for Copper Shield (25 mm2)		Required			
	Mastic Wrap		Required			
	Copper Mesh		Required			



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Technical Guarantees No. OT36_630

36 kv Heat Shrinkable Outdoor Termination Kit for XLPE Cable 1x630/35 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Standards		IEC60502 & CENELEC HD629.1 S1			
4	Max. Service Voltage (Um)	kV	36			
5	Outdoor Termination Material , form , Designation		Heat Shrink Tubing and Molded Parts Shall be Flexible, Made from Specially Formulated Cross-Lined Polymeric			
6	Cable and Conductor Type		Single Core Conductor Cable with Copper Wire Shield			
7	Cable Insulation Type / Thickness		XLPE / 5.5 mm			
8	Conductor Cross Sectional Area	mm^2	630			
9	Wire Screen Cross Sectional Area	mm^2	35			
10	Termination Length	mm	550			

Technical Guarantees No. OT36_630

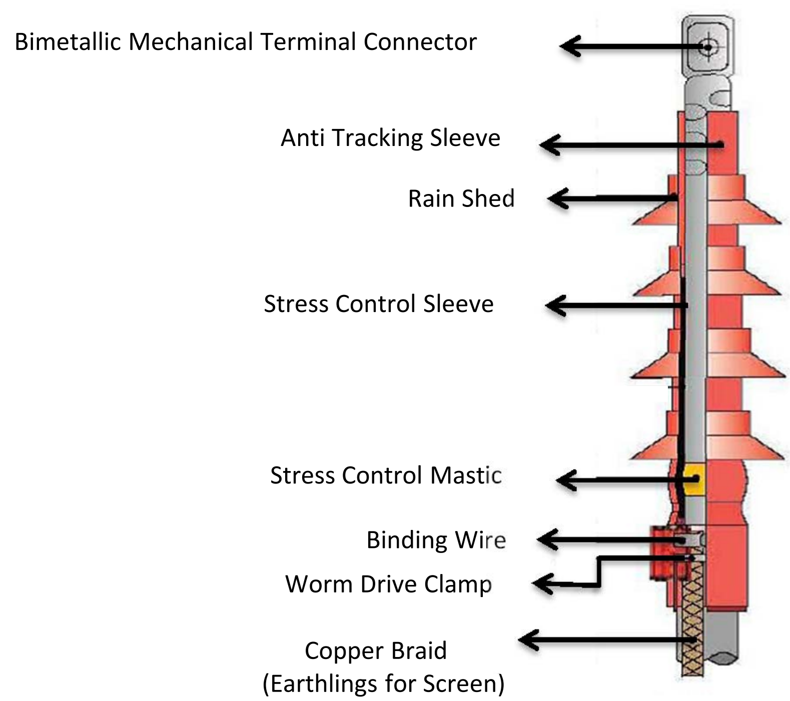
36 kv Heat Shrinkable Outdoor Termination Kit for XLPE Cable 1x630/35 mm^2

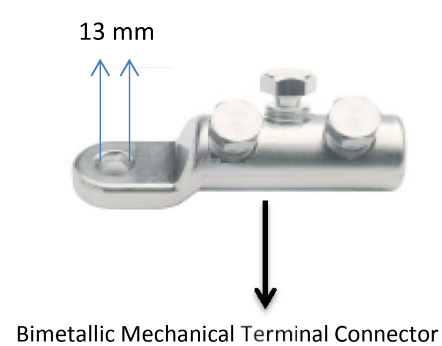
No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
11	Rain Shed Diameter	mm	135			
12	Number of Rain Sheds	No	4			
13	Insulating , Electrical Material and Rain Shed Brittle Temperature	^oC	<-40			
14	Impulse withstand Voltage Test 1.2 Micro Second Between Conductor & Screen Grounded	kV	170			
15- Test :						
15.1	All Type tests reports by qualified laboratory according to CENELEC HD 629.1 S1		Required			
15.2	Routine test report		Required			
16	**Heat Shrinkable Outdoor Termination Kit Parts**					
	Bimetallic Terminal Mechanical Lug with 13 mm Hole and 3 each Shear_Head Bolts (for Aluminium or Copper Conductors)		Required			
	Anti-Tracking Sleeve		Required			
	Rain-Sheds (4each)		Required			
	Stress Control Sleeve		Required			

Technical Guarantees No. OT36_630

36 kv Heat Shrinkable Outdoor Termination Kit for XLPE Cable 1x630/35 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
	Stress Control Mastic		Required			
	Binding Wire		Required			
	Worm Drive Clamp		Required			
	Copper Braid (Earthlings)		Required			
17	Installation Instruction Documents		Required			





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Technical Guarantees No. OT36_240

36 kv Heat Shrinkable Outdoor Termination Kit for XLPE Cable 1x240/25 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Standards		IEC60502 & CENELEC HD629.1 S1			
4	Max. Service Voltage (Um)	kV	36			
5	Outdoor Termination Material , form , Designation		Heat Shrink Tubing and Molded Parts Shall be Flexible, Made from Specially Formulated Cross-Lined Polymeric			
6	Cable and Conductor Type		Single Core Conductor Cable with Copper Wire Shield			
7	Cable Insulation Type / Thickness		XLPE / 5.5 mm			
8	Conductor Cross Sectional Area	mm^2	240			
9	Wire Screen Cross Sectional Area	mm^2	25			
10	Termination Length	mm	530			

Technical Guarantees No. OT36_240

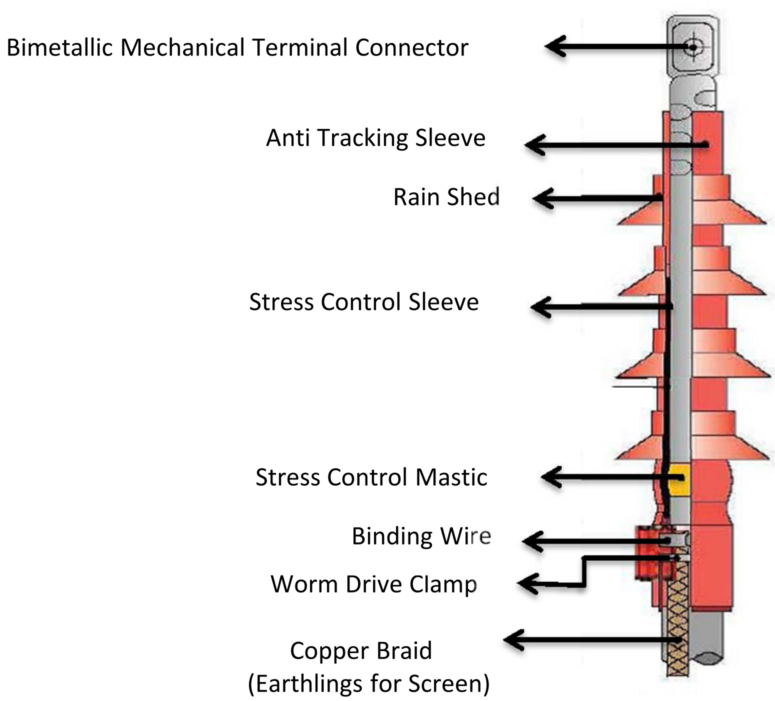
36 kv Heat Shrinkable Outdoor Termination Kit for XLPE Cable 1x240/25 mm^2

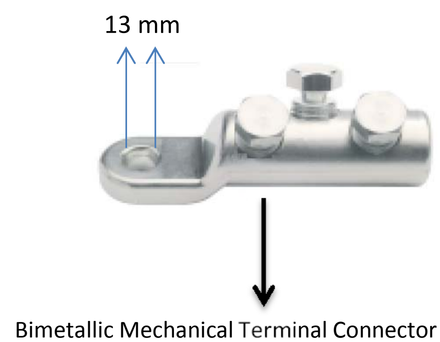
No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
11	Rain Shed Diameter	mm	115			
12	Number of Rain Sheds	No	4			
13	Insulating , Electrical Material and Rain Shed Brittle Temperature	^{o}C	<-40			
14	Impulse withstand Voltage Test 1.2 Micro Second Between Conductor & Screen Grounded	kV	170			
15- Test :						
15.1	All Type tests reports by qualified laboratory according to CENELEC HD 629.1 S1		Required			
15.2	Routine test report		Required			
16	**Heat Shrinkable Outdoor Termination Kit Parts**					
	Bimetallic Terminal Mechanical Lug with 13 mm Hole and 3 each Shear_Head Bolts (for Aluminium or Copper Conductors)		Required			
	Anti-Tracking Sleeve		Required			
	Rain-Sheds (4each)		Required			
	Stress Control Sleeve		Required			

Technical Guarantees No. OT36_240

36 kv Heat Shrinkable Outdoor Termination Kit for XLPE Cable 1x240/25 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
	Stress Control Mastic		Required			
	Binding Wire		Required			
	Worm Drive Clamp		Required			
	Copper Braid (Earthlings)		Required			
17	Installation Instruction Documents		Required			





Tenderer's Signature : ………………………..… Date: ………………………………

شركة تـــــوزيع كهرباء محافظـــــات غزة

Gaza Electricity Distribution Corporation

Technical Specifications

For

XLPE Insulated Single Core Underground Cables 12/20Kv Rated Voltage

March 2012

1. Medium Voltage XLPE Insulated Single Core Underground Cables

SCOPE

This specification covers the general requirements of the design, manufacture and test of Cross-linked Poly-ethylene (XLPE) Insulated single core underground cables for medium voltage underground systems.

1.1 System Details and Service Conditions

The performance of the cable and accessories shall be guaranteed for the upper operating, and environmental conditions of Palestinian National Authority areas.

1.2 Installation Conditions

- Cable laying method: Directly buried and Cables partially installed in separate pipes
- Laying depth: 100-110 cm
- Laying arrangement: flat or trefoil
- Average soil temperature at bury depth 30 ^{o}C
- Thermal resistivity of soil 1.5 Km/W
- Power factor 0.90

1.3 Applicable Standards

The items supplied shall be in accordance with the latest editions of the standards specified below and amendments thereof.

-IEC 60502- Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1.2 kV) up to 30 kV (Um = 36 kV)

- IEC 60228- Conductors of insulated cables

- IEC 60885- Electrical test methods for electric cables

- IEC 60540- Test methods for insulations and sheaths of electric cables and cords (elastomeric and thermoplastics compounds)

- IEC 60229- Tests on cable over sheaths which have a special protective function and are applied by extrusion

- IEC 60811- Common test methods for insulating and sheathing materials of electric cables

-IEC 60230- Impulse tests on cables and their accessories

1.4 Ratings and Performance/General

1.4.1 Rating, performance and testing of each product shall meet the requirements described in the relevant clauses.

1.4.2 The specified ratings and the minimum guaranteed performance shall be for the distribution system and service conditions described in the general specifications.

1.4.3 All the materials used in the construction of the cable shall be capable of withstanding mechanical, electrical and thermal stresses developed during the normal working (permanent or temporary loading), short circuit and emergency overloading under the service conditions described in the general specifications.

1.5 Construction Details

The cables are intended for underground lying it shall be 12/20 k v or 18/30 kv single core, XLPE insulated and class 2 Circular stranded Compacted Aluminium or Copper conductors.

The cable construction consists from these layers:

1- **Conductor**

2- **Inner semi-conductive layer**

3- **XLPE insulation**

4- **Outer semi-conductive layer**

5- **Semi-Conductive Swellable Tape.**

6- **Copper Wire Screen (including Equalizing Tape)**

7- **Separation sheath (Swelling tape)**

8- **LDPE outer cover**

1.5.1 Conductor

The conductor shall be class 2, Circular stranded Compacted Aluminium or Copper wires, it must comply with IEC60228.

The resistance of each conductor at 20 ºC shall be in accordance with relevant IEC standard, the conductor shall be clean, uniform in size, shape and quality, smooth and free from scale, spills, splits, sharp edges and other harmful defects. The cable phase conductor shall be longitudinally sealed (voids between conductor wires shall be filled with moisture swelling powder)

1.5.2 Inner semi-conductive layer (Conductor Screen)

Conductor screen shall be of Extruded Semi-conducting Compound type. The extruded layer shall be continuous and shall cover the surface of the conductor completely. The Conductor Screen shall be applied in the same operation as the insulation.

1.5.3 XLPE Insulation

The insulation shall be XLPE and shall be applied by extrusion and cross-linked to form a compact and homogeneous layer in accordance with the Standards specified.

The thickness of insulation shall conform to the relevant IEC standard and compliance shall be checked by the tests given in the relevant IEC standard.

Only dry processes shall be used in vulcanizing and cross linking of the XLPE-insulation. Special precautions shall be taken to avoid ingress and spreading of moisture and development of water-treeing. The Bidder shall documents the construction measures used to achieve these requirements. The Supplier can purpose an alternative treatment to prevent the possibility for treeing.

1.5.4 Outer semi- conductive layer (Insulation screen)

The insulation screen shall consist of extruded (triple extruded) semi - conducting thermosetting compound. The screen shall be firmly bonded (thermosetting) to the insulation. The thickness of semi – conducting layer of the conductor or over the insulation, shall not be included in the thickness of the insulation XLPE. Conductor screen, insulation and insulation screen shall be applied (extruded) simultaneously, using triple extrusion head, and shall cover the surface of the insulation completely.

The insulation screen shall be cold strippable to ease the process of terminating.

1.5.5 Semi conductive water swelling tape (Inner covering)

Extruded or lapped materials suitable for the operating temperature of the cable and compatible with the insulating materials, Conditions of cable being buried direct in ground in sustained wet conditions should be considered. Semi-conductive bedding tapes shall be used to assure good electrical connection between the concentric wire screen and the extruded semi-conducting insulation screen.

1.5.6 Copper Wire screen

The core shall be covered with a Copper wire screen including Equalizing Tape, the cross sectional area of the metallic screen shall be able to withstand the specified fault current & duration.

1.5.7 Separation sheath (Swelling tape)

Water barrier nonconductive swelling tape shall be provided to protect against longitudinal water penetration.

1.5.8 LDPE Outer Covering

The cable shall have an outer non - metallic Black Color sheath, it shall consist of LDPE ST7 (Low Density polyethylene).

The sheathing material shall be suitable for its operating temperature in accordance with sub-clause 4.3 IEC 60502.

Chemical additives will be requested for use in the over sheath for special purpose for example termite protection but they should not include materials harmful to mankind or environment acc. to IEC 60502.

The over sheath shall withstand the DC voltage test in accordance with relevant IEC standard. This test shall be carried out on each delivery lengths.

1.6 Manufacture

Adequate consideration shall have been given in the design of the cable and in the manufacturing process on the following (Documentary evidence shall be supplied along with the tender)

i) Maximum design electrical stress shall be such that purity of raw materials, manufacturing conditions and ageing of cables has been taken into account.

ii) Purity of raw materials.

iii) Close control of extrusion process to achieve smooth extruded surfaces, homogeneous extrudes and prevention of void formations.

1.7 Manufacturing Experience

The Manufacturer shall provide the years of experience in the manufacture of XLPE Insulated Cables and he shall furnish sufficient documentary evidence in the Bid to prove his manufacturing experience.

1.8 Performance Guarantee

Bidders shall furnish the Performance Certificates obtained from Electricity Supply Authorities to whom the Bidder have supplied XLPE Insulated Cables of similar type in the past years, the certificate shall indicate the Type, Size, Voltage & Current ratings of the XLPE Insulated Cables, Year of Supply and the Quantity Supplied.

1.9 Diagrams and Drawings

The following diagrams and drawings shall be submitted with the tender as a part of the tender documents:

- Complete sets of detailed dimension drawings and catalogues of the offered product.

- Calculation sheets for construction, thickness, and electrical stresses.

- Current rating computation and curves.

-Correction Factors

1.10 Testing

Testing and inspection of product:

The product shall be tested in accordance with the standards and specifications mentioned in this book.

1.10.1 Type Test

The type Test Certificates conforming to the relevant IEC Standards shall be furnished as listed in the applicable IEC 60502, IEC60230 and IEC60811 standards, applicable to the same voltage category and same cross section of the cable offered. Type test reports shall be in English language. The type test shall made in independent laboratory or in the laboratory which have accreditation certificate from international testing laboratory firms which acceptable to the purchaser.

a) Bending test
b) Partial discharge
c) Tanδ measurement
d) Heating cycle test, followed by a partial discharge test
e) Impulse test, followed by a voltage test
f) Voltage test for 4 h
g) Resistivity of semi-conducting screens

Type Test Certificate, Performance Curves, Tables etc. based on Type Tests shall conform to the relevant Standards specified. The Test Certificate should clearly identify the Items concerned, showing the manufacturers identity, type No. /catalogue No. and basic technical parameters. The Type Test Certificates shall carry an indication of the total number of pages in it (e.g. page 1 of 4 etc.) and any incomplete Type Test Certificates or copies with missing pages etc. will be rejected.

1.10.2 Routine Test

The routine test reports/ Factory test reports shall also be supplied with the cables to include following tests.

The Following tests shall perform on every completed cable as required in IEC60502-2 and IEC60885-3:

a) Measurement of electrical resistance of conductors

b) Measurement of electrical resistance of Copper wire screen

c) Power frequency voltage test (High Voltage test 3.5*Uo)

d) Partial discharge test for 12/20 kV rated cables

1.10.3 Acceptance Test

The Following tests shall perform on samples selected in agreement with the GEDCo.

The Factory test reports shall be supplied with the cables as required in IEC60502-2 and IEC60811-1-1 and IEC60811-2-1 and Witnessed by Three Purchaser Engineers.

a) Conductor examination

b) Measurement of thickness of insulation

c) Measurement of thickness of non- metallic sheath

d) Measurement of external diameter

e) Examination of sheath and protective coverings

f) Insulation and Sheath Elongation

g) Insulation and Sheath Tensile Strength

h) Hot set test for XLPE insulation & sheaths (under load and after cooling)

i) Measurement of electrical resistance of conductors and Copper wire screen

e) Power frequency voltage test (High Voltage test 3.5*Uo)

f) Partial discharge test

After Tests, the certificates shall include in addition to test results the following:

a) The order number of the Gedco.

b) The manufacturer's drum number. .

c) The date of testing.

d) The signature of the test engineer.

- If during inspection tests carried out by or supervised by Gedco. Any material proved defective or not manufactured according to the contractual specifications, Gedco shall have the right to reject such material.

- If any material is rejected, the contractor shall be obliged to replace it without extra payment.

- If any samples fail in any of the acceptance tests, the acceptance or rejection will be according to sub-clause 17.3 of IEC 60502-2.

- Supplier must provide the dates of the tests required before 30 days .

1.11 Packing and Shipment

- The type of packing should be suitable and provide complete protection inland transportation of drums in addition to that it should be robust and have suitable dimensions and weights.

- The contractor will take care on his own account that the commodity will be packed carefully in order to avoid damage of delivered materials and should be accepted by insurance company.

- The strength and quality of the packing materials should correspond to the weight of the packed materials.

- Delivery of cables shall be on drums of new wood .The cables on drum shall be protected by wooden batten.

- Empty drums after usage shall be non - returnable.

- The drums shall be new, substantially made to an approved international standard. An arrow on the side of each drum shall indicate the rolling direction.

- Both ends of the cable shall be sealed with adhesive coated heat shrink end caps to prevent the ingress of moisture in transport, shipping and storage

- The drums shall be transported in an upright position and properly secured against damage in transportation.

- The design details and the dimensioned drawing of the drum shall be submitted with the tender including design, material and marking to be approved by the GEDCO prior to manufacture.

- The drum shall meet all the above requirements, any deviation in the drum design, material and marking shall be with the approval of the GEDCO.

- Sufficient steel bands for drum shall be in accordance with their weight and dimensions.

- Each drum must include the packing list fixed on it.

1.12 Marking and Identification

1- GEDCO stresses great importance on distinct and durable identification.

2- Cable outer covering identification: The marking shall be hot stamping on the cable outer covering and shall be indelible and distinct and clearly show the following as sample:

Electric Cable, 12 /20 KV, 1 x 630 mm2 AL/XLPE / LDPE

Marking of length each 1 m / year and name of Manufacturer / GEDCO

3- It is important to mark each drum, clearly by the following:

- Contract number;
- GEDCO, the purchaser;
- Delivery number, shipment number;
- Manufacturing date;
- Name of manufacturer;
- Kind of materials;
- Quantities contained length;
- Main technical specification;
- Cross section;
- Gross weight, net weight

The marking must be clear and written on two sides of the drum with unerasable materials also metal label in both sides of drum including the same information (no.3) above should be fixed.

Technical Guarantees No. XLPEC_50

12/20 kV Single Core Cable with XLPE Insulation and Copper Circular Stranded Conductor 1x50 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Design Standards		IEC60502-2 & IEC60228			
4	Test Standards		IEC60230 & IEC60502-2 & IEC60811			
5	Code & Designation		N2XS(F)2Y , Power Cable with Copper Conductors and XLPE Insulation			
6	Climatic Design		.-.5^{o}C to 55^{o}C			
7-	**Rated Voltage**					
7.1	Between Conductor and Sheath (U_o)	kV	12			
7.2	Between any Two Conductors (U)	kV	20			
7.3	Max. Service Voltage (U_m)	kV	24			
7.4	System Nominal Voltage	kV	22			
8	Rated Frequency	HZ	50			
9	Impulse withstand Voltage 1,2/50 µs	kV	125			
10-	**Cable Design**					
10.1 Conductor :						
10.1.1	Cross Section	mm^2	50			
10.1.2	Material		Copper			
10.1.3	Class and Form		Class2 - Stranded Compacted Circular (filled with swelling powder)			
10.1.4	Minimum / Maximum Diameter	mm	8.1 / 8.8			

Technical Guarantees No. XLPEC_50

12/20 kV Single Core Cable with XLPE Insulation and Copper Circular Stranded Conductor 1x50 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
10.1.5	Minimum Number of Strands	No	6			
10.1.6	Weight of Conductor Per Meter	Kg/Km	shall be filled by manufacturer			
10.1.7	Maximum DC Resistance of Conductor at 20°C	Ω/km	0.387			
10.1.8	Max. Rated Temperature for Permanent Load	°C	90			
10.1.9	Max. Rated Temperature for Emergency Loads	°C	105			
10.1.10	Max. Rated Conductor Temperature at Short Circuit (1 sec. max. duration)	°C	250			
10.2 Inner Semi Conductive Layer (Conductor Screen) :						
10.2.1	Material		Triple Extruded Bonded Thermosetting Semi-Conductive Layer			
10.2.2	Thickness at Any Point	mm	0.3			
10.2.3	Max Service Temperature	°C	90			
10.3- XLPE Insulation :						
10.3.1	Material		Triple Extruded Dry Cured (XLPE)			
10.3.2	Nominal Thickness	mm	5.5			
10.3.3	Minimum Thickness at Any Point	mm	4.85			
10.3.4	Diameter Over Insulation	mm	shall be filled by manufacturer			
10.3.5	Max Service Temperature	°C	90			
10.3.6	Weight	Kg/Km	shall be filled by manufacturer			
10.4- Outer Semi Conductive Layer (Insulation Screen) :						

Technical Guarantees No. XLPEC_50

12/20 kV Single Core Cable with XLPE Insulation and Copper Circular Stranded Conductor 1x50 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
10.4.1	Material		Triple Extruded Bonded Thermosetting Semi-Conductive			
10.4.2	Thickness at Any Point	mm	0.3			
10.4.3	Max Service Temperature	°C	90			
10.5- Semi-Conductive Water Swelling Tape :						
10.5.1	Material		Semi Conductive			
10.5.2	Thickness at Any Point	mm	0.3			
10.5.3	Max Service Temperature	°C	90			
10.6- Copper Wire Screen (including Equalizing Tape) :						
10.6.1	Material of Wire and Equalizing Tape		Copper			
10.6.2	Minimum Wires Number		shall be filled by manufacturer			
10.6.3	Wire Geometrical Cross Section	mm^2	16			
10.6.4	Equalizing Tape Width	mm	10			
10.6.5	Equalizing Tape Thickness	mm	0.1			
10.7- Separation Sheath (Binder Tape) :						
10.7.1	Material		Water Blocking Tape Non-Conductive			
10.7.2	Thickness	mm	0.2 - 0.3			
10.7.3	Max Service Temperature	°C	90			
10.8- Outer Sheath :						
10.8.1	Material	mm	LDPE ST7 with Chemical Additives			
10.8.2	Nominal Thickness	mm	1.9			
10.8.3	Minimum Thickness at Any Point	mm	shall be filled by manufacturer			

Technical Guarantees No. XLPEC_50

12/20 kV Single Core Cable with XLPE Insulation and Copper Circular Stranded Conductor 1x50 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
10.8.4	Max Service Temperature	°C	90			
10.8.5	Color		Red			
10.8.6	Weight	Kg/Km	shall be filled by manufacturer			
10.9- Completed Cable :						
10.9.1	Overall Diameter of the Cable	mm	shall be filled by manufacturer			
10.9.2	Total Weight of the Cable	kg/km	shall be filled by manufacturer			
10.9.3	Minimum Bending Radius	mm	shall be filled by manufacturer			
10.9.4	**Sustained Current Rating in Underground Under Below Conditions :**					
10.9.4.1	At **Flat** Laying Arrangement (Buried in 0.7 m Deep in Soil at 20 °C with 1 k.m/w Thermal Resistivity and Load Factor 0.7)	A	250			
10.9.4.2	At **Trefoil** Laying Arrangement (Buried in 0.7 m Deep in Soil at 20 °C with 1 k.m/w Thermal Resistivity and Load Factor 0.7)	A	222			
11	Maximum Short-Circuit Current of Conductor During 1 sec.	KA	≥7.2			
12- Drum :						
12.1	Method of Cable Delivery		on Drums			
12.2	Length of Cable on Drum	m	500			
12.3	Drum Material		New Wood			
12.4	Cable Protection on Drum		Wooden Batten			

Technical Guarantees No. XLPEC_50

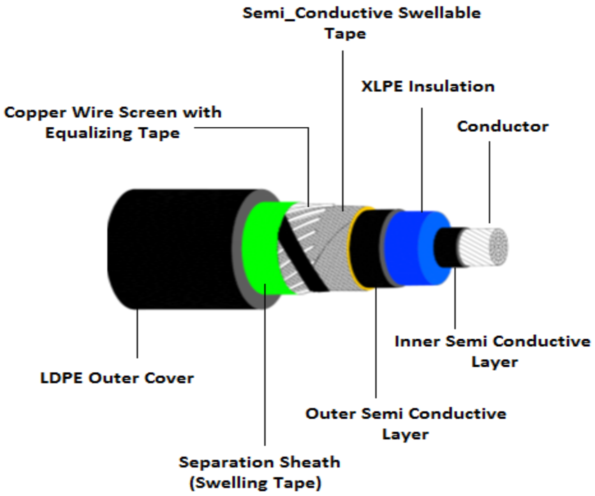
12/20 kV Single Core Cable with XLPE Insulation and Copper Circular Stranded Conductor 1x50 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
12.5	Max. Gross Weight of Drum with Cable	kg	shall be filled by manufacturer			
12.6	Dimension of Drum	mm	shall be filled by manufacturer			
13	Permissible Pulling Forces	N	shall be filled by manufacturer			
14- Test :						
14.1	Type Test Certificates /Reports from internationally reputed testing agency		Required			
14.2	ptance & Routine tests witnessed by three Engineers		Required			
15	Marking		***Hot Stamping, giving :*** 1- Type of cable 2- Conductor Cross-section area 3- Beneficiary Name **(Gedco)** 4- Manufacturer name 5- Nominal voltage 6- Length for Each Meter 7- Production year			

Technical Guarantees No. XLPEC_50

12/20 kV Single Core Cable with XLPE Insulation and Copper Circular Stranded Conductor 1x50 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments



Tenderer's Signature : ……………………..…   Date: ………………………………

Technical Guarantees No. XLPEA_630

12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 630 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Design Standards		IEC60502-2 & IEC60228			
4	Test Standards		IEC60230 & IEC60502-2 & IEC60811 & IEC 60885			
5	Code & Designation		NA2XS(F)2Y , Power Cable with Aluminum Conductors and XLPE Insulation			
6	Climatic Design		.-.5^{o}C to 55^{o}C			
7-	**Rated Voltage**					
7.1	Between Conductor and Sheath (U_o)	kV	12			
7.2	Between any Two Conductors (U)	kV	20			
7.3	Max. Service Voltage (U_m)	kV	24			
7.4	System Nominal Voltage	kV	22			
8	Rated Frequency	HZ	50			
9	Impulse withstand Voltage 1,2/50 µs	kV	125			
10-	**Cable Design**					
10.1 Conductor :						
10.1.1	Cross Section	mm^2	630			
10.1.2	Material		Aluminum			
10.1.3	Class and Form		Class2 - Stranded Compacted Circular (filled with swelling powder)			
10.1.4	Minimum / Maximum Diameter	mm	29.5 / 32.5			

Technical Guarantees No. XLPEA_630

12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 630 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
10.1.5	Minimum Number of Strands	No	53			
10.1.6	Weight of Conductor Per Meter	Kg/Km	shall be filled by manufacturer			
10.1.7	Maximum DC Resistance of Conductor at 20°C	Ω/km	0.0469			
10.1.8	Max. Rated Temperature for Permanent Load	°C	90			
10.1.9	Max. Rated Temperature for Emergency Loads	°C	105			
10.1.10	Max. Rated Conductor Temperature at Short Circuit (1 sec. max. duration)	°C	250			
10.2 Inner Semi Conductive Layer (Conductor Screen) :						
10.2.1	Material		Triple Extruded Bonded Thermosetting Semi-Conductive Layer			
10.2.2	Thickness at Any Point	mm	0.3			
10.2.3	Max Service Temperature	°C	90			
10.3- XLPE Insulation :						
10.3.1	Material		Triple Extruded Dry Cured (XLPE)			
10.3.2	Nominal Thickness	mm	5.5			
10.3.3	Minimum Thickness at Any Point	mm	4.85			
10.3.4	Diameter Over Insulation	mm	shall be filled by manufacturer			
10.3.5	Max Service Temperature	°C	90			
10.3.6	Weight	Kg/Km	shall be filled by manufacturer			
10.4- Outer Semi Conductive Layer (Insulation Screen) :						

Technical Guarantees No. XLPEA_630

12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 630 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
10.4.1	Material		Triple Extruded Bonded Thermosetting Semi-Conductive			
10.4.2	Thickness at Any Point	mm	0.3			
10.4.3	Max Service Temperature	°C	90			
10.5- Semi-Conductive Water Swelling Tape :						
10.5.1	Material		Semi Conductive Tape			
10.5.2	Thickness at Any Point	mm	0.3			
10.5.3	Max Service Temperature	°C	90			
10.6- Copper Wire Screen (including Equalizing Tape) :						
10.6.1	Material of Wire and Equalizing Tape		Copper			
10.6.2	Minimum Wires Number		45			
10.6.3	Wire Geometrical Cross Section	mm^2	35			
10.6.4	Equalizing Tape Width	mm	20			
10.6.5	Equalizing Tape Thickness	mm	0.1			
10.7- Separation Sheath (Binder Tape) :						
10.7.1	Material		Water Blocking Tape Non-Conductive			
10.7.2	Thickness	mm	0.2 - 0.3			
10.7.3	Max Service Temperature	°C	90			
10.8- Outer Sheath :						
10.8.1	Material	mm	LDPE ST7 with Chemical Additives			
10.8.2	Nominal Thickness	mm	2.5			
10.8.3	Minimum Thickness at Any Point	mm	shall be filled by manufacturer			

Technical Guarantees No. XLPEA_630

12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 630 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
10.8.4	Max Service Temperature	°C	90			
10.8.5	Color		Black			
10.8.6	Weight	Kg/Km	shall be filled by manufacturer			
10.9- Completed Cable :						
10.9.1	Overall Diameter of the Cable	mm	shall be filled by manufacturer			
10.9.2	Total Weight of the Cable	kg/km	shall be filled by manufacturer			
10.9.3	Minimum Bending Radius	mm	shall be filled by manufacturer			
10.9.4	**Sustained Current Rating in Underground Under Below Conditions :**					
10.9.4.1	At **Flat** Laying Arrangement (Buried in 0.7 m Deep in Soil at 20 ^{o}C with 1 k.m/w Thermal Resistivity and Load Factor 0.7)	A	730			
10.9.4.2	At **Trefoil** Laying Arrangement (Buried in 0.7 m Deep in Soil at 20 ^{o}C with 1 k.m/w Thermal Resistivity and Load Factor 0.7)	A	701			
11	Maximum Short-Circuit Current of Conductor During 1 sec.	KA	≥59.2			
12- Drum :						
12.1	Method of Cable Delivery		on Drums			
12.2	Length of Cable on Drum	m	500			
12.3	Drum Material		New Wood			
12.4	Cable Protection on Drum		New Wooden Batten			

Technical Guarantees No. XLPEA_630

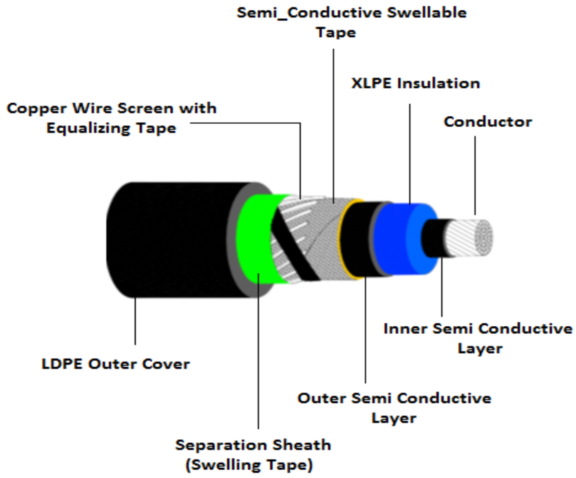
12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 630 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
12.5	Max. Gross Weight of Drum with Cable	kg	shall be filled by manufacturer			
12.6	Dimension of Drum	mm	shall be filled by manufacturer			
13	Permissible Pulling Forces	N	shall be filled by manufacturer			
14- Test :						
14.1	Type Test Certificates /Reports from internationally reputed testing agency		Required			
14.2	ptance & Routine tests witnessed by three Engineers		Required			
15	Marking		***Hot Stamping, giving :*** 1- Type of cable 2- Conductor Cross-section area 3- Beneficiary Name **(Gedco)** 4- Manufacturer name 5- Nominal voltage 6- Length for Each Meter 7- Production year			

Technical Guarantees No. XLPEA_630

12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 630 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments



Tenderer's Signature : ……………………..…   Date: ………………………………

Technical Guarantees No. XLPEA_240

12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 1x240 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Design Standards		IEC60502-2 & IEC60228			
4	Test Standards		IEC60230 & IEC60502-2 & IEC60811			
5	Code & Designation		NA2XS(F)2Y , Power Cable with Aluminum Conductors and XLPE Insulation			
6	Climatic Design		- 5^{o}C to 55^{o}C			
7-	**Rated Voltage**					
7.1	Between Conductor and Sheath (U_o)	kV	12			
7.2	Between any Two Conductors (U)	kV	20			
7.3	Max. Service Voltage (U_m)	kV	24			
7.4	System Nominal Voltage	kV	22			
8	Rated Frequency	HZ	50			
9	Impulse withstand Voltage 1,2/50 µs	kV	125			
10-	**Cable Design**					
10.1	**Conductor :**					
10.1.1	Cross Section	mm^2	240			
10.1.2	Material		Aluminum			
10.1.3	Class and Form		Class2 - Stranded Compacted Circular (filled with swelling powder)			

Technical Guarantees No. XLPEA_240

12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 1x240 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
10.1.4	Minimum / Maximum Diameter	mm	18 / 19.2			
10.1.5	Minimum Number of Strands	No	30			
10.1.6	Weight of Conductor Per Meter	Kg/Km	shall be filled by manufacturer			
10.1.7	Maximum DC Resistance of Conductor at 20°C	Ω/km	0.125			
10.1.8	Max. Rated Temperature for Permanent Load	°C	90			
10.1.9	Max. Rated Temperature for Emergency Loads	°C	105			
10.1.10	Max. Rated Conductor Temperature at Short Circuit (1 sec. max. duration)	°C	250			
10.2 Inner Semi Conductive Layer (Conductor Screen) :						
10.2.1	Material		Triple Extruded Bonded Thermosetting Semi-Conductive Layer			
10.2.2	Thickness at Any Point	mm	0.3			
10.2.3	Max Service Temperature	°C	90			
10.3- XLPE Insulation :						
10.3.1	Material		Triple Extruded Dry Cured (XLPE)			
10.3.2	Nominal Thickness	mm	5.5			
10.3.3	Minimum Thickness at Any Point	mm	4.85			
10.3.4	Diameter Over Insulation	mm	shall be filled by manufacturer			

Technical Guarantees No. XLPEA_240

12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 1x240 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
10.3.5	Max Service Temperature	°C	90			
10.3.6	Weight	Kg/Km	shall be filled by manufacturer			
10.4- Outer Semi Conductive Layer (Insulation Screen) :						
10.4.1	Material		Triple Extruded Bonded Thermosetting Semi-Conductive Layer			
10.4.2	Thickness at Any Point	mm	0.3			
10.4.3	Max Service Temperature	°C	90			
10.5- Semi-Conductive Water Swelling Tape :						
10.5.1	Material		Semi Conductive Tape			
10.5.2	Thickness at Any Point	mm	0.3			
10.5.3	Max Service Temperature	°C	90			
10.6- Copper Wire Screen (including Equalizing Tape) :						
10.6.1	Material of Wire and Equalizing Tape		Copper			
10.6.2	Minimum Wires Number		shall be filled by manufacturer			
10.6.3	Wire Geometrical Cross Section	mm^2	25			
10.6.4	Equalizing Tape Width	mm	10			
10.6.5	Equalizing Tape Thickness	mm	0.1			
10.7- Separation Sheath (Binder Tape) :						
10.7.1	Material		Water Blocking Tape Non-Conductive			

Technical Guarantees No. XLPEA_240

12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 1x240 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
10.7.2	Thickness	mm	0.2 - 0.3			
10.7.3	Max Service Temperature	°C	90			
10.8- Outer Sheath :						
10.8.1	Material	mm	LDPE ST7 with Chemical Additives			
10.8.2	Nominal Thickness	mm	2.2			
10.8.3	Minimum Thickness at Any Point	mm	shall be filled by manufacturer			
10.8.4	Max Service Temperature	°C	90			
10.8.5	Color		Black			
10.8.6	Weight	Kg/Km	shall be filled by manufacturer			
10.9- Completed Cable :						
10.9.1	Overall Diameter of the Cable	mm	shall be filled by manufacturer			
10.9.2	Total Weight of the Cable	kg/km	shall be filled by manufacturer			
10.9.3	Minimum Bending Radius	mm	shall be filled by manufacturer			
10.9.4	**Sustained Current Rating in Underground Under Below Conditions :**					
10.9.4.1	At **Flat** Laying Arrangement (Buried in 0.7 m Deep in Soil at 20 °C with 1 k.m/w Thermal Resistivity and Load Factor 0.7)	A	455			

Technical Guarantees No. XLPEA_240

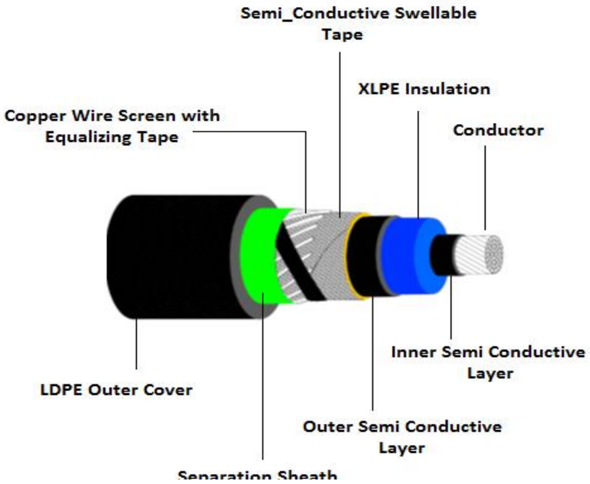
12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 1x240 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
10.9.4.2	At **Trefoil** Laying Arrangement (Buried in 0.7 m Deep in Soil at 20 °C with 1 k.m/w Thermal Resistivity and Load Factor 0.7)	A	417			
11	Maximum Short-Circuit Current of Conductor During 1 sec.	KA	≥22.6			
12- Drum :						
12.1	Method of Cable Delivery		on Drums			
12.2	Length of Cable on Drum	m	500			
12.3	Drum Material		New Wood			
12.4	Cable Protection on Drum		Wooden Batten			
12.5	Max. Gross Weight of Drum with Cable	kg	shall be filled by manufacturer			
12.6	Dimension of Drum	mm	shall be filled by manufacturer			
13	Permissible Pulling Forces	N	shall be filled by manufacturer			
14- Test :						
14.1	Type Test Certificates /Reports from internationally reputed testing agency		Required			

Technical Guarantees No. XLPEA_240

12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 1x240 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
14.2	Acceptance & Routine tests witnessed by Three Beneficiary Engineers		Required			
15	Marking		***Hot Stamping, giving :***			
			1- Type of cable			
			2- Conductor Cross-section area			
			3- Beneficiary Name **(Gedco)**			
			4- Manufacturer name			
			5- Nominal voltage			
			6- Length for Each Meter			
			7- Production year			
			8- No. Of Purchase order (GEDCo)			



Technical Guarantees No. XLPEA_240

12/20 kV Single Core Cable with XLPE Insulation and Aluminium Circular Stranded Conductor 1x240 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments

Separation Sheath
(Swelling Tape)

Tenderer's Signature : ………………………..…   Date: ………………………………

شـركة تـــــوزيع كهـرباء محافظـــــــات غـزة

Gaza Electricity Distribution Corporation

Technical Specifications

For

XLPE Insulated Single & Multi Core Cables 0.6/1Kv Rated Voltage

March 2012

1 XLPE Insulated Single & Multi Core Cables 0.6/1Kv Rated Voltage

SCOPE

This specification covers the general requirements of the design, manufacture and test of Cross-linked Poly-ethylene (XLPE) Insulated single and Multi core cables for Low voltage underground systems.

1.1 System Details and Service Conditions

The performance of the cable and accessories shall be guaranteed for the upper operating, and environmental conditions of Palestinian National Authority areas.

1.2 Installation Conditions

- Cable laying method: Directly buried or overhead
- Laying depth: 80 cm
- Laying arrangement: flat or trefoil
- Average soil temperature at bury depth 25 ^{o}C
- Thermal resistivity of soil 1.5 Km/W
- Power factor 0.85

1.3 Applicable Standards

The items supplied shall be in accordance with the latest editions of the standards specified below and amendments thereof.

- IEC 60502-1- Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1.2 kV) up to 3 kV (Um = 3.6 kV)

- IEC 60228- Conductors of insulated cables

- IEC 60885- Electrical test methods for electric cables

- IEC 60540- Test methods for insulations and sheaths of electric cables and cords (elastomeric and thermoplastics compounds)

- IEC 60229- Tests on cable over sheaths which have a special protective function and are applied by extrusion

- IEC 60811- Common test methods for insulating and sheathing materials of electric cables

-IEC 60230- Impulse tests on cables and their accessories

1.4 Ratings and Performance/General

- Rating, performance and testing of each product shall meet the requirements described in the relevant clauses.

- The specified ratings and the minimum guaranteed performance shall be for the distribution system and service conditions described in the general specifications.

- All the materials used in the construction of the cable shall be capable of withstanding mechanical, electrical and thermal stresses developed during the normal working (permanent or temporary loading), short circuit and emergency overloading under the service conditions described in the general specifications.

1.5 Construction Details

The cables are intended for underground laying it shall be 0.6/1 k v single or multicore, XLPE insulated and class 2 Circular stranded Aluminium or Copper conductor.

The cable construction consists from these layers:

1-Conductor

2-XLPE insulation

3-Filling

4-LDPE outer cover

1.5.1 Conductor

The conductor shall be class 2, Circular stranded Compacted Aluminium or Copper wires or Shaped stranded Aluminium or Copper wires as per specifications and comply with IEC60228.

The resistance of each conductor at 20ºC shall be in accordance with relevant IEC standard, the conductor shall be clean, uniform in size, shape and quality, smooth and free from scale, spills, splits, sharp edges and other harmful defects.

1.5.2 XLPE Insulation

The insulation shall be XLPE and shall be applied by extrusion and cross-linked to form a compact and homogeneous layer in accordance with the Standards specified. The thickness of insulation shall conform to the relevant IEC standard and compliance shall be checked by the tests given in the relevant IEC standard.

Only dry processes shall be used in vulcanizing and cross linking of the XLPE-insulation. Special precautions shall be taken to avoid ingress and spreading of moisture and development of water-treeing. The Bidder shall documents the construction measures used to achieve these requirements. The Supplier can purpose an alternative treatment to prevent the possibility for treeing.

1.5.3 Filling

The cores of all twin and multicore cables shall be laid-up together with suitable fillers, wormed circular and binding tapes applied overall.

The fillers for XLPE cables shall be non-hygroscopic. The direction of lay of the cores shall be right- hand for all twin and multicore power cables. The term "right-hand" has the same meaning as for screw threads. All cables shall be circular.

1.5.4 LDPE Outer Covering

The cable shall have an outer non - metallic Black Color sheath, it shall consist of LDPE ST7 (Low Density polyethylene).

The sheathing material shall be suitable for its operating temperature in accordance with sub-clause 4.3 IEC 60502.

Chemical additives will be requested for use in the over sheath for special purpose for example termite protection but they should not include materials harmful to mankind or environment acc. to IEC 60502.

The over sheath shall withstand the DC voltage test in accordance with relevant IEC standard. This test shall be carried out on each delivery lengths.

1.6 Cables Colour

All multicore cables outer sheath color shall be Green and the Core coloring identification for 4 core cables shall be as below:

- The phases color: Brown, brown with black strip & brown with orange strip
- The Neutral color: Blue

1.7 Quality Control

ISO 9001 Quality Assurance System shall be followed in the manufacture of XLPE Insulated Cables. Bidders shall furnish documentary evidence (Complete Document) that he has obtained ISO 9001 Certification for the manufacturing plant. Offers of Bidders who fail to furnish the proof of ISO 9001 Certification will be rejected.

1.8 Manufacturing Experience

The Manufacturer shall provide the years of experience in the manufacture of XLPE Insulated Cables and he shall furnish sufficient documentary evidence in the Bid to prove his manufacturing experience.

1.9 Performance Guarantee

Bidders shall furnish five Performance Certificates obtained from Electricity Supply Authorities to whom the Bidder have supplied XLPE Insulated Cables of similar type in the past years, three (3) of which shall be from outside the country of Manufacture. The certificate shall indicate the Type, Size, Voltage & Current ratings of the XLPE Insulated Cables, Year of Supply and the Quantity Supplied.

1.10 Diagrams and Drawings

The following diagrams and drawings shall be submitted with the tender as a part of the tender documents:

- Complete sets of detailed dimension drawings and catalogues of the offered product.

- Calculation sheets for construction, thickness, electrical stresses...

- Current rating computation and curves.

1.11 Testing

- The contractor should carry out all kinds of tests (routine, type and sample tests) on a sample of the first delivery.

-Testing and inspection of product:

The product shall be tested in accordance with the standards and specifications mentioned in this book.

- If type tests have been already affected by an independent testing authority, the type test reports and certificates shall be enclosed with the offer.

1.11.1 Type Test Certificates

Type Test Certificates conforming to the relevant IEC Standards shall be furnished as listed in the applicable IEC 60502, IEC60230 and IEC60811 standards, applicable to the voltage category of the cable offered. Type test reports shall be in English language. The Type Test Certificates furnished shall be from a recognized independent testing authority acceptable to the purchaser.

Type tests, electrical:

a) Insulation resistance measurement at ambient temperature
b) Insulation resistance measurement at maximum conductor temperature
c) Voltage test for 4 h

Type tests, non-electrical

a) Measurement of thickness of insulation
b) Measurement of thickness of non-metallic sheaths
c) Tests for determining the mechanical properties of insulation before and after ageing
d) Tests for determining the mechanical properties of non-metallic sheaths before and after ageing
e) Pressure test at high temperature on insulations and non-metallic sheaths
f) Hot set test for XLPE insulation & elastomeric sheaths
g) Water absorption test on insulation
h) Shrinkage test for XLPE insulation
i) Shrinkage test for LDPE over sheaths
j) Special bending test

Type Test Certificate, Performance Curves, Tables etc. based on Type Tests shall conform to the relevant Standards specified. The Test Certificate should clearly identify the Items concerned, showing the manufacturers identity, type No. /catalogue No. and basic technical parameters. The Type Test Certificates shall carry an indication of the total number of pages in it (e.g. page 1 of 4 etc.) and any incomplete Type Test Certificates or copies with missing pages etc. will be rejected.

1.11.2 Routine Test Certificates

The routine test reports/ Factory test reports shall also be supplied with the cables to include following tests.

Following tests shall perform on every completed cable as required IEC60502-1:

a) Measurement of electrical resistance of conductors

b) Power frequency voltage test

Following tests shall perform on samples selected in agreement with the GEDCo. The Factory test reports shall be supplied with the cables as required IEC60502-1:

Conductor examination and check of dimensions

a) Physical tests

b) Repetition of tests

c) Conductor examination

d) Measurement of thickness of insulation and of non-metallic sheaths

e) Measurement of external diameter

f) Hot set test for XLPE insulations

- GEDCO has the right to carry out type test on sample for any delivery of the contract.

- Test certificates shall include in addition to test results the following:

a) The order number of the Gedco.

b) The manufacturer's drum number. .

c) The date of testing.

d) The signature of the test engineer.

- If during inspection tests carried out by or supervised by Gedco. Any material proved defective or not manufactured according to the contractual specifications, Gedco shall have the right to reject such material.

- If any material is rejected, the contractor shall be obliged to replace it without extra payment.

- If any samples fail in any of the acceptance tests, the acceptance or rejection will be according to sub-clause 16.3 of IEC 60502-1.

1.12 Packing and Shipment

- The type of packing should be suitable and provide complete protection inland transportation of drums in addition to that it should be robust and have suitable dimensions and weights.
- The contractor will take care on his own account that the commodity will be packed carefully in order to avoid damage of delivered materials and should be accepted by insurance company.
- The strength and quality of the packing materials should correspond to the weight of the packed materials.
- Delivery of cables shall be on drums of new wood .The cables on drum shall be protected by wooden batten.
-Empty drums after usage shall be non - returnable.
- The drums shall be new, substantially made to an approved international standard. An arrow on the side of each drum shall indicate the rolling direction.
- Both ends of the cable shall be sealed with adhesive coated heat shrink end caps to prevent the ingress of moisture in transport, shipping and storage
- The drums shall be transported in an upright position and properly secured against damage in transportation.
- The design details and the dimensioned drawing of the drum shall be submitted with the tender including design, material and marking to be approved by the GEDCO prior to manufacture.
- The drum shall meet all the above requirements, any deviation in the drum design, material and marking shall be with the approval of the GEDCO.
- Sufficient steel bands for drum shall be in accordance with their weight and dimensions.
- Each drum must include the packing list fixed on it.

1.13 Marking and Identification

1- The GEDCO stresses great importance on distinct and durable identification.
2- Cable outer covering identification: The marking on the cable outer covering shall be indelible and distinct and clearly show the following:

Electric Cable, 0.6/1 KV, 4 x 240 mm2 AL/XLPE / LDPE

Marking of length each 1 m / year and name of Manufacturer / GEDCO

3- It is important to mark each drum, clearly by the following:

- Contract number;
- GEDCO, the purchaser;
- Delivery number, shipment number;
- Manufacturing date;
- Name of manufacturer;
- Kind of materials;
- Quantities contained length;
- Main technical specification;
- Cross section;
- Gross weight, net weight

The marking must be clear and written on two sides of the drum with unerasable materials also metal label in both sides of drum including the same information (no.3) above should be fixed.

Technical Guarantees No. LV1C_240

0.6/1 kV Single Core Cable with XLPE Insulation and Circular Stranded Compacted Copper Conductor 1x240 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Design Standards		IEC60502-1 & IEC60228			
4	Test Standards		IEC60230 & IEC60502-1 & IEC60811			
5	Code & Designation		N2X2Y FR1 , L.V Cable with Copper Conductors and XLPE Insulation			
6	Climatic Design		- 5°C to 55°C			
7-	**Rated Voltage**					
7.1	Between Conductor and Sheath (U_o)	kV	0.6			
7.2	Between any Two Conductors (U)	kV	1			
7.3	Max. Service Voltage (U_m)	kV	1.2			
7.4	Rated Frequency	HZ	50			
8-	**Cable Design**					
8.1	Cross Section	mm^2	240			
8.2	Core No.	No	1			
8.3	Material		Copper			
8.4	Class and Form		Class2 - Circular Stranded Compacted			
8.5	Minimum No. of wires	No	34			

Technical Guarantees No. LV1C_240

0.6/1 kV Single Core Cable with XLPE Insulation and Circular Stranded Compacted Copper Conductor 1x240 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
8.6	Conductor Minimum / Maximum Diameter	mm	17.5 / 19.2			
8.7	Insulation Material		Cross Linked Polyethylene (XLPE)			
8.8	Nominal Insulation Thickness	mm	1.7			
8.9	Insulation Max Service Temperature	°C	90			
8.10	Outer Sheath Material		LDPE ST7 with Chemical Additives			
8.11	Nominal Sheath Thickness	mm	1.8			
8.12	Overall Diameter of the Cable	mm	shall be filled by manufacturer			
8.13	Max. Rated Temperature for Permanent Load	°C	90			
8.14	Max. Rated Temperature for Emergency Loads	°C	105			
8.15	Max. Rated Conductor Temperature at Short Circuit (1 sec. max. duration)	°C	250			
8.16	Total Weight of the Cable	kg/km	shall be filled by manufacturer			
8.17	DC Resistance (R_{dc})	ohm/km	shall be filled by manufacturer			
8.18	Minimum Bending Radius	mm	shall be filled by manufacturer			

Technical Guarantees No. LV1C_240

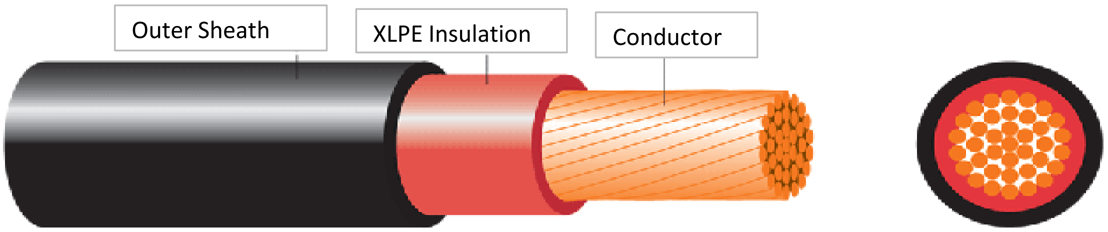
0.6/1 kV Single Core Cable with XLPE Insulation and Circular Stranded Compacted Copper Conductor 1x240 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
8.19	Continuous Current Carrying Capacity Single Cable Laid Buried in 0.7 m Deep in Soil at 20 °C with 1 k.m/w Thermal Resistivity and Load Factor 0.7	A	521			
8.20	Short circuit rating (1 sec) based on an initial conductor temperature of 90 °C and a final temperature of 250 °C	KA	34.3			
9- Drum :						
9.1	Method of Cable Delivery		on Drums			
9.2	Length of Cable on Drum	m	500			
9.3	Drum Material		New Wood			
9.4	Cable Protection on Drum		Wooden Batten			
9.5	Max. Gross Weight of Drum with Cable	kg	shall be filled by manufacturer			
9.6	Dimension of Drum	mm	shall be filled by manufacturer			
10	Permissible Pulling Forces	N				
11- Tests :						
11.1	Type Test Certificates /Reports from internationally reputed testing agency		Required			
11.2	Acceptance & Routine tests witnessed by Beneficiary		Required			

Technical Guarantees No. LV1C_240

0.6/1 kV Single Core Cable with XLPE Insulation and Circular Stranded Compacted Copper Conductor 1x240 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
12	Marking		***Embedded print, giving :*** 1- Type of cable 2- Cross-section 3- Manufacturer name 4- Nominal voltage 5- Length for Each Meter 6- No. Of Purchase order (GEDCo) 7- Production year			



Tenderer's Signature : ………………………..…   Date: ………………………………

Technical Guarantees No. PVC_70

PVC Insulated Stranded Compacted Circular Copper Conductor 70 mm^2 , Yellow/Green

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		IEC 60227 , BS 6004 , HD21.3			
4	Rated Voltage Uo/U (Um)	V	450/750			
5	Test Voltage	V	2500			
6	Conductor Material		Copper			
7	Conductor Construction		Stranded Compacted Circular			
8	Nominal Cross-Sectional Area of Conductor	mm^2	70			
9	Min. No. of Copper Strands	No.	12			
10	Diameter of Copper Strand	mm	shall be filled by manufacturer			
11	Insulation		Yellow/Green Weather-Resistant PVC			
12	Insulation Minimum Thickness	mm	1.4			
13	Overall Diameter	mm	shall be filled by manufacturer			
14	Max. Conductor DC Resistance at 20 °C	Ω/km	0.268			

Technical Guarantees No. PVC_70

PVC Insulated Stranded Compacted Circular Copper Conductor 70 mm^2 , Yellow/Green

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
15	Current rating based upon continuous operation at 70 °C conductor, 30 °C ambient, wires enclosed in conduit on wall , AC one Phase	A	190			
16	Approximate Total Weight of the Conductor	kg/km	shall be filled by manufacturer			
17	Drum Material		New Wood			
18	Cable Protection on Drum		Wooden Batten			
19	Wire Length on Drum	m	500			
20	Acceptance & Routine tests witnessed by Beneficiary		Required			

Tenderer's Signature : ……………………..… Date: ………………………………

شركة تـــوزيع كهرباء محافظـــــات غزة

Gaza Electricity Distribution Corporation

TECHNICAL SPECIFICATIONS FOR DISTRIBUTION TRANSFORMERS

March 2013

PARTICULAR TECHNICAL SPECIFICATIONS FOR DISTRIBUTION TRANSFORMERS

Scope

This chapter covers the particular technical requirements of the medium 22 kV voltage equipment to be procured under this contract. By conflict between the general specification and the particular specifications below the particular specifications shall prevail.

1. Applicable Standards

The equipment and the components supplied shall be in accordance with the latest edition of the standards specified below and amendments thereof. However the GEDCo Specification shall supersede these Standards in the event there is a discrepancy

a) **IEC 60076 (1993) -** Power Transformers

b) **DIN42500 -** Three-phase oil-immersed distribution transformers 50 Hz, 50 up to 2500 kVA; general requirements and requirements for transformers Um up to 24 kV; German version HD 428.1 S1:1992

c) **IEC 60156 (1995) -** Insulating liquids-determination of the breakdown voltage at power frequency – test methods

d) **IEC 60296:3 -** unused minerals insulating oils for transformers and switch-gear

e) **IEC 60354 (1991) -** Loading guide for oil-immersed transformers

f) **IEC 60551 (1987) -** Determination of transformer and reactor sound levels

g) **IEC 60616 (1978) -** Terminal and tapping markings for power Transformers

h) **IEC 60722 (1982) -** Guide to the lightning impulse and switching impulse testing

i) **IEC 60815 (1986) -** Guide for the selection of insulators in respect of polluted conditions

j) **IEC 60137 (1995) -** Insulating bushing for alternating voltages above 1 kV

k) **BS 5493 (1997) -** Protective coating of iron and steel structures against corrosion

L) **IEC 60085 -** Thermal evaluation and classification of electrical insulation

2. Ambient Temperatures, Relative Humidity, Wind Pressure

Unless otherwise specifically stated in Particular Technical Specification, any equipment, component and assembly shall be designed for the following service conditions:

Item	Description	Unit	Value
1	Altitude of site above sea level	m	- 50 to + 200
2	Ambient Temps:- Maximum / Minimum	°C	+45 / - 5
3	Wind Speed	m/s	15
4	Isokeraunic Level		15
5	Pollution Type		Dust
6	Relative Humidity Maximum/ Minimum	%	100 / 50
7	Rainfall Average annual	mm	600
8	Hail		Yes
9	Fog		Yes
10	Sand Storms		Occasional

3. BASIC FEATURES

3.1 The transformers shall be 22/0.4kv, 3-phase, two winding, liquid immersed, sealed or Breathing type rated for continuous operation under site ambient conditions at full rated power, naturally cooled (ONAN), with off load, manual, operated tap-changer, lockable in all positions on primary side.

3.2 Vector Group

Unless otherwise specified, the transformer shall be connected delta-star in accordance with vector group reference Dyn11.

3.3 Impedance Voltage

The impedance voltage at normal tap shall be 4% for transformers up to 800KVA and 6% for 800KVA transformers or greater .

3.4 Temperature Rise:

At the rated power the transformer shall comply with the following Maximum temperature rises:

Top oil 45°C Max.

Winding 50°C Max.

Hot Spot 98°C Max.

Avg. temp. due to short circuit 250°C Max.

3.5 Overload capacity

After thermal equilibrium has been reached at 75% of rated load, the transformer shall be capable of sustaining the overload conditions listed in the following table without the transformer winding hot spot temperature exceeding 110 ºC:

Load Percent of rating (%)	Minimum Duration in Minutes at Ambient Temperature of Percent of	
	30 ºC	40 ºC
133	240	155
150	98	65

The supplier shall demonstrate by test and calculation that these requirements are met.

3.6 Noise Level

In general is to be less than 68 dB at 0.3m for ratings up to 2000 kVA and in accordance with IEC 551.

3.7 Transformer Construction

The primary and secondary windings shall be constructed from high conductivity E.C. grade copper. All turns of windings shall be adequately supported to prevent movement. The high voltage winding shall be of layered winding and the low voltage winding shall be of foil winding using Copper sheets.

The core and coil assembly shall have the core and coils rigidly connected. The core/coil assembly shall be mounted on the cover plate so that the assembly could be removed from the tank using the suitably placed lugs provided on the cover plate.

No material which can be deleteriously affected by the action of oil under the operating conditions of the transformers shall be used in the transformers or leads or bushings.

To ensure that the core and coils of transformers are seated on the floor of the tank, supporting frames shall be designed to accommodate variations in tank height. The core and coil assembly shall be rigidly connected to the tank and suitably closed lugs shall be provided for removing the core and coil assembly from the tank.

Construction features shall permit local repairs to be easily carried out in the event of equipment failure.

3.8 Transformer Tank

Variable volume steel tank, with corrugated wall design forming integral cooling pockets, heavy rolled and welded steel bottom and base frame and hermetically sealed bolted-on cover. Tank is to be completely filled with insulating liquid drawn in under vacuum. Tank cover is to have provision for two thermometers or temperature sensors, lugs for lifting, four lashing lugs and filler-pipe with valve. Tank is to have drain plug at bottom, earthing bolt on cover and earthing pad on base-frame, and a rating plate.

The transformer tank shall be fabricated from steel and shall be of robust construction. Care should be taken at the manufacturing stage so as not to have leaks during transportation or when the transformer is continuously operated at rated power.

With the exception of radiator elements, all external joints shall be seam welded. There shall be only one vertical seam weld for the fin radiator and the other three vertical corner edges of the transformer shall be formed by bending. Corner ribs shall be avoided for the fin radiator. The bearing surface of the tank to which bushings are clamped shall be substantially flat.

All matching faces of joints shall be made oil tight and finished with a smooth surface to ensure that the gasketing materials make a satisfactory joint.

Flanges and covers of tanks shall be of sufficient thickness to prevent any depression occurring, which would retain water around the bolts. The horizontal edges of the cover plate shall be bent over the tank flange to facilitate water dripping out of the tank. The bent collar width shall be about 10mm to 15mm.

All the nut and bolts used shall be hot dip galvanised and spaced at sufficiently close intervals to avoid buckling of either flange or covers and shall provide reasonably uniform compression of the gasket.

Each transformer shall be provided with a minimum of two closed lifting lugs. The minimum diameter of the hole or width of the slot shall be 25 mm. The two lifting lugs shall be located such that there would be a minimum of 50 mm between the lifting chain and the nearest part of the bushings.

3.9 Transformer Sealing / Gasket

The transformers shall provide with a satisfactory lid sealing gaskets.The gasket shall of the good quality to maintain the sealing effect through its life span and shall prevent seeping of oil due to ageing and extreme operating temperature.

Gaskets provided with the transformers shall be suitable for making oil tight joints, and there would be no deleterious effects on either gaskets or oil when the gaskets are continuously in contact with hot oil. No gaskets shall be used in which the material of the gasket is mounted on a textile backing.

Exterior gaskets shall be of rubberized cork material, weather-proof and shall not be affected by strong sunlight.

3.10 Internal and External Finish

The external surface shall be prepared for powders painting by applying a suitable etch primer. The powder shall then be applied and the powder used shall be epoxy polyester cured with hydroxyl alkyl. The powder coating thickness shall not be less than 50µm.

The Finish colour shall be Cement Grey, RAL 7033

3.11 Rating Plate

A brass /stainless steel rating plate shall be fitted to each transformer. The information shall be deeply etched including the diagram of the connections of the windings, the vector diagram showing the general phase relations of the transformer, and a diagrammatic plan of the transformer cover showing the terminal positions and marking and other essential particulars.

The plate shall be mounted in an accessible position and following information shall be clearly and indelibly marked in English language.

a) Transformer type

b) Manufacturer's name

c) Manufacturer's serial number

d) Year of manufacture

e) Number of phases

f) Rated power

g) Rated frequency

h) Rated voltages

i) Rated currents

j) Connection symbol (Vector Group)

k) Mass of insulating oil

l) Insulation levels

m) Details regarding tapping

n) Gross weight

o) Impedance voltage at rated current

p) Type of cooling

q) Total mass

3.12 Bushings

All bushings shall be of porcelain clad, of the highest quality and comply with IEC 60137. They shall be sealed in a manner to prevent ingress of moisture and to facilitate removal. The neutral bushings and stems shall be identical to those provided for phase terminations. Bushing palms shall be made of brass and be suitable for the bolting of conductor compression lugs.

The palms shall be suitably dimensioned, to suit the bushing rod and the holes spaced sufficiently apart to enable tightening of bolts using standard spanners and to prevent overlap of lugs. The LV bushing palms shall be as indicated in the attached drawings

The MV bushings shall be labeled U, V, and W by using indelible black color paint. Phase identification by adhesive stickers is not acceptable.

All Indoor Transformers MV bushings shall be K180 –AR3 Type

All Outdoor Transformers MV bushings shall be 30 NF -250 Type

All Transformers LV bushings shall be as below bushings type

The Transformers 160 KVA & 250 KVA LV bushings shall be with drilled hole 2x Ø14 mm Brass Flag

The Transformers 400 KVA, 630 KVA, 800 KVA, 1000 KVA, 1250 KVA, 1600 KVA and 2000 KVA LV bushings shall be with drilled hole 4x Ø14 mm Brass Flag

Rating (kva)	Installation	Type of bushing	
		H.V	L.V
2000	Indoor	K180 –AR3	DT4000
1600	Indoor	K180 –AR3	DT3150
1250	Indoor	K180 –AR3	DT2000
800	Indoor	K180 –AR3	DT2000
800	Outdoor	30 NF -250	DT2000
630	Indoor	K180 –AR3	DT1000
630	Outdoor	30 NF -250	DT1000
400	Outdoor	30 NF -250	DT1000
250	Outdoor	30 NF -250	DT630

3.13 Earthing Connections

Earthing connections shall be provided with connection facilities for 70mm2 copper stranded conductors.

Three bolts of M12 size shall be located on either side of the tank base (two) and on the cover plate (one).

3.14 Off Load Tap Changer

Voltage tapings shall be provided on the primary side of each transformer. Tapping step shall be ±2.5%. Number of tapings shall be as specified in Technical guarantees.

The tapings shall be selected by an 'off load' tapping switch with an external hand wheel with provision for locking on to a selected tapping. The shaft shall be adequately sealed so that no seepage of oil occurs under all conditions of service.

The voltage operating positions, together with tap change positions shall be ` clearly and indelibly marked.

3.15 Surge Arrester Mounting Bracket/Bracket to fixing the fuse holder

The surge arrester mounting bracket/ Bracket to fixing the fuse holder made of steel shall be provided on the transformer cover plate.

The bracket shall be hot dip galvanised and suitable to accommodate three surge arresters/fuse holder as indicated Specifications in the drawings

3.16 Oil

Generally all transformers shall be filled to the required level with a new, unused, clean, standard mineral oil in compliance with IEC60296.

PCB synthetic liquids (Poly Chlorinated Biphenyls) or other chlorinated hydro carbons are not acceptable and shall not be used.

3.17 Conservator

For Outdoor Transformers only , the Conservator shall have an adequate sump, a filling cap and a drain valve. To permit cleaning of internal side conservator, one end of the conservator to have removable cover with facility for lifting.

Level gauge with markings to be provided on conservator. The level gauge to indicate maximum, minimum and normal level.

3.18 Radio Interference

When operated at voltage even up to 10% in excess of the normal system rating, transformers shall be substantially free from partial discharges (i.e. corona discharges in either internal or external insulation) which are likely to cause interference with radio or telephone communication

3.19 Accessories

3.19.1 All outdoor transformers shall be including below accessories:

a) Expansion vessel (Conservator)

b) Oil Filling Opening

c) Oil Drain Valve

d) Grounding Terminals

e) Diagram and Name Plate

f) Thermometer Pocket

g) Oil Level Indicator

h) Lifting lugs

i) Safety Valve (over Pressure Relief Device)

j) U - Base

k) Dehydrating breather (silica-gel breather)

3.19.2 All indoor transformers shall be including below accessories:

a) Oil Filling Opening

b) Oil Drain Valve

c) Grounding Terminals

d) Diagram and Name Plate

e) Thermometer Pocket

f) Oil Level Indicator for indoor transformers ratings up to 630 KVA

g) Lifting lugs

h) Safety Valve (over Pressure Relief Device)

i) U - Base with Wheels

j) DGPT (Combined Gas-Pressure Temperature Relay) or R.I.S. (Integrated Safety detector) Including Oil Level Indicator for indoor transformers ratings bigger than 630 KVA

4. Characteristics

a. rated power: 1600 kVA /1250 kVA / 800kVA /630kVA /400KVA/250KVA/160KVA/100KVA/50KVA

b. winding connection: Dyn 11, neutral insulated and brought out
c. frequency: 50 Hz
d. rated voltage primary: 22 kV
e. rated voltage secondary 0.4 kV
f. impedance 6% For 800 , 1250, 1600KVA , 4% for 50,100,160,250,400,630KVA

g. tap-changer positions: Plus 1x 2.5% Minus 3x 2.5% or Plus 1x 2.5% Minus 4x 2.5%
g. Insulation level :
- Impulse withstand voltage (Peak 1.2/50 µs (kV)) 125

- Power Frequency withstand Voltage (r.m.s 1 minute (kV)) 50

h. available fault current of system at location: 20kA
i. Duration of short-circuit: 3 sec.
j. terminal connections:
-HV side: fully insulated with epoxy sealed end, bolted

-LV side: LV busbars

5. LOSSES, IMPEDANCE VOLTAGE AND NOISE LEVEL

The indicated figures below are the maximum acceptable values. Transformers with losses exceeding these values will be rejected.

Rating (kVA)	Losses (Watt)		Impedance Voltage (%)	Noise Level (dB)
	No load	Load		
2000	2050	17500	6	68
1600	1700	14000	6	66
1250	1300	11400	6	64
800	950	7400	6	62
630	900	5100	4	60
400	610	3850	4	58
250	425	2750	4	55
160	300	2350	4	52
100	210	1750	4	49
50	125	1100	4	47

6. Outline Drawings, Maintenance Manual and Packing

Outline drawings and other necessary drawings baring an effect on customers' installation shall be provided with each transformer and a comprehensive maintenance manual shall also provided.

7. Quality Assurance

The manufacturer shall possess ISO 9001 Quality Assurance Certification for the manufacture of distribution transformers for the plant where the manufacture of distribution transformers is done. Bidders shall furnish a copy of the ISO certificate certified as true copy of the original by the manufacturer, along with the offer.

8. Routine Tests

The following routine tests as per IEC 60076: 1993 shall be carried out on all the distribution transformers ordered and the routine test reports shall be made available for the observation of the GEDCo Inspector at the time of inspection.

a) Measurement of winding resistance
b) Measurement of insulation resistance
c) Separate source voltage withstand test (High Voltage tests on HV & LV)
d) Induced Over voltage Withstand test (DVDF test)
e) Measurement of voltage ratio
f) Measurement of No Load Loss & Current.
g) Measurement of Load Loss & Impedance. (Efficiency & Regulation)
h) Vector Group Verification

9. Type Test

The following Certificates of Type tests as per IEC 60076 by an internationally recognized independent testing authority shall be furnished with the offer:

a) Lightning Impulse withstand voltage test

b) Temperature-rise test

c) Acoustic Sound Level Measurements

The type test certificates shall be furnished for each type of transformer offered which, in addition to other required data, shall show the actual no-load and full-load losses of the transformer at rated load. For the purpose of evaluation, the higher values of no-load and load losses shall be considered from the values guaranteed by the Bidder and the values given in the type test reports. The test of the transformer shall have been conducted by a reputed independent laboratory accredited by International Laboratory Accreditation Corporation (ILAC) or International Accreditation Forum (IAF) or other reputed accreditation agencies.

If the upper type tests are not made before, GEDCo want to be in the presence of witness.

10. Acceptance /Sample Tests

The following Acceptance/Sample tests conforming to IEC 60076 (1993) on minimum 10% of all transformers as per GEDCO Requests, and shall be witnessed by three Engineers. Extra copies of these Test Certificates shall also be supplied with the equipment.

1. Measurement of winding resistance
2. Measurement of insulation resistance
3. Separate source voltage withstand test (High Voltage tests on HV & LV)
4. Induced Over voltage Withstand test (DVDF test)
5. Measurement of voltage ratio
6. Measurement of NO Load Loss & current.
7. Measurement of Load Loss & Impedance. (Efficiency & Regulation)
8. Vector Group Verification
9. Oil leakage test

11. Information's to be furnished with the Offer

The following Information shall be furnished the offer

a) Technical Guarantees.

b) Constructional features and materials used for components

c) Separate explanatory drawings and dimensions of tap changer.

d) Overall dimensional drawings

e) Drawing of rating plate to scale incorporating the particulars called for.

f) Certified copy of the quality assurance conforming to ISO 9001.

12. Operating conditions:

-1 the existing transformers may expose to sudden loads that may reach 150%.

-2 The loads of the low voltage directly is connected to the transformers through Manual L.V Disconnector with Fuses.

3- There is excess voltage levels resulted from the manual disconnecting and connection due to the load shedding program which is applied due to the electricity shortage.

So the manufacturer must design the transformers to be able to withstand such high and sudden loads.

Technical Guarantees No. IDT_1600S

22/0.4 KV Low Losses , 3 phase , Indoor Distribution Transformer 1600 KVA Rating with Silicon Oil

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		DIN42500 & IEC 60076			
4	Type		3 phase oil-immersed Hermetically Sealed			
5	Continuous Maximum Rating (C.M.R)	KVA	1600			
6	Rated Frequency	Hz	50			
7	Cooling method		KNAN			
8	**Normal Voltage Between Phases at No Load**					
	a) H.V	Volts	22000			
	b) L.V	Volts	400			
9	**Connection and Vector Group**					
	a) H.V Winding		Delta			
	b) L.V Winding		Star			
	c) Vector Group		Dyn11			
10	**Tapping Range on H.V Side**					
	a) Rating of the Tap change		**+1x2.5% -3x2.5%**			
	b) Type of Tap Changer		Off Load			
11	**Losses (Low Losses Type)**					
	a) No-load losses	Watts	1700			
	b) Load losses at 75C^{o}	Watts	14000			
12	Max. Impedance Voltage of Short Circuit at 75 ^{o}C	%	6			

Technical Guarantees No. IDT_1600S

22/0.4 KV Low Losses , 3 phase , Indoor Distribution Transformer 1600 KVA Rating with Silicon Oil

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
13	**Voltage Drop at Full Load**					
	a) at unity Power Factor (Cosφ = 1)	%	1.095			
	b) at 0.8 Power Factor (Cosφ = 0.8)	%	4.38			
14	**Efficiency at full load**					
	a)at unity Power Factor (Cosφ = 1)	%	98.99			
	b)at 0.8 Power Factor (Cosφ = 0.8)	%	98.74			
15	**Max Temperature rise at C.M.R**					
	a) Top Oil by Thermometer	^oC	45			
	b) Average Winding by Resistance	^oC	50			
	c) Hot Spot Corresponding to (b)	^oC	98			
16	**Insulating Voltage Level**					
	a) Rated lighting – Impulse withstand Voltage 1.2/50 μs (Peak Value)	kV	125			
	b) Rated Duration Power Frequency withstand Voltage 1 min (r.m.s Value)	kV	50			
17	Material thermal class insulation (According IEC 60085)		Class A			
18	**Overloading**					
	a) Minimum Duration of %133 Overloading at 30C^o Ambient Temperature and Preload 75% F.L	Min.	240			
	b) Minimum Duration of %150 Overloading at 30C^o Ambient Temperature and Preload 75% F.L	Min.	98			
19	**Winding Conductor Material**					
	a) H.V winding		high conductivity electrolytic copper			

Technical Guarantees No. IDT_1600S

22/0.4 KV Low Losses , 3 phase , Indoor Distribution Transformer 1600 KVA Rating with Silicon Oil

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
	b) L.V winding		high conductivity electrolytic copper			
20	**Type of insulation**					
	a) H.V winding		Diamond pattern epoxy coated Kraft paper			
	b) L.V winding		Diamond pattern epoxy coated Kraft paper			
21	**Type of Bushing**					
	a) H.V Plug in Bushing		Euromold K180-AR3			
	b) L.V Bushing (with drilled hole 4x Ø14 mm Brass Flag)		DT3150			
22	Installation		Indoor			
23	Noise level at 0.3 m (Lwa)	dB	≤ 66			
24	**Silicon Transformer Oil (as Standard IEC61100&IEC60836 &ASTM D4652)**					
24.1	**Physical**					
24.1.1	Color		Max 35			
24.1.2	Appearance		Crystal clear fluid			
24.1.3	Specific Gravity		0.995 to 0.960			
24.1.4	Viscosity @ 25°C	°C	50mm2 sec (cSt)			
24.1.5	Flashpoint (close cup)	°C	Min 240°C			
24.1.6	Flashpoint (open cup)	°C	Min 300°C			
24.1.7	Fire Point (open cup)	°C	Min 330°C			

Technical Guarantees No. IDT_1600S

22/0.4 KV Low Losses , 3 phase , Indoor Distribution Transformer 1600 KVA Rating with Silicon Oil

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
24.1.8	Refractive Index		1.404 +0.002			
24.1.9	Pour Point,	°C	Max -50°C			
24.2	**Chemical**					
24.2.1	Water content,	ppm	Max 50			
24.2.2	Neutralization value	mg KOH/g	Max 0.02			
24.3	**Electrical**					
24.3.1	Breakdown voltage	kV	Min 40			
24.3.2	Dissipation factor (tg) @ 90°C, 50Hz		Max 0.001			
24.3.3	Permittivity @ 90°C		2.55+0.05			
24.3.4	d.c. rsistivity @ 90°C	g ohm.m	Min 100			
24.3.5	Environmental Requirements		Polychlorinated biphenyls (PCBs) Free			
24.4	Type		Silicon oil			
24.6	Type Test Certificates /Reports from internationally reputed testing agency		1)Physical properties 2) Chemical Properties 3) Electrical properties			
25	Oil weight	Kg				
26	Total weight	Kg				
	Overall Dimensions					

Technical Guarantees No. IDT_1600S

22/0.4 KV Low Losses , 3 phase , Indoor Distribution Transformer 1600 KVA Rating with Silicon Oil

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
27	a) Height	mm				
	b) Length	mm				
	c) Width	mm				
	e) Space Between Wheel Centers	mm				
28	**Accessories**					
	a) Oil Filling Opening		Required			
	b) Oil Drain Valve		Required			
	c) Grounding Terminals		Required			
	d) Diagram and Name Plate		Required			
	e) Thermometer Pocket		Required			
	f) Lifting lugs		Required			
	g) Safety Valve (over Pressure Relief Device)		Required			
	h) Wheels		Required			
	i) DGPT (Combined Gas-Pressure Temperature Relay) or R.I.S. (Integrated Safety detector) Including Oil Level Indicator		Required			
29	Type Test Certificates/Reports from internationally reputed testing agency According IEC 60076		Required			
30	Acceptance & Routine tests witnessed by Beneficiary According IEC 60076		Required			
31	Attached Drawing		Drawing No IDT_1600			

Tenderer's Signature : ……………………..… Date: ………………………………

Technical Guarantees No. IDT_630S

22/0.4 KV Low Losses , 3 phase , Indoor Distribution Transformer 630 KVA Rating with Silicon Oil

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		DIN42500 & IEC 60076			
4	Type		3 phase oil-immersed Hermetically Sealed			
5	Continuous Maximum Rating (C.M.R)	KVA	630			
6	Rated Frequency	Hz	50			
7	Cooling method		KNAN			
8	**Normal Voltage Between Phases at No Load**					
	a) H.V	Volts	22000			
	b) L.V	Volts	400			
9	**Connection and Vector Group**					
	a) H.V Winding		Delta			
	b) L.V Winding		Star			
	c) Vector Group		Dyn11			
10	**Tapping Range on H.V Side**					
	a) Rating of the Tap change		**+1x2.5% -3x2.5%**			
	b) Type of Tap Changer		Off Load			
11	**Losses (Low Losses Type)**					
	a) No-load losses	Watts	900			
	b) Load losses at 75C^{o}	Watts	5100			
12	Max. Impedance Voltage of Short Circuit at 75 ^{o}C	%	4			

Technical Guarantees No. IDT_630S

22/0.4 KV Low Losses , 3 phase , Indoor Distribution Transformer 630 KVA Rating with Silicon Oil

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
13	**Voltage Drop at Full Load**					
	a) at unity Power Factor (Cosφ = 1)	%	1.11			
	b) at 0.8 Power Factor (Cosφ = 0.8)	%	3.17			
14	**Efficiency at full load**					
	a)at unity Power Factor (Cosφ = 1)	%	98.76			
	b)at 0.8 Power Factor (Cosφ = 0.8)	%	98.45			
15	**Max Temperature rise at C.M.R**					
	a) Top Oil by Thermometer	^{o}C	45			
	b) Average Winding by Resistance	^{o}C	50			
	c) Hot Spot Corresponding to (b)	^{o}C	98			
16	**Insulating Voltage Level**					
	a) Rated lighting – Impulse withstand Voltage 1.2/50 μs (Peak Value)	kV	125			
	b) Rated Duration Power Frequency withstand Voltage 1 min (r.m.s Value)	kV	50			
17	Material thermal class insulation (According IEC 60085)		Class A			
18	**Overloading**					
	a) Minimum Duration of %133 Overloading at 30C^{o} Ambient Temperature and Preload 75% F.L	Min.	240			
	b) Minimum Duration of %150 Overloading at 30C^{o} Ambient Temperature and Preload 75% F.L	Min.	98			
19	**Winding Conductor Material**					
	a) H.V winding		high conductivity electrolytic copper			

Technical Guarantees No. IDT_630S

22/0.4 KV Low Losses , 3 phase , Indoor Distribution Transformer 630 KVA Rating with Silicon Oil

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
	b) L.V winding		high conductivity electrolytic copper			
20	**Type of insulation**					
	a) H.V winding		Diamond pattern epoxy coated Kraft paper			
	b) L.V winding		Diamond pattern epoxy coated Kraft paper			
21	**Type of Bushing**					
	a) H.V Plug in Bushing		Euromold K180-AR3			
	b) L.V Bushing (with drilled hole 4x Ø14 mm Brass Flag)		DT1000			
22	Installation		Indoor			
23	Noise level at 0.3 m (Lwa)	dB	≤ 60			
24	**Silicon Transformer Oil (as Standard IEC61100&IEC60836 &ASTM D4652)**					
24.1	**Physical**					
24.1.1	Color		Max 35			
24.1.2	Appearance		Crystal clear fluid			
24.1.3	Specific Gravity		0.995 to 0.960			
24.1.4	Viscosity @ 25°C	°C	50mm2 sec (cSt)			
24.1.5	Flashpoint (close cup)	°C	Min 240°C			
24.1.6	Flashpoint (open cup)	°C	Min 300°C			

Technical Guarantees No. IDT_630S

22/0.4 KV Low Losses , 3 phase , Indoor Distribution Transformer 630 KVA Rating with Silicon Oil

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
24.1.7	Fire Point (open cup)	°C	Min 330°C			
24.1.8	Refractive Index		1.404 +0.002			
24.1.9	Pour Point,	°C	Max -50°C			
24.2	**Chemical**					
24.2.1	Water content,	ppm	Max 50			
24.2.2	Neutralization value	mg KOH/g	Max 0.02			
24.3	**Electrical**					
24.3.1	Breakdown voltage	kV	Min 40			
24.3.2	Dissipation factor (tg) @ 90°C, 50Hz		Max 0.001			
24.3.3	Permittivity @ 90°C		2.55+0.05			
24.3.4	d.c. rsistivity @ 90°C	g ohm.m	Min 100			
24.3.5	Environmental Requirements		Polychlorinated biphenyls (PCBs) Free			
24.4	Type		Silicon oil			
24.6	Type Test Certificates /Reports from internationally reputed testing agency		1)Physical properties 2) Chemical Properties 3) Electrical properties			
	Transformer Oil (as Standard IEC61100&IEC60836)					
	a) Type		Silicon oil			

Technical Guarantees No. IDT_630S

22/0.4 KV Low Losses , 3 phase , Indoor Distribution Transformer 630 KVA Rating with Silicon Oil

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
24	b) Appearance		Crystal clear fluid			
	c) Minimum fire point (open cup)	C°	330			
	d) Flash point (open cup)	C°	300			
	e) Pour point	C°	-55			
	f) Dielectric Breakdown voltage	kv	43			
	g) Viscosity , at 25 °C		50mm2 sec (cSt)			
	c) Density	kg/dm^3	0.96			
	h) Environmental Requirements		Polychlorinated biphenyls (PCBs) Free			
25	Oil weight	Kg				
26	Total weight	Kg				
27	**Overall Dimensions**					
	a) Height	mm				
	b) Length	mm				
	c) Width	mm				
	e) Space Between Wheel Centers	mm				
28	**Accessories**					
	a) Oil Filling Opening		Required			
	b) Oil Drain Valve		Required			
	c) Grounding Terminals		Required			
	d) Diagram and Name Plate		Required			
	e) Thermometer Pocket		Required			

Technical Guarantees No. IDT_630S

22/0.4 KV Low Losses , 3 phase , Indoor Distribution Transformer 630 KVA Rating with Silicon Oil

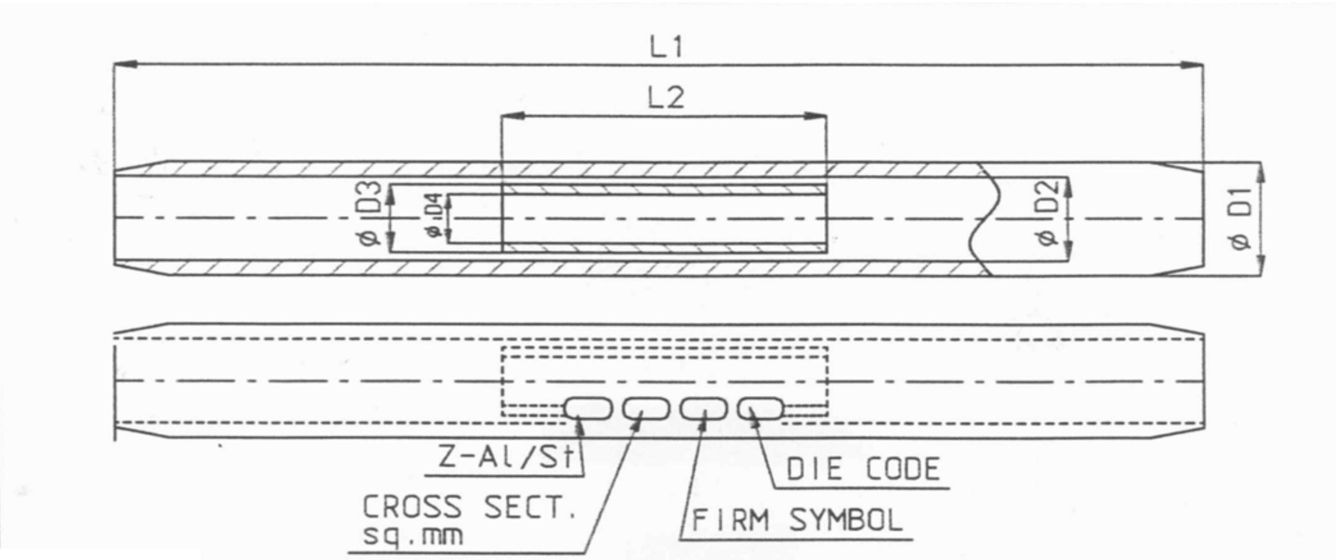
No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
	f) Oil Level Indicator		Required			
	g) Lifting lugs		Required			
	h) Safety Valve (over Pressure Relief Device)		Required			
	i) Wheels		Required			
29	Type Test Certificates/Reports from internationally reputed testing agency According IEC 60076		Required			
30	Acceptance & Routine tests witnessed by Beneficiary According IEC 60076		Required			
31	Attached Drawing		Drawing No IDT_630			

Tenderer's Signature : ………………………..… Date: ………………………………

Technical Guarantees No. TACJ_50A

22Kv Full Tension Compression Joint for ACSR Wire Rabbit

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		DIN 482085/3			
4	Description		up to 36kv , ACSR wires Full-Tension Compression Joint			
5	Material		Steel sleeve:ST52, Aluminium Sleeve AL99.5			
6	Surface		Steel sleeve zinc galvanized, aluminium sleeve uncoated			
7	Conductor		Rabbit			
8	Dimensions		as per Drawing			

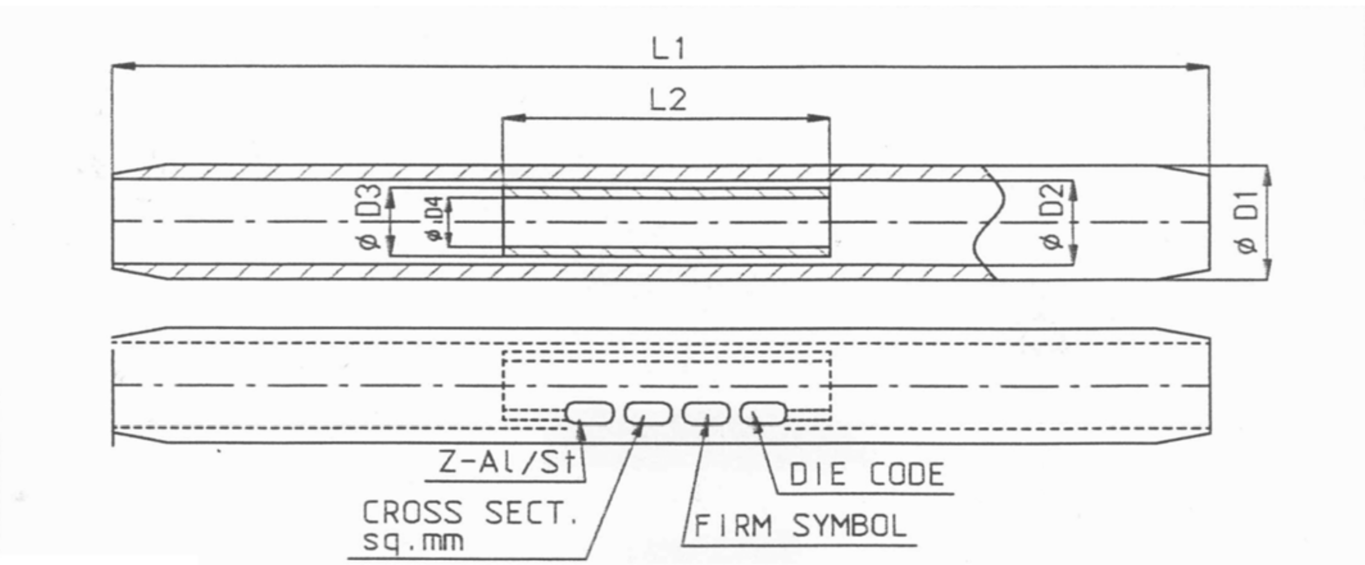


Cross Sect mm²	Die Code		Al		ST		L1 mm	L2 mm	Number of Compressions				
	ST	Al	D1 mm	D2 mm	D3 mm	D4 mm			ST mech.	ST hydr.	Al mech.	Al hydr. small	Al hydr. wide
50/8	7	16	16	10.8	7.5	3.5	280	95	6-6	—	9-9	5-5	—

Technical Guarantees No. TACJ_150A

22Kv Full Tension Compression Joint for ACSR Wire 150/25

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		DIN 482085/3			
4	Description		up to 36kv , ACSR wires Full-Tension Compression Joint			
5	Material		Steel sleeve:ST52, Aluminium Sleeve AL99.5			
6	Surface		Steel sleeve zinc galvanized, aluminium sleeve uncoated			
7	Conductor		150/25			
8	Dimensions		as per Drawing			



Cross Sect mm²	Die Code		Al		ST		L1 mm	L2 mm	Number of Compressions				
									ST		Al		
	ST	Al	D1 mm	D2 mm	D3 mm	D4 mm			mech.	hydr.	mech.	hydr. small	hydr. wide
150/25	13	28	28.5	18.3	13	6.8	390	120	—	(*)	—	—	2-2

Technical Guarantees No. ACSR_5

ACSR Conductor Rabbit

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		British Sizes BS215 PART2 or EN 50182			
4	Type		Aluminium Conductor Steel Reinforced - (ACSR)			
5	Core Material		Greased Stranded Galvanized Steel Wires			
6	Conductor Material		Stranded Aluminium Wires			
7	Code		ACSR Rabbit			
8	Nominal Cross-Sectional area of ACSR Wire	mm^2	61.7			
9	Number of Steel Core Strands	No.	1			
10	Diameter of Steel Core Strand	mm	3.35			
11	Number of Aluminium Strands	No.	6			
12	Diameter of Aluminium Strand	mm	3.35			
13	Total Overall Diameter of Conductor	mm	10.05			
14	Max. Conductor DC Resistance at 20 °C	Ω/km	0.5426			

Technical Guarantees No. ACSR_5

ACSR Conductor Rabbit

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
15	Breaking Strength	KN	18.3			
16	Min. Current Rating in free Air	Amps	185			
17	Conductor resistance for base temperature 20 C^o	ohm/Km	shall be filled by manufacturer			
18	Modulus of Elasticity	kg/mm^2	shall be filled by manufacturer			
19	Coefficient of Thermal Elongation , per ^{o}C		shall be filled by manufacturer			
20	Weight of Aluminium Conductors	kg/km	145			
21	Weight of Steel Conductors	kg/km	68.5			
22	Total Weight of the Conductor	kg/km	shall be filled by manufacturer			
23	Drum Material		New Wood			
24	Cable Protection on Drum		Wooden Batten			
25	Drum Dimensions	mm	shall be filled by manufacturer			
26	Conductor Length on Drum	m	2000			
27	Type Test Certificates/Reports from internationally reputed testing agency		Required			
28	Acceptance & Routine tests witnessed by Two Gedco Engineers		Required			

Tenderer's Signature : ……………………..…   Date: ………………………………

Technical Guarantees No. ACSR_150

ACSR Conductor 150/25 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		German Conductor Sizes DIN48204 or EN 50182			
5	Type		Aluminium Conductor Steel Reinforced - (ACSR)			
6	Core Material		Greased Stranded Galvanized Steel Wires			
7	Conductor Material		Stranded Aluminium Wires			
8	Code		ACSR 150/25			
9	Nominal Cross-Sectional area of ACSR Wire	mm^2	173.1			
10	Number of Steel Core Strands	No.	7			
11	Diameter of Steel Core Strand	mm	2.1			
12	Number of Aluminium Strands	No.	26			
13	Diameter of Aluminium Strand	mm	2.7			
14	Total Overall Diameter of Conductor	mm	17.1			
15	Max. Conductor DC Resistance at 20 °C	Ω/km	0.1939			

Technical Guarantees No. ACSR_150

ACSR Conductor 150/25 mm^2

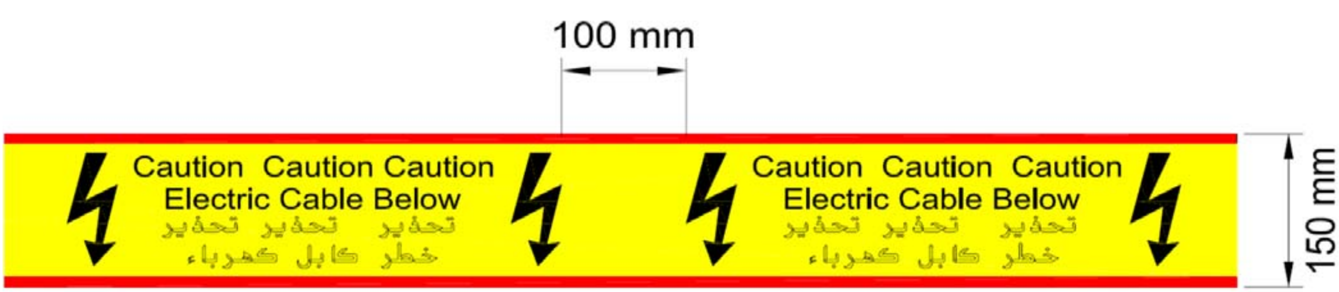
No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
16	Breaking Strength	KN	55.2			
17	Min. Current Rating in free Air	Amps	470			
18	Conductor resistance for base temperature 20 C^o	ohm/Km	shall be filled by manufacturer			
19	Modulus of Elasticity	kg/mm^2	shall be filled by manufacturer			
20	Coefficient of Thermal Elongation , per ^{o}C		shall be filled by manufacturer			
21	Weight of Aluminium Conductors	kg/km	410			
22	Weight of Steel Conductors	kg/km	190			
23	Total Weight of the Conductor	kg/km	shall be filled by manufacturer			
24	Drum Material		New Wood			
25	Cable Protection on Drum		Wooden Batten			
26	Drum Dimensions	mm	shall be filled by manufacturer			
27	Conductor Length on Drum	m	2000			
28	Type Test Certificates/Reports from internationally reputed testing agency		Required			
29	Acceptance & Routine tests witnessed by Two Gedco Engineers		Required			

Tenderer's Signature : ………………………..…   Date: ………………………………

Technical Guarantees No. WT_250

Warning Tape

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Description		Warning Tape			
4	Material		Low Density Polyethylene			
5	Roll Length	meter	250			
6	Width	mm	150			
7	Minimum Thickness	mm	0.1			
8	Printed Legend (2 Language)	English	**CAUTION CAUTION CAUTION Electrical Cables Buried Below**			
		Arabic	**تحذير تحذير تحذير خطر كابل كهرباء**			
9	Tape Colour		Phosphoric Yellow			
10	Text Colour		Dark Black			
11	Text Form		Big			
12	Space Between Text	mm	100			
13	Resistant		Acid / Alkali Resistant			



Tenderer's Signature : ……………………….….   Date: ………………………………

Technical Guarantees No. TPYI_1050

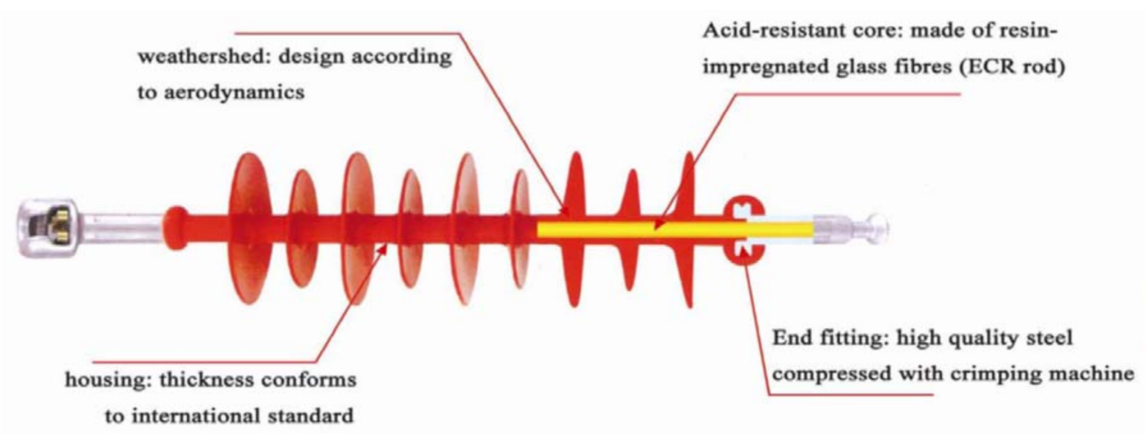
22kv Overhead Line Tension Polymeric Composite Insulator with Ball and Socket and Creepage Distance 1050 mm

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Design Standards		BS 3288 , IEC61109 , IEC60815			
4	Nominal System Voltage	kV	24			
5	Type		Ball and Socket type			
6	Insulating Material		Composite Polymer			
7	Housing		Silicon			
8	Metal Parts		Hot Dip Galvanized			
9	Number of Sheds		Shall be filled by manufacturer			
10	Total Length	mm	Shall be filled by manufacturer			
11	Shed Diameter	mm	Shall be filled by manufacturer			
12	Min. Creepage Distance	mm	1050			
13	Min. Mechanical Failing Load	kN	70			
14	Socket and Ball Size	mm	Φ16			
15	Weight	Kg	Shall be filled by manufacturer			
16	AC 1 min. Flashover (Dry)	kV	130			
17	AC 1 min. withstand (Dry)	kV	120			

Technical Guarantees No. TPYI_1050

22kv Overhead Line Tension Polymeric Composite Insulator with Ball and Socket and Creepage Distance 1050 mm

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to	Evaluation Committee Comments
18	AC 1 min. Flashover (Wet)	kV	120			
19	AC 1 min. withstand (Wet)	kV	95			
20	Type Test Certificates/Reports from internationally reputed testing agency		Required			

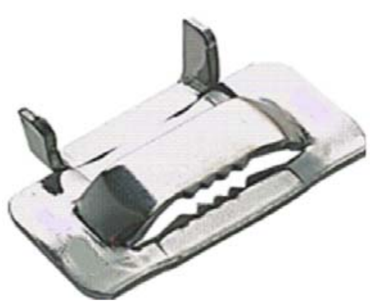


Tenderer's Signature : ……………………..… Date: ………………………………

Technical Guarantees No. STB_254

Stainless Steel Ear-Lokt Buckle

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Standards					
4	Description		Buckle to hold wrapped band for cable bundling			
5	Construction		with teeth and ears provide for maximum clamping strength			
6	Material		201 Stainless Steel			
7	Entry Slot High (for Band Thickness 0.76mm)	mm	2.3			
8	Min. Width (for Band Width 12.7mm)	mm	15			



Tenderer's Signature : ……………………..… Date: ………………………………

Technical Guarantees No. STB_204

Stainless Steel Band

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Standards					
4	Material		201 Stainless Steel			
5	Coil		The steel band Roll Must be properly coiled on Reinforced weatherproof plastic Totes			
6	Width	mm	12.7			
7	Thickness	mm	0.76			
8	Cabbaged Length on the tote	m	30			

Tenderer's Signature : ……………………..…. Date: ………………………………

Technical Guarantees No. SDC_35

Soft Drawn (Annealed) Stranded Copper Conductor 35 mm2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		BS EN 60228			
4	Conductor Material		Copper			
5	Conductor Construction		Soft Drawn (Annealed) Stranded			
6	Nominal Cross-Sectional Area of Conductor	mm^2	35			
7	Number Copper Strands	No.	7			
8	Diameter of Copper Strand	mm	2.52			
9	Overall Diameter of Conductor	mm	7.56			
10	Max. Conductor DC Resistance at 20 °C	Ω/km	0.524			
11	Minimum Breaking Load	Newton	shall be filled by manufacturer			
12	Current Rating in Free Air	Amps	200			
13	Conductor Geometric Mean radius	mm	shall be filled by manufacturer			
14	Conductor Nominal mass per unit Length	kg/km	shall be filled by manufacturer			
15	Drum Material		New Wood			
16	Cable Protection on Drum		Wooden Batten			
17	Drum Dimensions		shall be filled by manufacturer			

Technical Guarantees No. SDC_35

Soft Drawn (Annealed) Stranded Copper Conductor 35 mm2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
18	Conductor Length on Drum	m	500			
19	Total mass of Conductor with Drum	Kg	shall be filled by manufacturer			
20	Type Test Certificates/Reports from internationally reputed testing agency		Required			
21	Acceptance & Routine tests witnessed by Beneficiary		Required			

Tenderer’s Signature : ………………………..…   Date: ………………………………

Technical Guarantees No. SCT_150

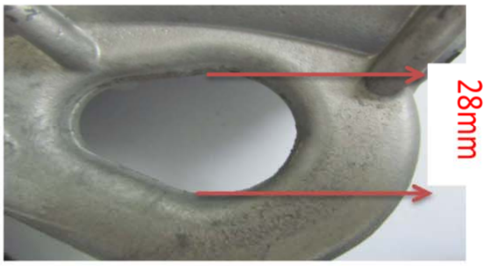
Strain Clamp for ACSR Wire 150/25 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards					
4	Description		Dead End Tension Clamp			
5	**Material**					
	a) Body and keeper		High Strength Corrosion Resistant Aluminium alloy			
	b) Bolts and Nuts		Hot Galvanized Steel			
6	Conductor Type and Code		ACSR - 150/25			
7	Conductor Diameter	mm	16-17.5			
8	Bolts		4 x M12			
9	Bolt Torque Moments	Nm	80			
10	Failure Load	KN	70			
11	Metal Stamping		Required including manufacturer Logo and the Size of the Clamp			
12	Dimensions		as Below Drawing			

Technical Guarantees No. SCT_150

Strain Clamp for ACSR Wire 150/25 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments



Tenderer's Signature : ……………………….….   Date: ………………………………..

Technical Guarantees No. SA_19A

Metal-Oxide Surge Arresters gap-less Type for 22KV Network With Silicon-Polymeric housing

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer		Tyco or Equivalent			
2	Country of Origin					
3	Standards		ANSI C62.1 / IEC60099_4			
4	Surge arrester Type		10kA Heavy Zinc Oxide Duty Polymer Gap-Less			
5-	**Service Conditions**					
5.1	Ambient air temperature		-10 ^{o}C to 55^{o}C			
5.2	Temperature with solar radiation		65 ^{o}C			
5.3	Installation		Outdoor			
5.4	Type of installation		Phase to earth			
5.5	Nominal syst. Voltage between phases	kV	22			
5.6	Max. syst. Voltage between phases	kV	24			
5.7	Rated Frequency	Hz	50			
6	Impulse withstand Voltage 1,2/50 µs	kV	125			
7	Maximum continues operating voltage (M.C.O.V)	kV	19.5			
8-	**Temporary overvoltages: Utov**					
8.1	a) For 1 sec.	kV				

Technical Guarantees No. SA_19A

Metal-Oxide Surge Arresters gap-less Type for 22KV Network With Silicon-Polymeric housing

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
8.2	b) For 10 sec.	kV				
9	submit arrester curves of Utov as function of their duration at 40-60 °C ambient temperature		Should be submitted			
10	Nominal discharge current (8/20μs) In	kA peak	10			
11	Partial discharge at 1.05 Uc		≤5 pc			
12	Arrester housing Material		High quality Silicon-Polymeric			
13	Creepage Distance	mm	910			
14	Equivalent Front-of-Wave (maximum discharge voltage for a 10 kA impulse current wave which produces a voltage wave cresting in 0.5 μs.)	kV Crest	≤88			
15- Max. Discharge Voltage Using an 8/20 μs Current Impulse						
15.1	a) 2.5 KA	kV	≤65			
15.2	b) 5 KA	kV	≤70			
15.3	c) 10 KA	kV	≤75			
15.4	c) 20 KA	kV	≤80			
16- Discharge current withstand						
16.1	a) High current impulse 4/10μs	KA_{peak}	100			
16.2	b) Long duration current 2000μs	A_{peak}	250			

Technical Guarantees No. SA_19A

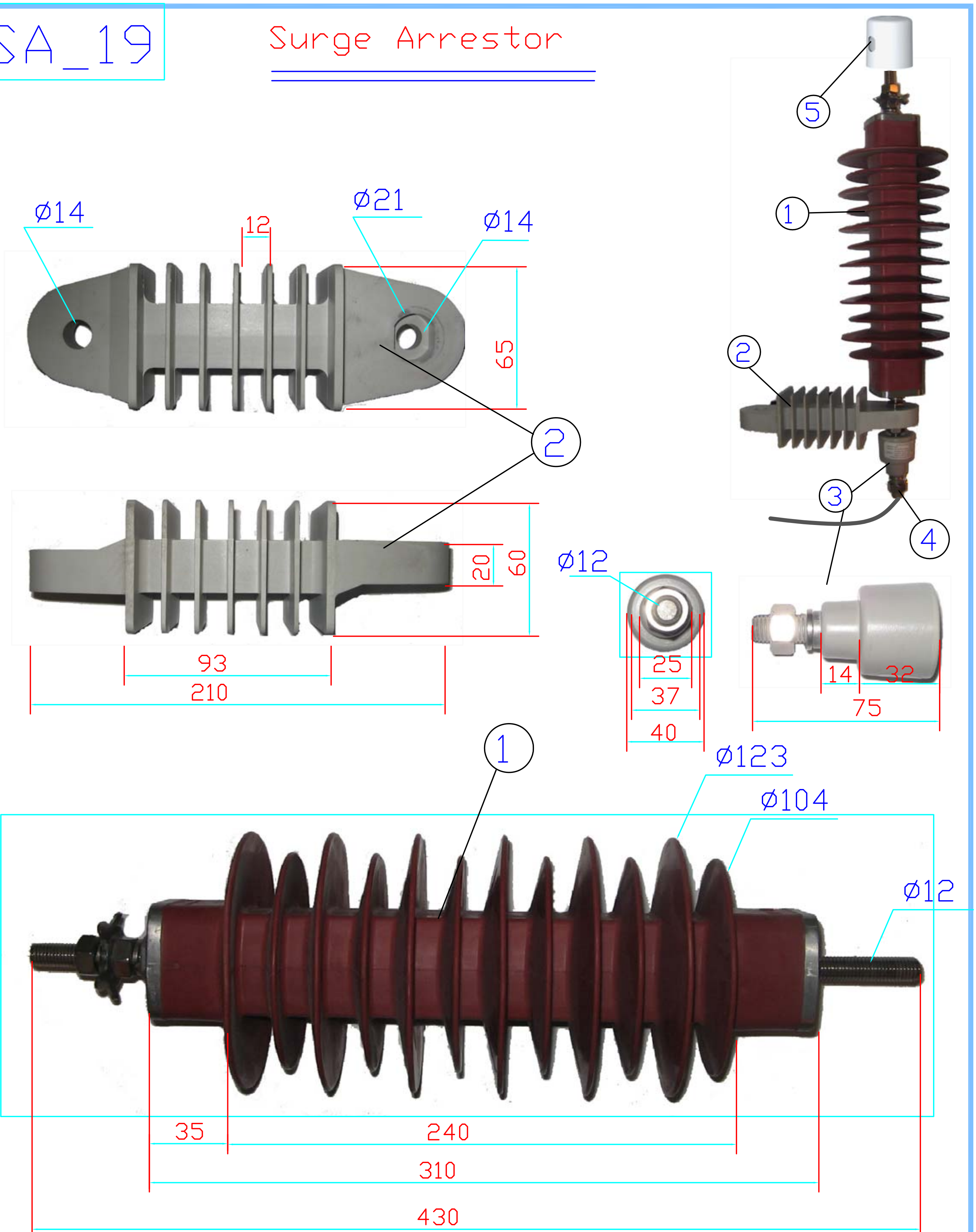
Metal-Oxide Surge Arresters gap-less Type for 22KV Network With Silicon-Polymeric housing

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
17	All Test reports for all materials of surge arrester		should be submitted			
18-	**Additional equipment & fittings:**					
18.1	a) Disconnector		Required			
18.2	b) Brackets		Required			
18.3	c) Bird cap		Required			
18.4	b) Earth lead		Required			
19	Type Test Certificates /Reports from internationally reputed testing agency (According IEC 60099-4)		Required			
20	Attached Drawing		Drawing No SA_19			

Tenderer's Signature : ……………………..… Date: ………………………………

SA_19

Surge Arrestor



شركة توزيع كهرباء محافظات غزة
Gaza Electricity Distribution Corporation LTD.
GEDCo

Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

Outdoor Metal Oxide
Surge Arrestor
M.C.O.V 19.5 KV

1	Surge Arrestor
2	Bracket
3	Disconnector
4	Ground lead
5	Bird Cap

Note: According to the attached specification

Technical Guarantees No. PPI_1050

22kv Overhead Line Pin Type Porcelain Insulator with Creepage Distance 1050 mm

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Design Standards		DIN 40680			
4	Test Standards		IEC 60383-1			
5	Nominal System Voltage	kV	24			
6	Insulating Material		Porcelain			
7	Color of Porcelain		Brown Glazed			
8	Number of Sheds					
9	Dimensions		As Attached Drawing			
10	Total Length (L)	mm	370			
11	Shed Diameter	mm	240			
12	Creepage Distance	mm	1050			
13	Cantilever Strength	KN	12.5			
14	Weight	Kg				
15- Power Frequency withstand Voltage (1 min)						
15.1	a) Dry	kV	125			
15.2	b) Wet	kV	100			
15.3	c) Impulse +VE & -VE	kV	≥210			

Technical Guarantees No. PPI_1050

22kv Overhead Line Pin Type Porcelain Insulator with Creepage Distance 1050 mm

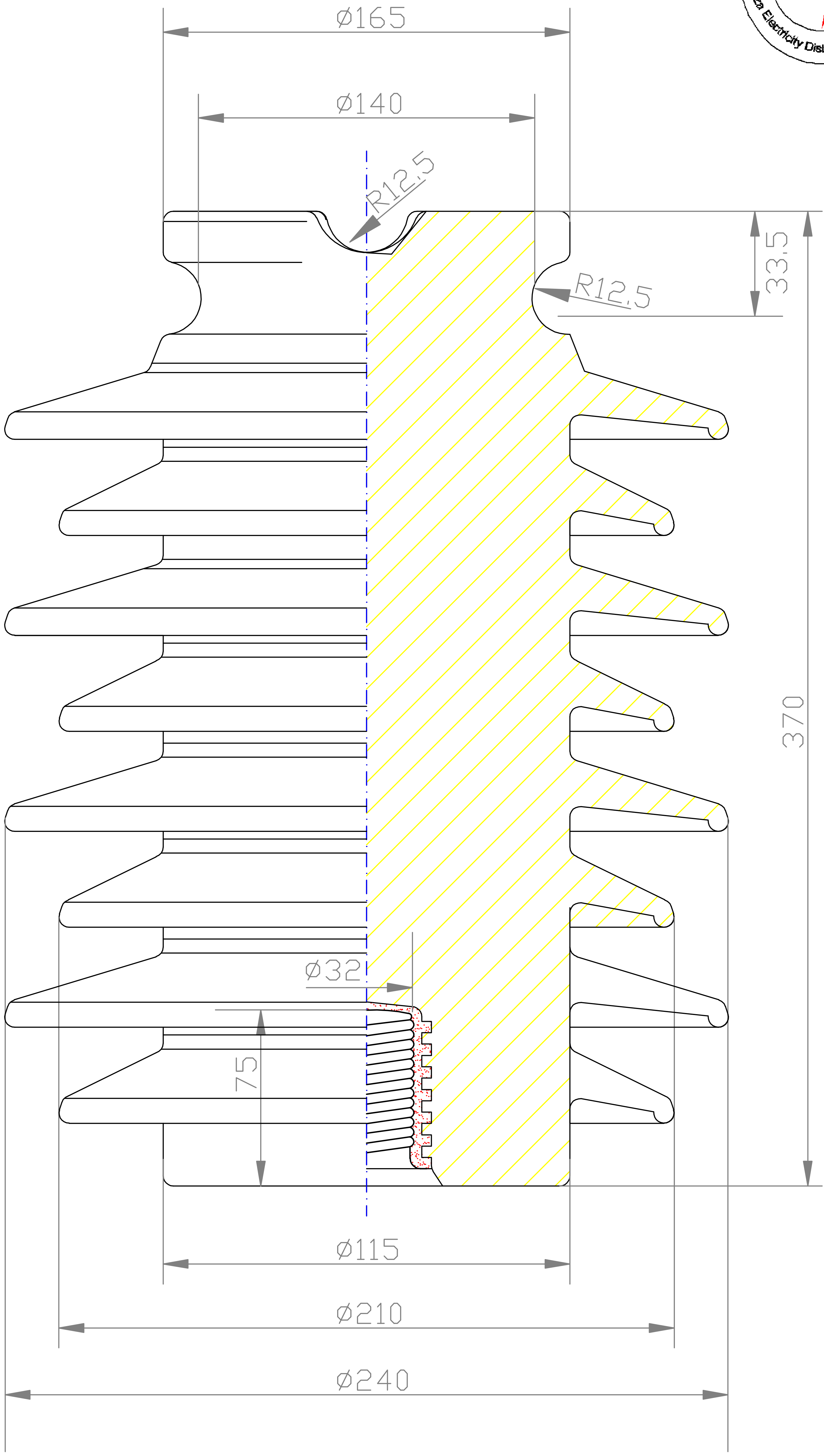
No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
16- Flashover Voltage						
16.1	a) Power Frequency (Dry)	kV	140			
16.2	b)Power Frequency (Wet)	kV	110			
16.3	c) Impulse +VE & -VE	kV	≥200			
17- Radio Influence Voltage						
17.1	Test Voltage to Ground	kV	44			
17.2	Max. R.I. Value at 1000kHZ	µv	200			
18	Hole Diameter for Pin	mm	Φ 32			
19	Attached Drawing		Drawing No. PPI_1050			

Tenderer's Signature : ……………………..… Date: ………………………………

PPI_1050

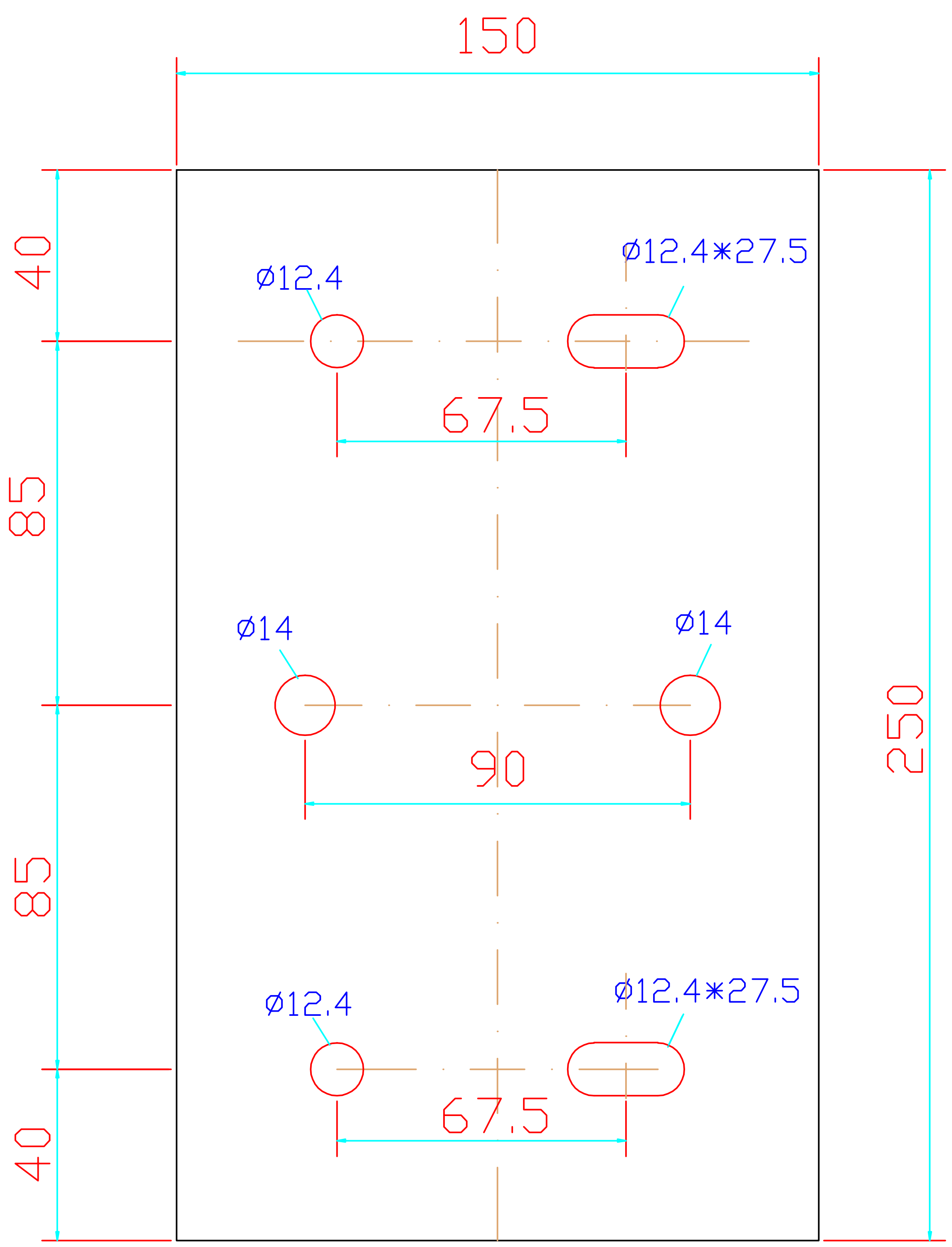
22kv Overhead Line Pin Type Porcelain Insulator with Creepage Distance 1050 mm

Gaza Electricity Distribution Corporation



Drawn By : I.hefni	Checked By : Eng. Wael Ahmed

PMV_250	Plate for M.V Cable



Bolts Required for
installation on the Arm

2 UNC Bolt 1/2"*35mm

Unit mesurment mm	Description	Item	Quant.
250	Plate ∅150*3	1	1

Plate for M.V Cable

Nots: All component must be Steel 37.2
hot dip galvanized

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GEDCo
Prepared: Eng. ziad ALHoussaini

Technical Guarantees No. NCT_50

Natural Nylon Cable Tie 500 mm Long

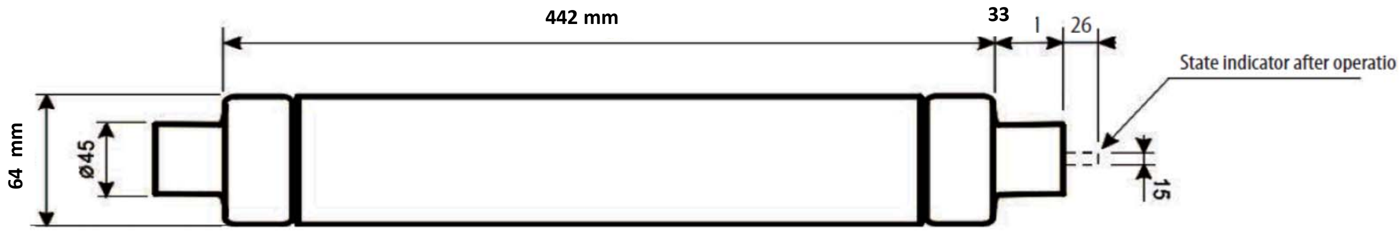
No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Standards		DIN 4102			
4	Material		UV Resistant , UL94 V0 self-extinguishing Natural Nylon ties			
5	Size	mm	7.5			
6	Length	mm	500			
7	Max. bundle diameter	mm	160			
8	Thickness	mm	1.8			
9	Average opening load	daN	65			

Tenderer’s Signature : …………………….…. Date: ………………………………

Technical Guarantees No. MP_80

Medium Voltage Porcelain Barrel Fuse Link 80 A

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		IEC 60282-1, VDE0670 Parts 4 and 402 & DIN43625			
4	Rated Voltage	kV	24			
5	Fuse Link Current	A	80			
6	Basic parts Material		Porcelain			
7	Dissipated power	W	shall be filled by manufacturer			
8	Cold Resistance	mΩ	shall be filled by manufacturer			
9	Min. breaking current	A	350			
10	Rated Breaking Capacity	KA	40			
11	Size		As Drawing			
12	Quality Certificate		Required			

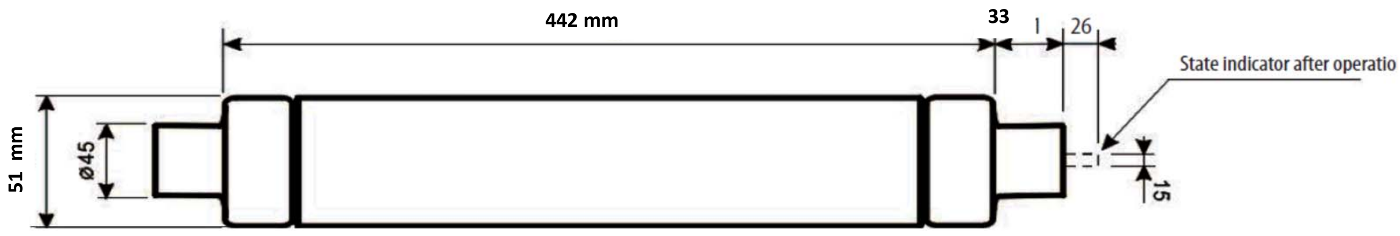


Tenderer’s Signature : ………………………..… Date: ………………………………

Technical Guarantees No. MP_40

Medium Voltage Porcelain Barrel Fuse Link 40 A

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		IEC 60282-1, VDE0670 Parts 4 and 402 & DIN43625			
4	Rated Voltage	kV	24			
5	Fuse Link Current	A	40			
6	Basic parts Material		Porcelain			
7	Dissipated power	W	shall be filled by manufacturer			
8	Cold Resistance	mΩ	shall be filled by manufacturer			
9	Min. breaking current	A	170			
10	Rated Breaking Capacity	KA	40			
11	Size		As Drawing			
12	Quality Certificate		Required			



Tenderer’s Signature : ………………………..… Date: ………………………………

Technical Guarantees No. MK_02

Hardened Steel Key Lock with master Key for isolating switch hand

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Standards					
3.0	Key Lock Body		Hard Steel			
4.0	Lock U-Shackle Material		Boron-steel alloy			
5.0	Cylinder Mechanism		High precision telescopic pin tumbler system. Pick and drill resistant for high security needs			
6.0	Lock U-Shackle Dimension		40 mm, Ø10			
7.0	Master Key		included each 5 Lock			

Technical Guarantees No. LTPI_01

Low Tension Shackle Porcelain Insulator for Earth line Including Bracket and Bolt

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Design Standards		BS , IEC			
4-	**Material**					
4.1	Shackle Insulator		Porcelain			
4.2	U - Bracket		Hot-Dip Galvanized Steel			
4.3	Nail		Hot-Dip Galvanized Steel			
4.4	Buckle		Copper Plated			
4.5	Steel Bolt with Nut and Washers (for Connecting with the Pole)		Hot Galvanized Bolt 5/8"-35mm			
5	Dimensions		As Drawing			
6	Insulator Mechanical Failing Load	KN	13			
7	Bracket Ultimate Tensile Strength	KN	20			
8-	**Insulator Power Frequency withstand Voltage (1min)**					
8.1	Dry	kV	25			
8.2	Wet	kV	12			
9	Accessories		U - Bracket , Nail & Buckle , Steel Bolt			
10	Attached Drawing		Drawing No LTPI_01			

Tenderer’s Signature : ……………………..….   Date: ………………………………

LTPI_01

Low Tension Shackle Porcelain Insulator for Earth line

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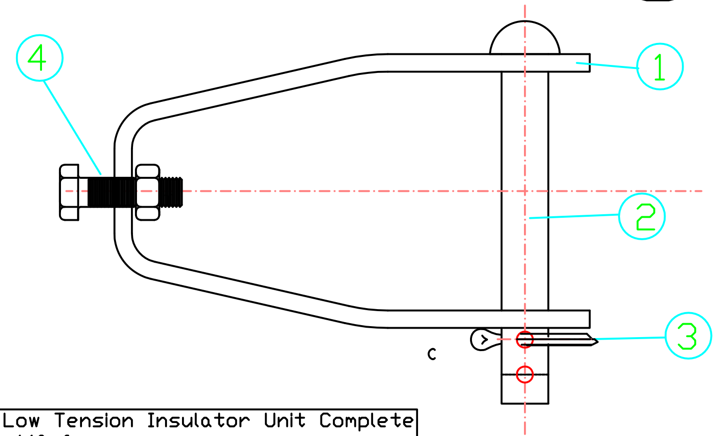
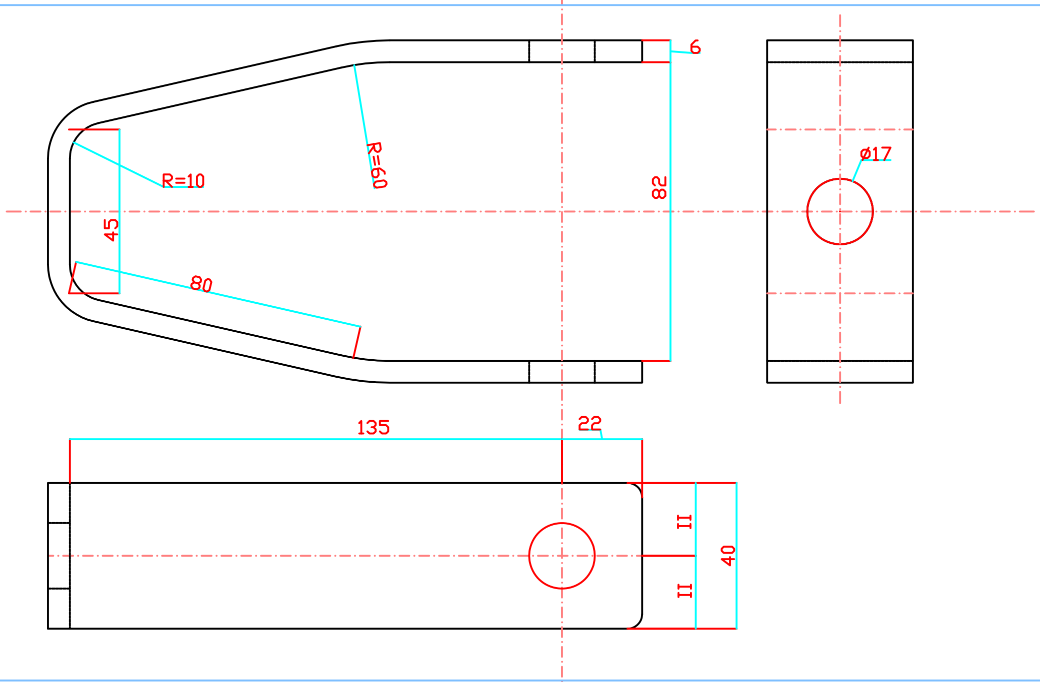
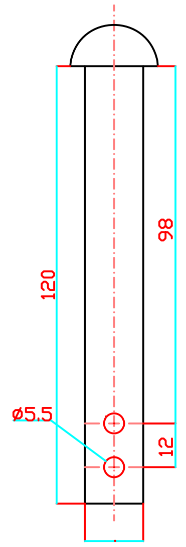
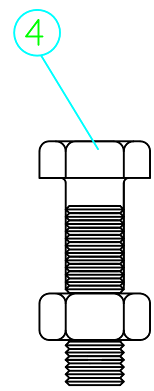
مساهمة محدودة
Gaza Electricity Distribution Corporation

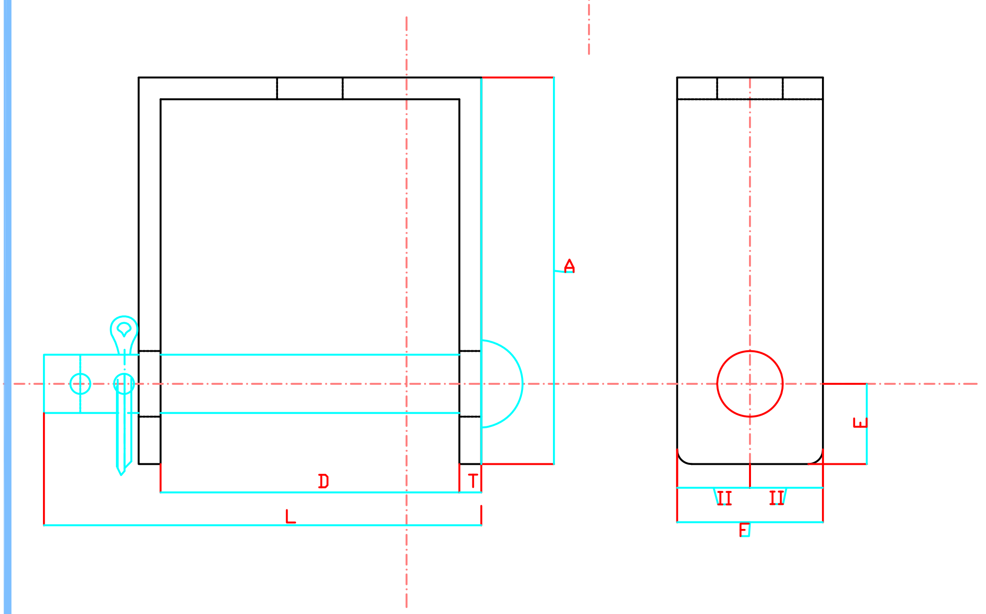


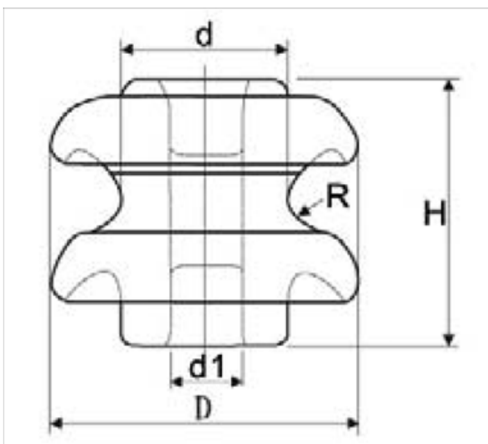
1	Low Tension Insulator Unit Complete ø40*6
2	Iron Nail 5/8"
3	Copper Nail Buckle
4	5/8" Hot Galvanized Steel Bolt 3.5cm with Nut and Washers











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76	89	48	17.5	10

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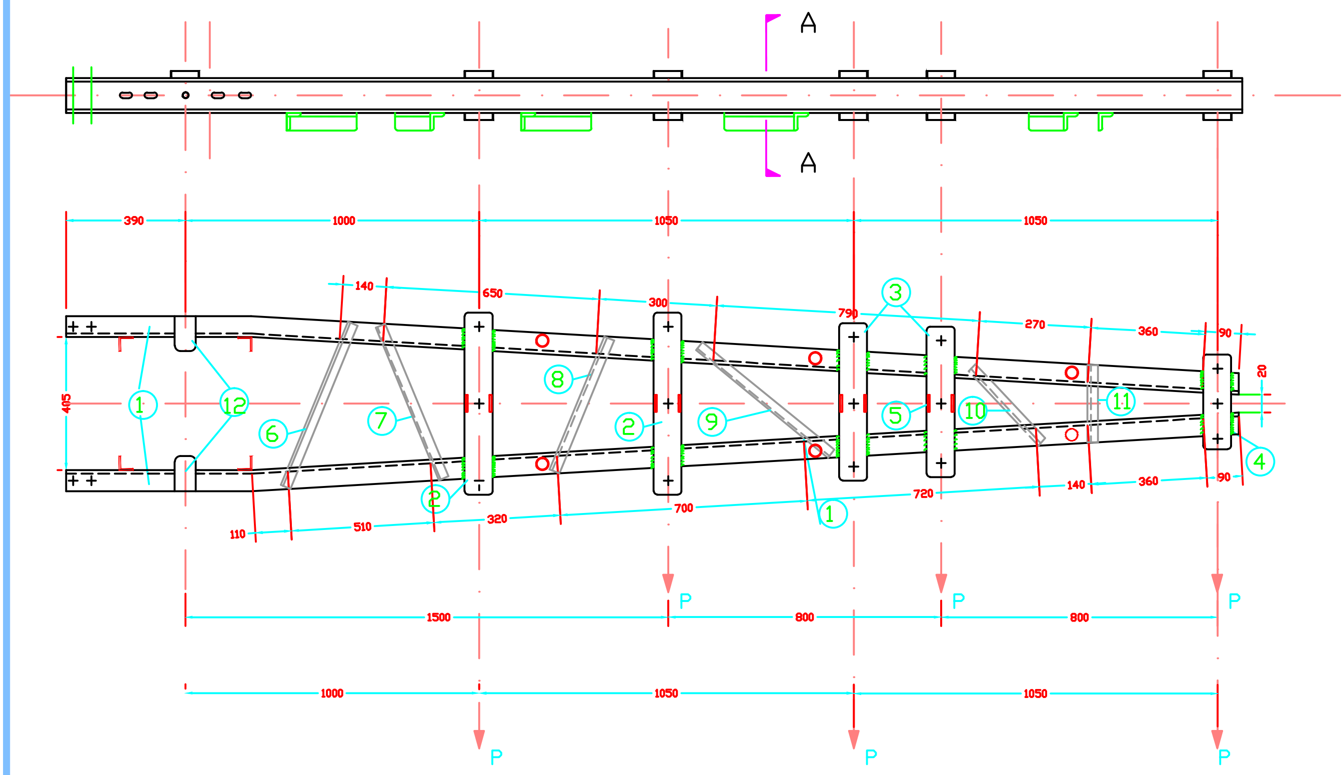
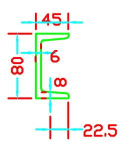


Bolts Required for
installation on the pole

8 UNC Bolt 3/4"*40mm
8 square washer 3/4"
2 UNC Bolt 5/8"*35mm
2 Ring washer 5/8"

C№8



Note : All component must be Steel 37.2
hot dip galvanized

Welding thickness
for Items:
2 3 4 — 8mm
6 12 — 4mm

شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

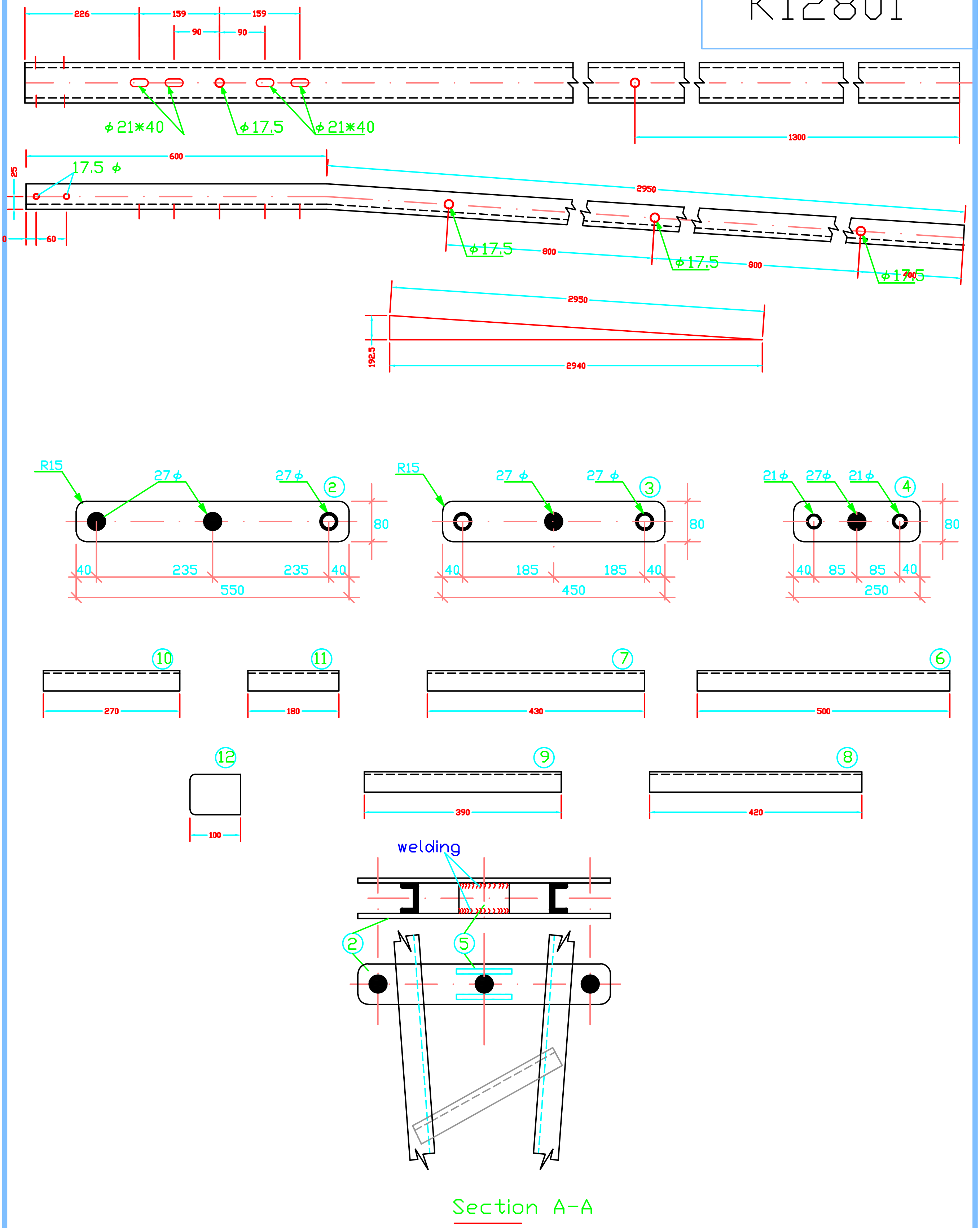
Hot Galavanized Lattice
Steel Pole Tension Side
Arm K12801

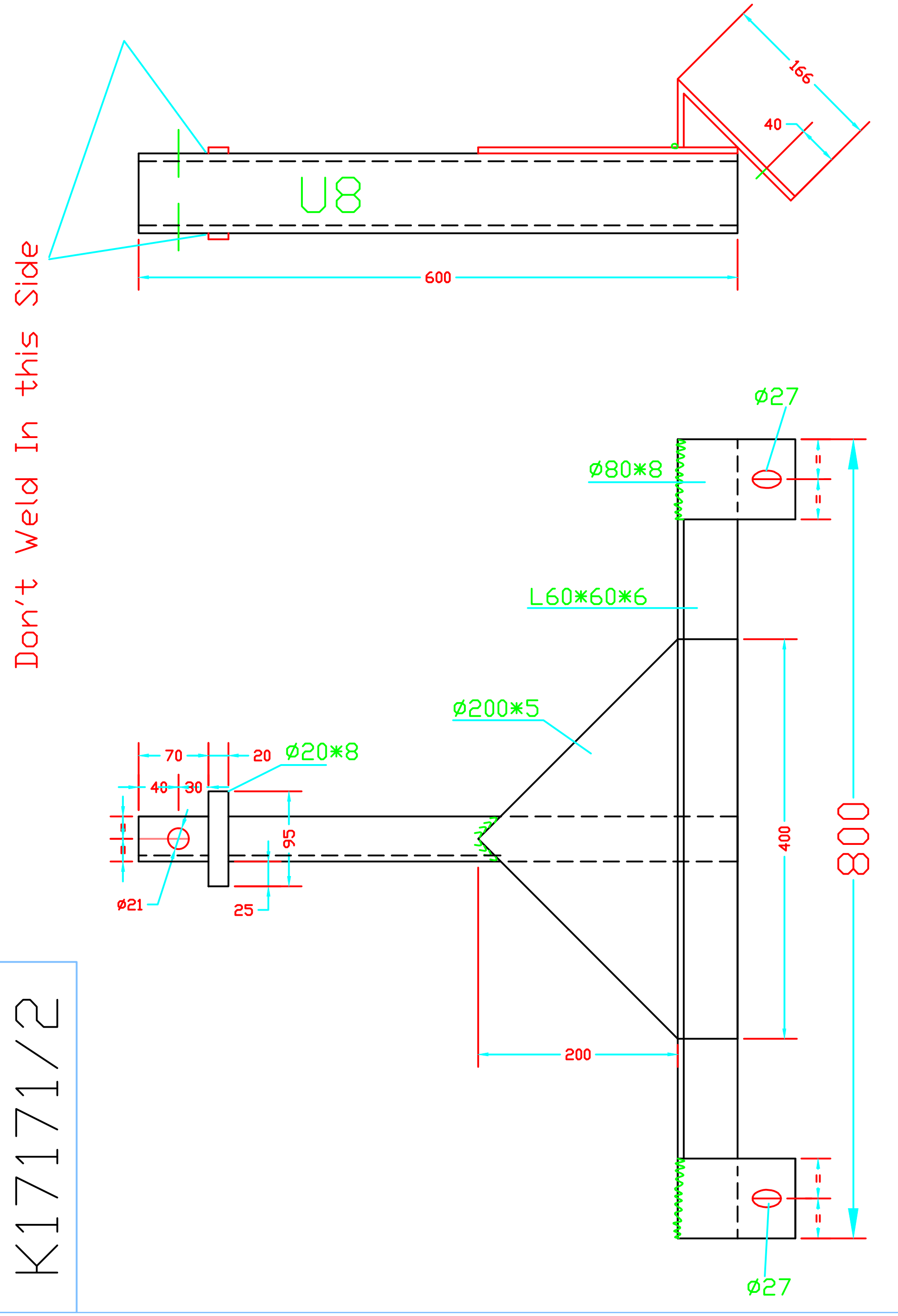
1.0m at 1.st Phase

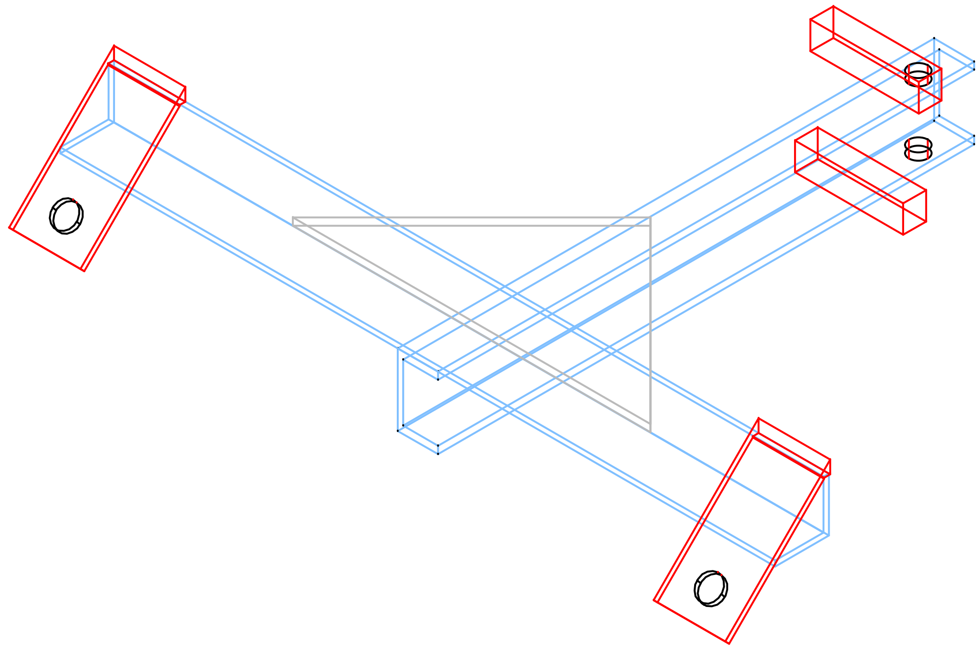
Weight kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
61.2	7100	3550	C№ 8	1	1+1
24.7	2200	550	Plate Ф 80*8	2	4
	1800	450	Plate Ф 80*8	3	4
	500	250	Plate Ф 80*8	4	2
	800	100	Plate Ф 80*8	5	8
5.9	2190	500	Strut L40*40*4	6	1
		430	Strut L40*40*4	7	1
		420	Strut L40*40*4	8	1
		390	Strut L40*40*4	9	1
		270	Strut L40*40*4	10	1
		180	Strut L40*40*4	11	1
2kg	200	100	Plate Ф 80*8	12	2

93.8kg Total Weight

K12801


226
159
159
90
90
ϕ21*40
ϕ17.5
ϕ21*40
1300
600
17.5 ϕ
25
60
2950
ϕ17.5
800
ϕ17.5
800
ϕ17.5
700
2950
192.5
2940
R15
27ϕ
27ϕ
2
80
40
235
235
40
550
R15
27 ϕ
27 ϕ
3
80
40
185
185
40
450
21ϕ
27ϕ
21ϕ
4
80
40
85
85
40
250
10
270
11
180
7
430
6
500
12
100
9
390
8
420
welding
2
5
Section A-A





Bolts Required for
installation on
the pole

2 UNC Bolt 3/4"*35mm

2 Ring washer 3/4"

K17171/2

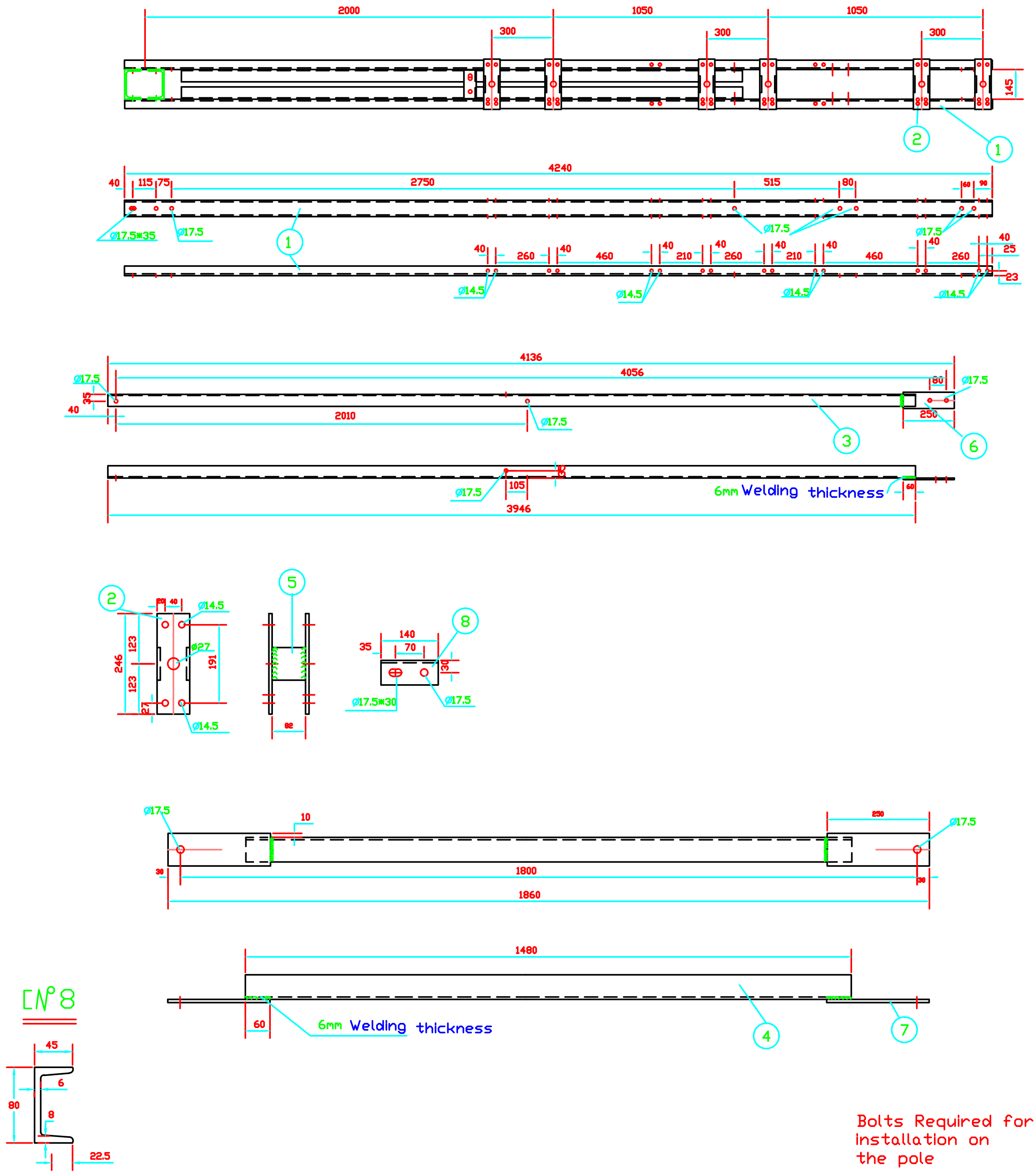
Hot Galvanized Auxilliary
Steel Arm K12171/2

شركة توزيع كهرباء محافظات غزة

GEDCo

Prepared Eng. ziad ALHoussaini

K10354C



Bolts Required for installation on the pole

14 UNC Bolt 5/8"*35mm

14 Ring washer 5/8"

Note: All component must be Steel 37.2 hot dip galvanized and Welding thickness 8mm

Weight kg	Total mm mesurment	Unit mm mesurment	Description	Quant.	Item
73.3	8480	4240	CN° 8	2	1
14.7	2952	246	Plate ▭ 80*8	12	2
42.8	7892	3946	Strut L60*60*6	1R+1L	3
15.9	2960	1480	Strut L60*60*6	1R+1L	4
4.8	960	80	Reinforcing Plate ▭ 80*8	12	5
2.5	500	250	Plate ▭ 80*8	2	6
5	1000	250	Plate ▭ 80*8	4	7
0.8	140	140	Strut L60*60*6	1	8
			UNC Bolt 1/2"*35	48	9
159.8 Total Weight			Spring washer 1/2"	48	10

شركة توزيع كهرباء محافظات غزة

GEDCo

Prepared:Eng. ziad AL Houssaini

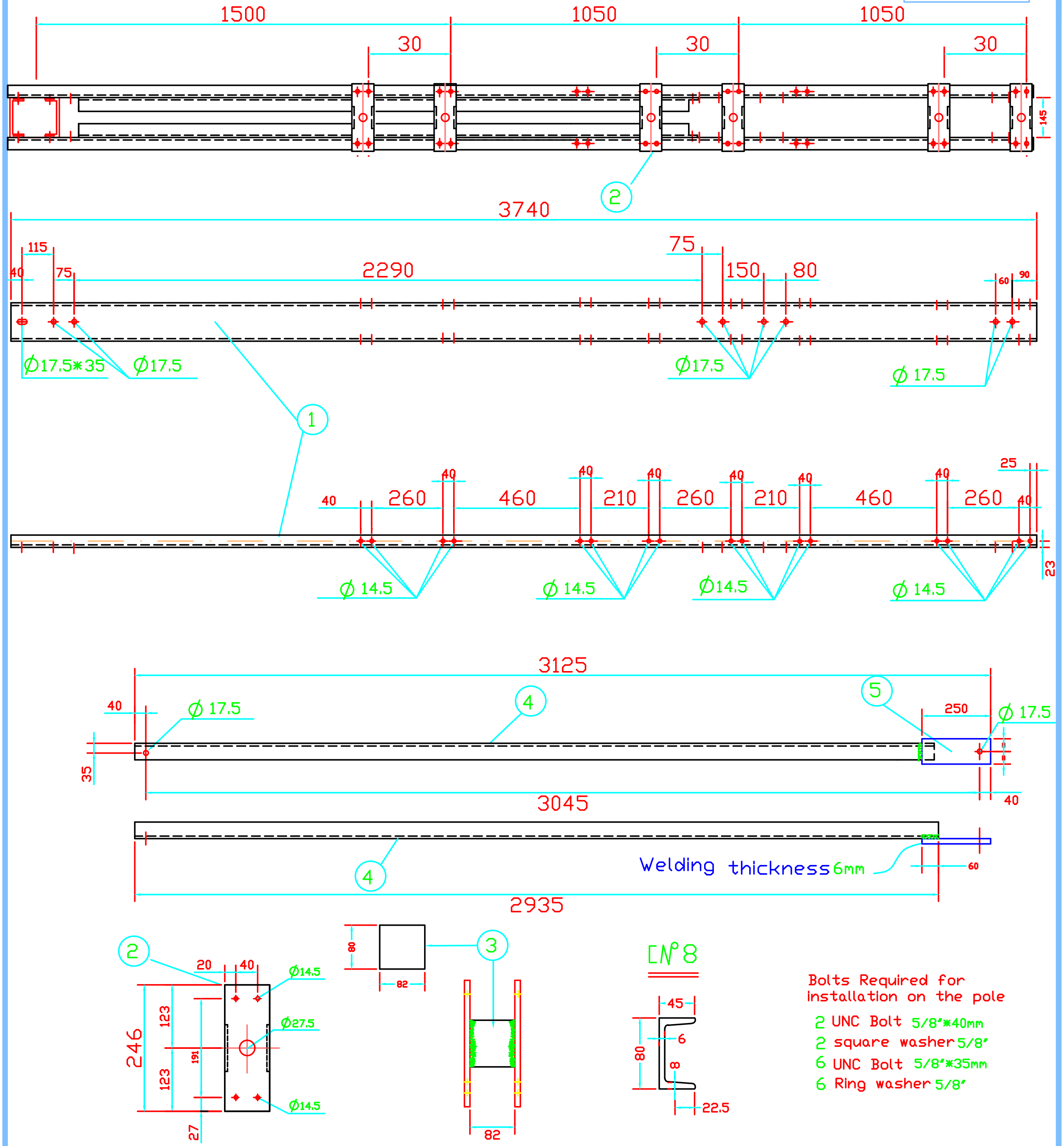
Checked By:Eng. Kamil Rabah

Hot Galvanized C.S.P

Suspension Side Arm

K10354C

2m at 1.st Phase



Bolts Required for installation on the pole

2 UNC Bolt 5/8"*40mm
2 square washer 5/8"
6 UNC Bolt 5/8"*35mm
6 Ring washer 5/8"

شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

Hot Galvanized

C.S.P Suspension

Side Arm K10155C

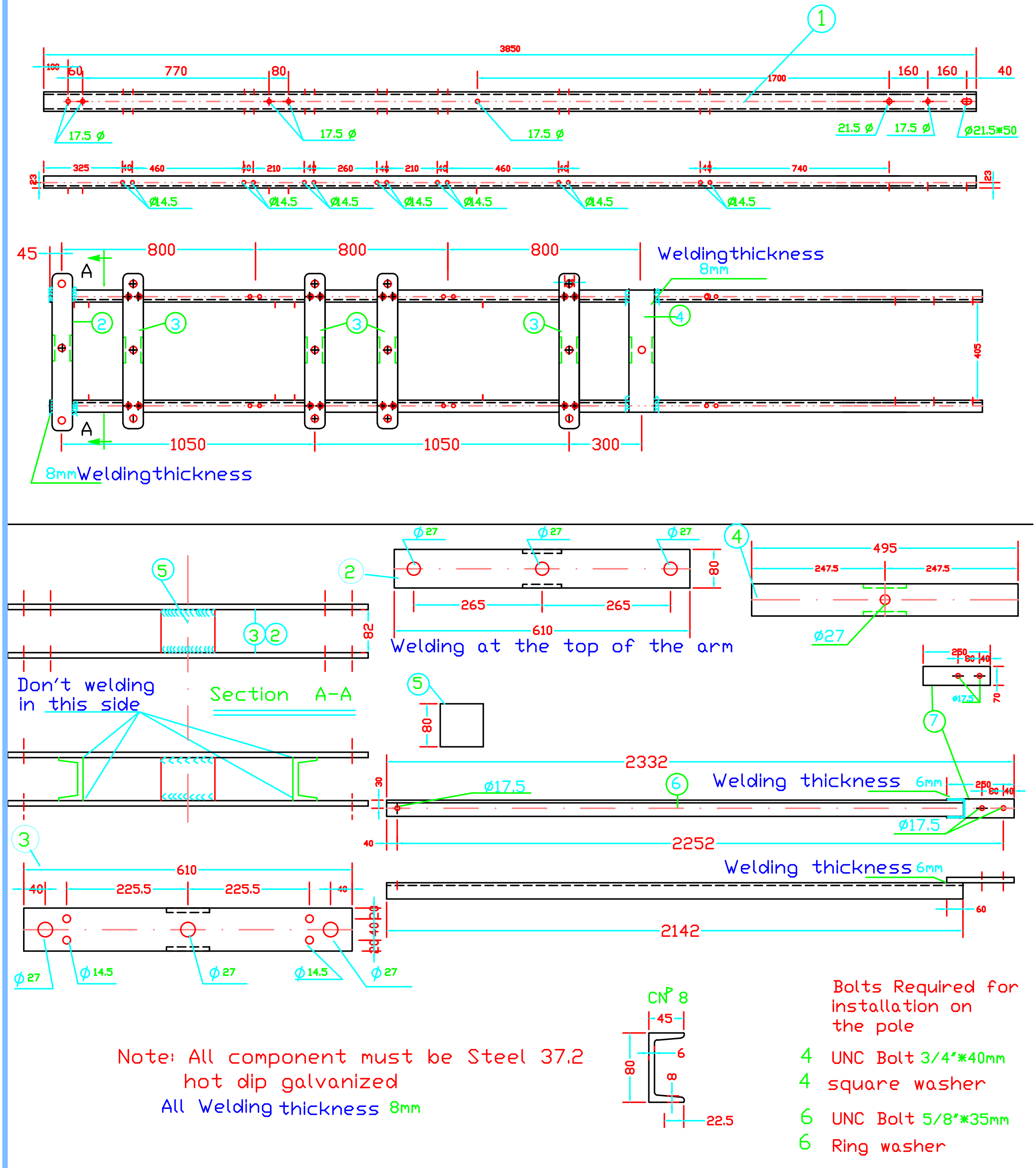
1.5m 1.st Phase

Weight kg	Total mm mesurment	Unit mm mesurment	Description	Quant.	Item
64.6	7480	3740	[N°8	2	1
14.7	2952	246	Plate ф 80*8	12	2
4.8	960	80	Support ф 80*8	12	3
31.9	5870	2935	Strut L60*60*6	1L+1R	4
2.5	500	250	Plate ф 80*8	2	5
			UNC Bolt 1/2"*30	48	6
			Ring washer 1/2"	48	7
118.5Kg Total Weight					

Note: All component must be Steel 37.2 hot dip galvanized

All Welding thickness 8mm

K7972



Note: All component must be Steel 37.2
hot dip galvanized
All Welding thickness 8mm

Bolts Required for installation on the pole

4 UNC Bolt 3/4"*40mm
4 square washer
6 UNC Bolt 5/8"*35mm
6 Ring washer

شركة توزيع كهرباء محافظات غزة
GEDCo
Gaza Electricity Distribution Corporation LTD.

Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

Hot Galvanized Lattice Pole Suspension Side Arm

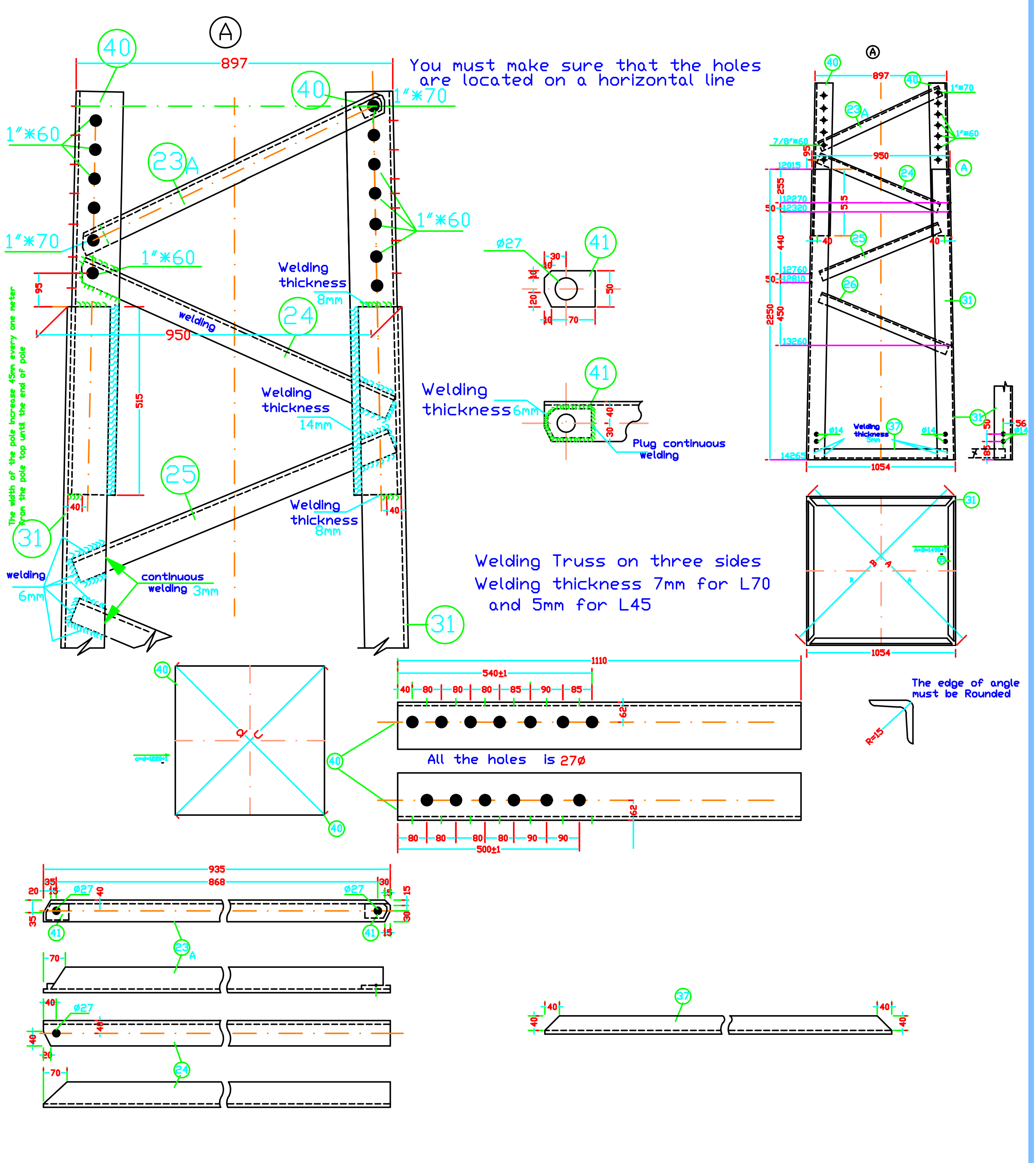
K7972

1.5m at 1.st Phase

	Weight Kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
	66.6	7700	3850	CN 8	1	2
The angle must be fillet	4.3	1220	610	Plate Ø80*8	2	2
	17.2	4880	610	Plate Ø80*8	3	8
	5.5	990	495	Plate Ø80*8	4	2
	4.9	960	80	Support Ø80*8	5	12
	23.2	4284	2142	Strut L60*60*6	6	1R+1L
	2.5	500	250	Plate Ø80*8	7	2
				UNC Bolt 1/2"*35	8	16
				spring washer 1/2"	9	16

124kg Total Weight

k2172



Stell Base 2.25m Long

for Lattice steel Pole

120/130 -12m

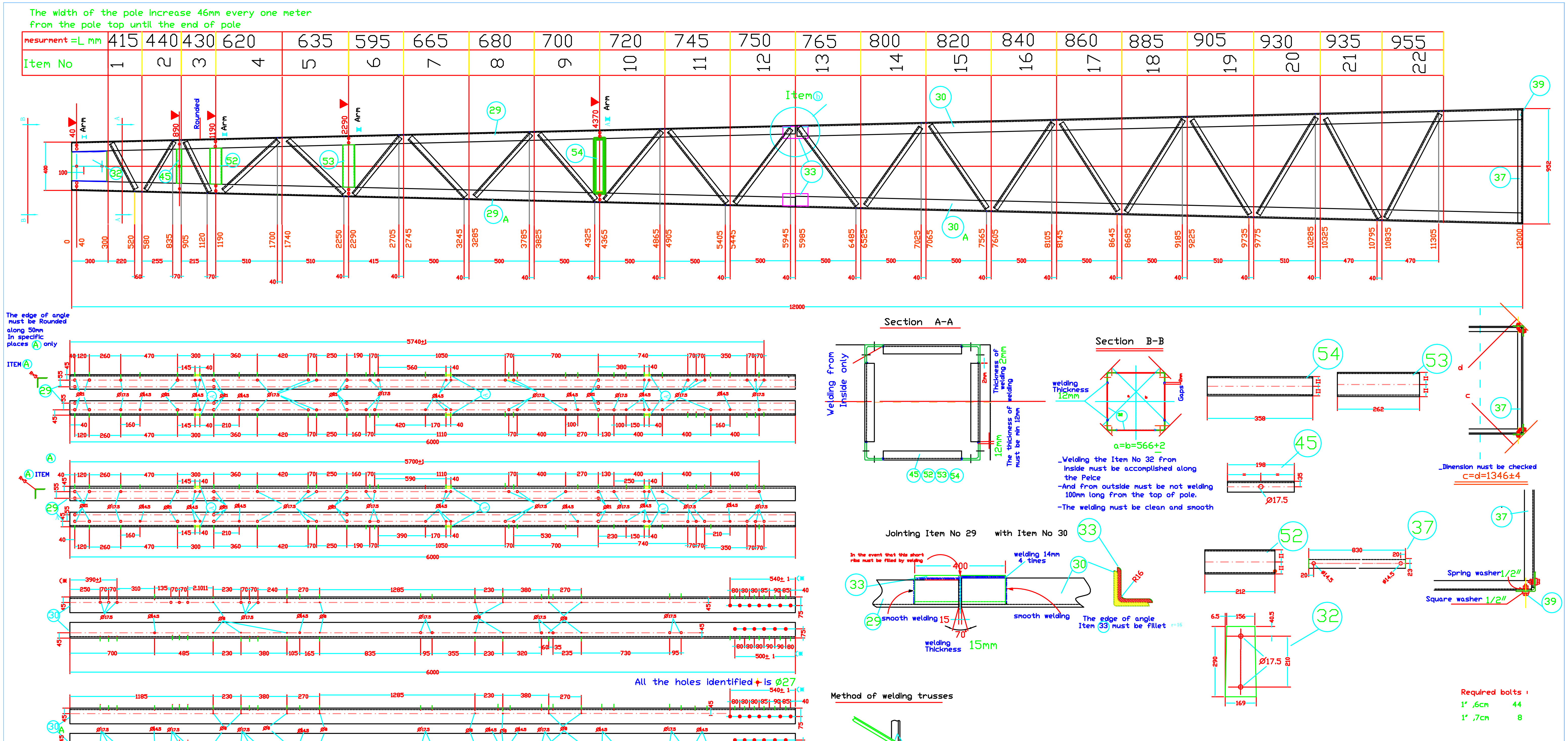
Note: All component must be RSt 37.2
hot dip galvanized

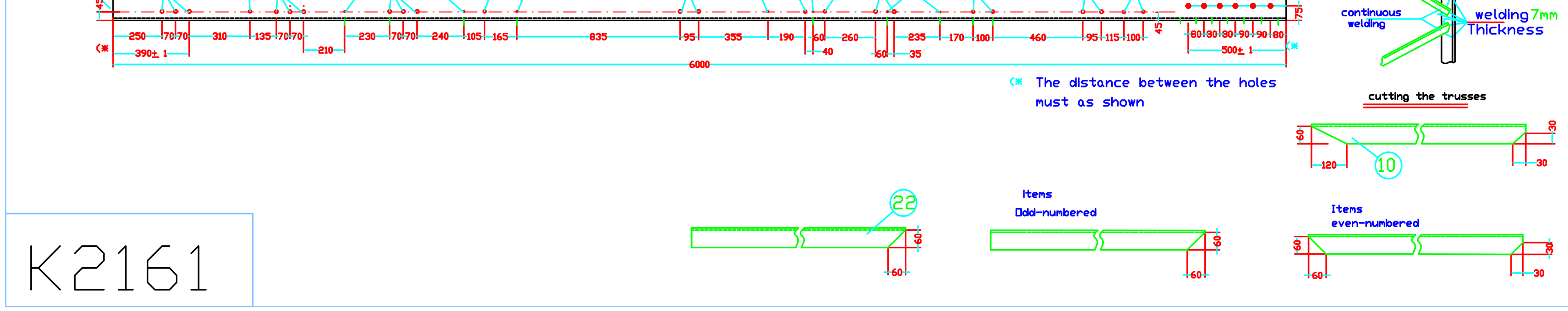
شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

Weight kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
1.2	560	70	▢50*6	41	8
104.8	4440	1110	L130*130*12	40	4
13.3	3920	980	Truss L45*45*5	37	4
212.4	9000	2250	L130*130*12	31	4
13.6	4040	1010	Truss L45*45*5	26	4
13.2	3900	975	Truss L45*45*5	25	4
27.6	3760	940	Truss L70*70*7	24	4
27.6	3740	935	Truss L70*70*7	23A	4
414kg Total Weight					





شركة توزيع كهرباء محافظات غزة
GEDCo

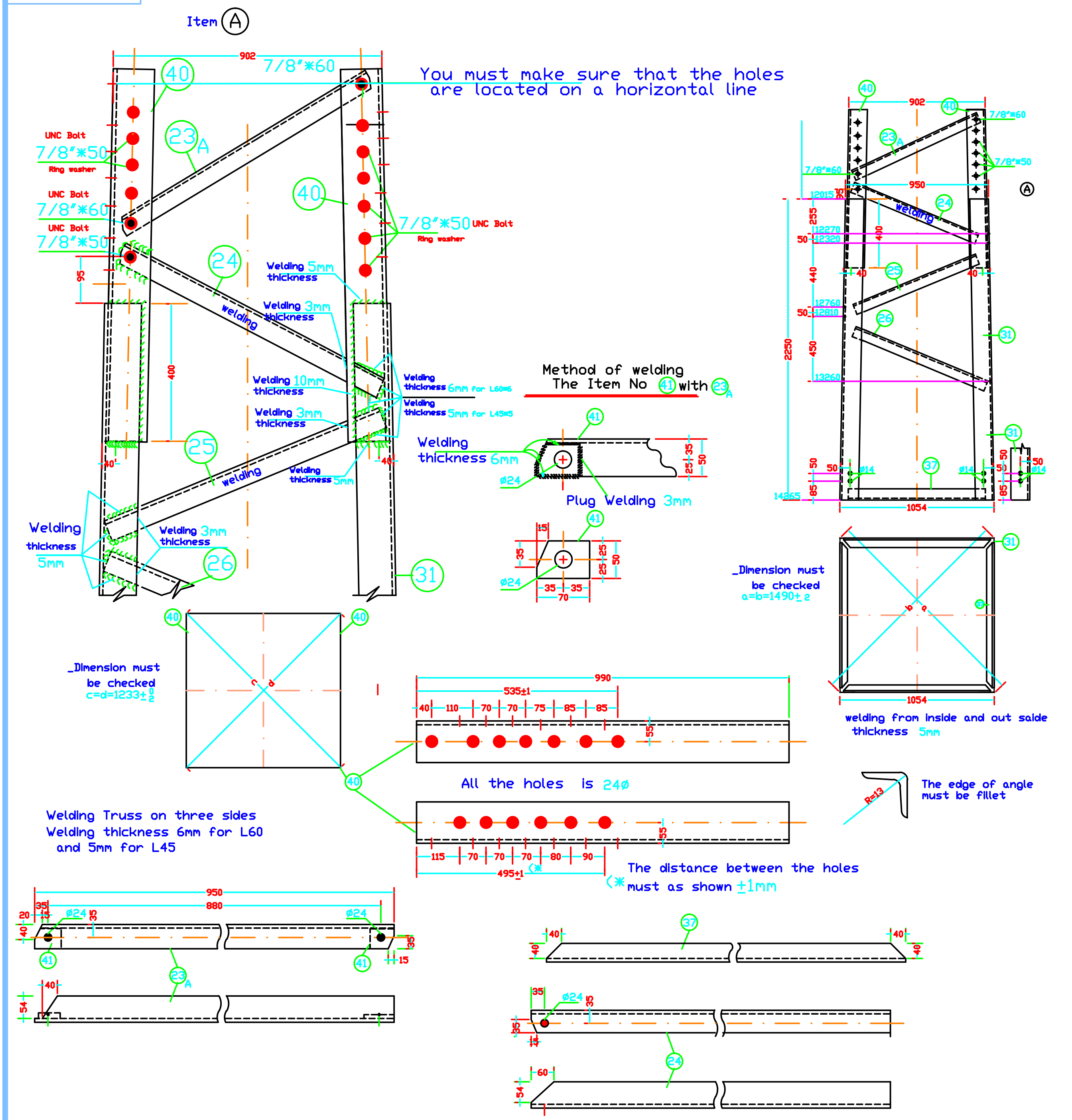
Prepared:Eng. ziad ALHoussaini

M.V. Lattice Steel Pole 120/130 long 12m

Note: All component must be RSt 37.2 hot dip galvanized

Wieght kg	Total mm mesurment	Unit mm mesurment	Description	Quant.	Item
475	64360	L	L70*70*7	22*4	1-22
477.6	24000	6000	L120*120*11	2+2	29+29A
566.4	24000	6000	L130*130*12	2+2	30+30A
37.8	676	169	⌀ 290*8	4	32
23.2	1600	400	L130*130*12	4	33
11.2	3320	830	L45*45*5	4	37
UNC Bolt 1/2"*35				8	39
Spring washer 1/2"				8	
Square washer 1/2"				8	
5.8	792	198	L70*70*7	4	45
7.3	848	212	U 8	4	52
9	1048	262	U 8	4	53
12.4	1432	358	U 8	4	54
1615kg Total Wieght					

k2152



Note: All component must be RSt 37.2 hot dip galvanized

شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

Stell Base 2.25m Long

for Lattice steel Pole

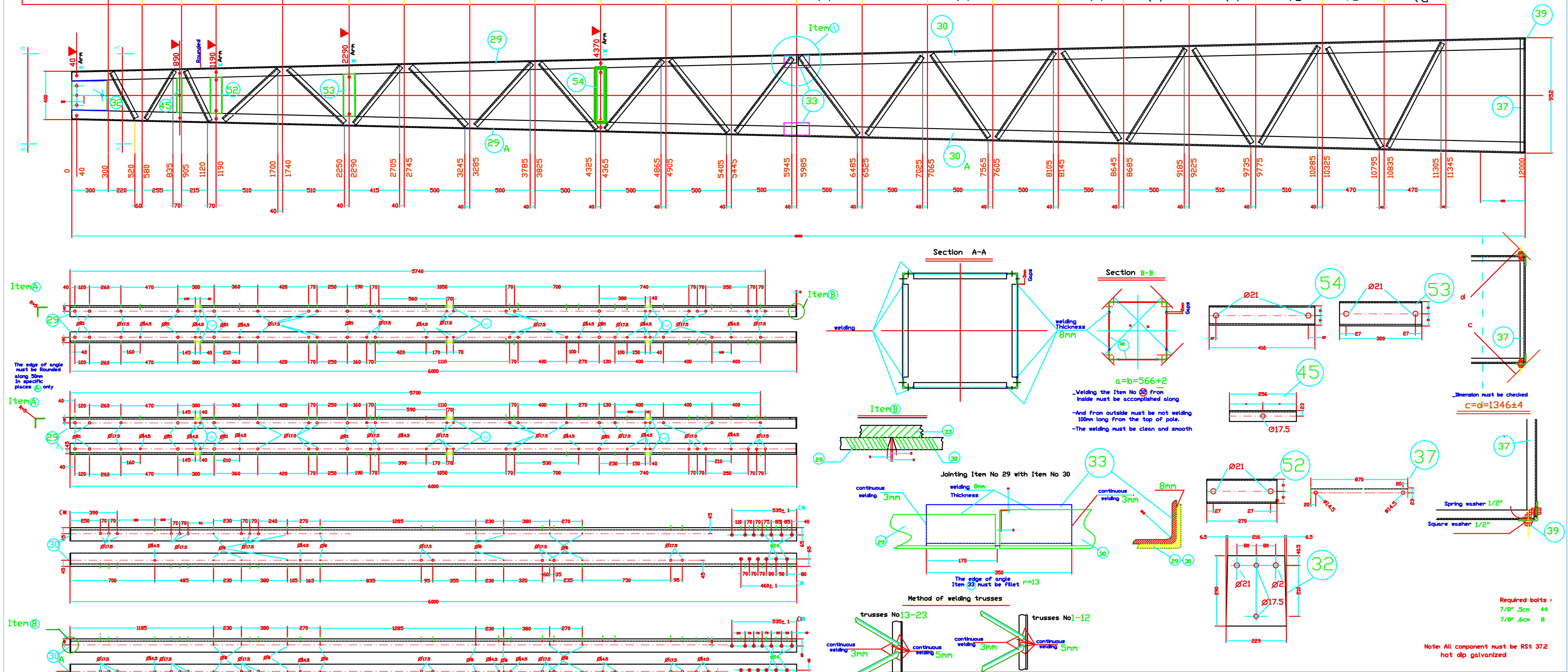
90*110-12m

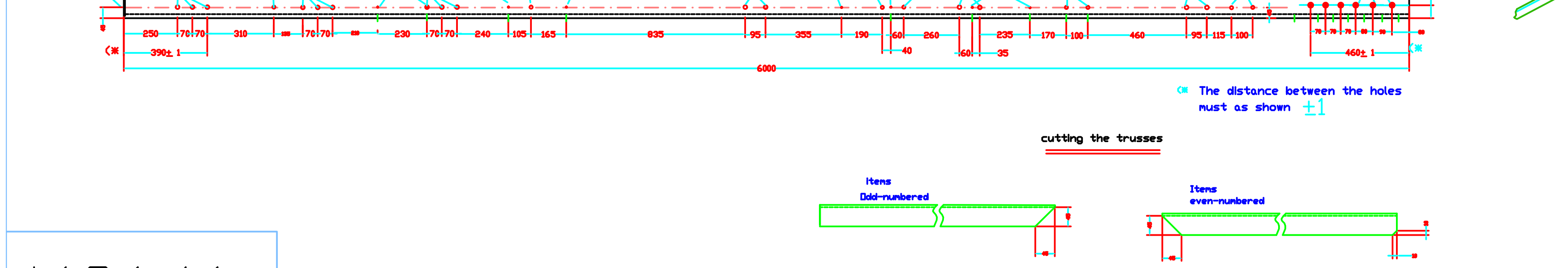
Weight kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
1.3	400	50	⌀70*6	41	8
65	3960	990	L110*110*10	40	4
13.3	3920	980	L45*45*5	37	4
149.4	9000	2250	L110*110*10	31	4
13.8	4080	1020	Truss L45*45*5	26	4
13.3	3940	985	Truss L45*45*5	25	4
20.5	3800	950	Truss L60*60*6	24	4
20.7	3800	950	Truss L60*60*6	23A	4

297Kg Total Weight

The width of the pole increase 46mm every one meter
from the pole top until the end of pole

mesurment =L mm	425	450	440	630	645	605	675	690	710	730	755	760	775	810	830	850	870	895	915	940	945	965
Item No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22





Note: All component must be RSt 37.2
hot dip galvanized

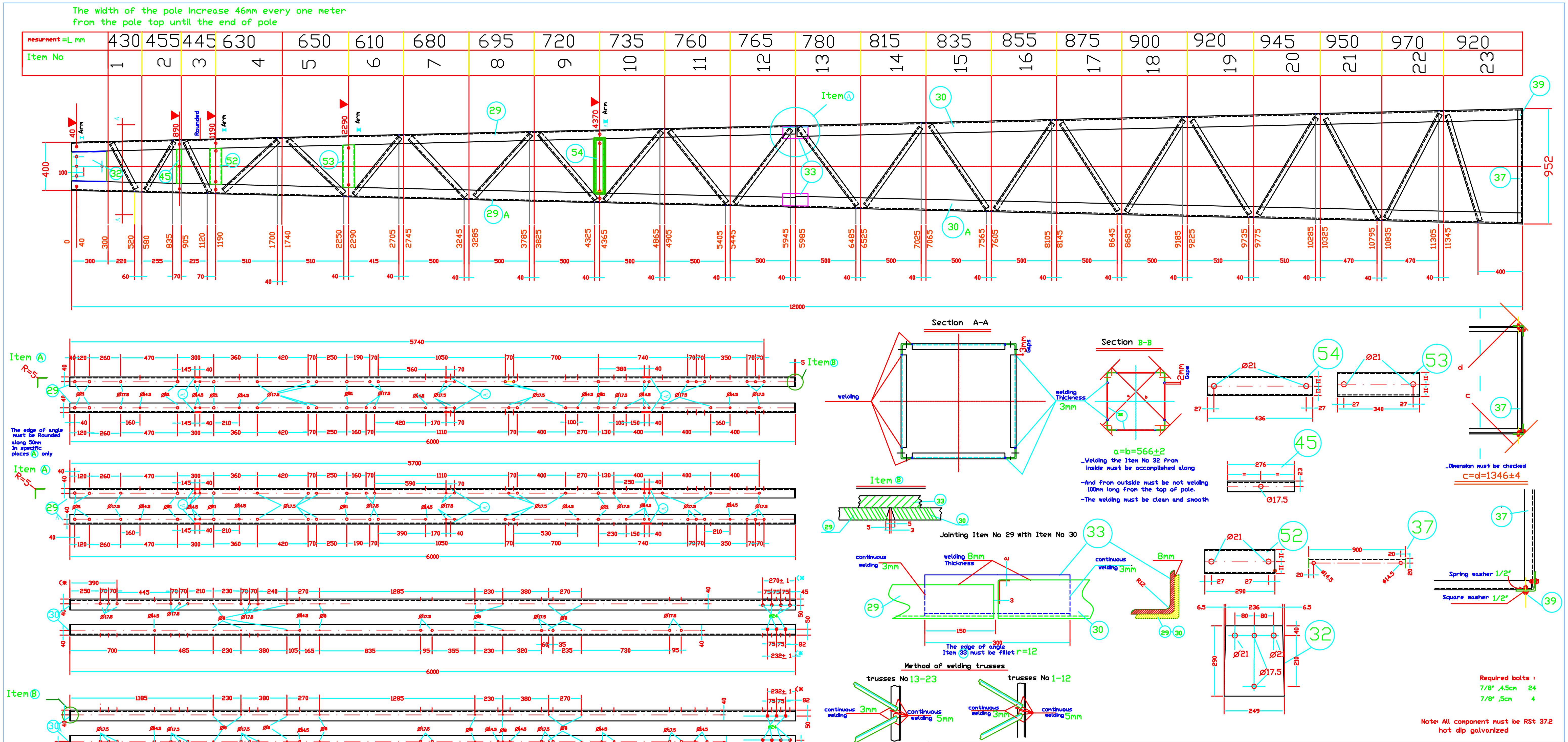
K2141

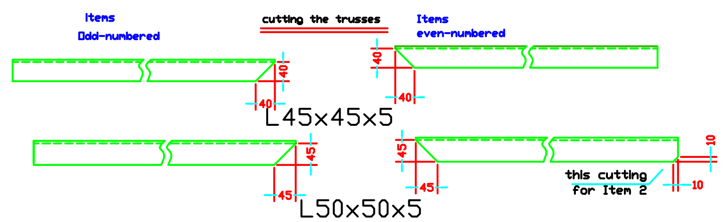
شركة توزيع كهرباء محافظات غزة
Gaza Electricity Distribution Corporation LTD.
GEDCo

Prepared:Eng. ziad ALHoussaini

M.V. Lattice Steel Pole 90/110 long 12m

Wieght kg	Total mm mesurment	Unit mm mesurment	Description	Quant.	Item
245.9	65240	L	L50*50*5	22*4	1-22
292.8	24000	6000	L90*90*9	2+2	29+29A
398.4	24000	6000	L110*110*10	2+2	30+30A
16.6	916	229	▱ 290*8	4	32
23.2	1400	350	L110*110*10	4	33
11.7	3480	870	L45*45*5	4	37
UNC Bolt 1/2"*35				8	39
Spring washer 1/2"				8	
Square washer 1/2"				8	
3.9	1024	256	L50*50*5	4	45
9.3	1080	270	U 8	4	52
11.1	1280	320	U 8	4	53
14.4	1664	416	U 8	4	54
1027kg Total Weight					





K2103

شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

M.V. Lattice

Steel Pole

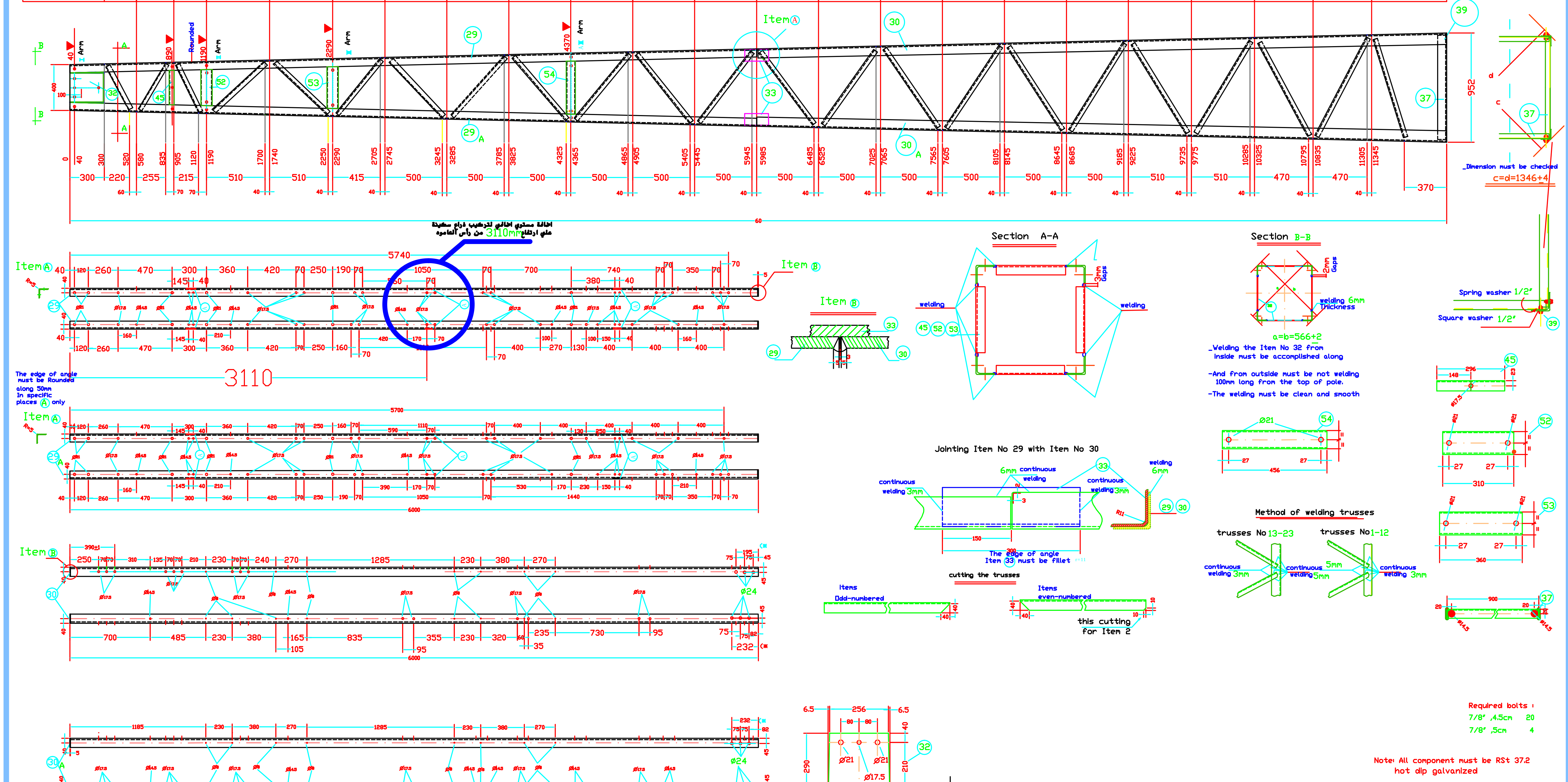
80/90 long

12m

Wieght kg	Total mm mesurment	Unit mm mesurment	Description	Quant.	Item
102.7	27240	L	L50*50*5	11*4	1-11
142.3	42120	L	L45*45*5	12*4	12-23
231.8	24000	6000	L80*80*8	2+2	29+29A
292.1	24000	6000	L90*90*9	2+2	30+30A
18.0	996	249	⌀ 290*8	4	32
14.6	1200	300	L90*90*9	4	33
8.7	3600	900	L40*40*4	4	37
UNC Bolt 1/2"*35				8	39
Spring washer 1/2"				8	
Square washer 1/2"				8	
3.7	1104	276	L45*45*5	4	45
10.	1160	290	U 8	4	52
11.8	1360	340	U 8	4	53
15.1	1744	436	U 8	4	54
851kg Total Weight					

The width of the pole increase 46mm every one meter
from the pole top until the end of pole

mesurment =L mm	435	400	450	635	655	615	685	700	725	740	760	770	785	820	840	860	880	905	930	950	955	980	930
Item No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23



Note: All component must be RSt 37.2
hot dip galvanized

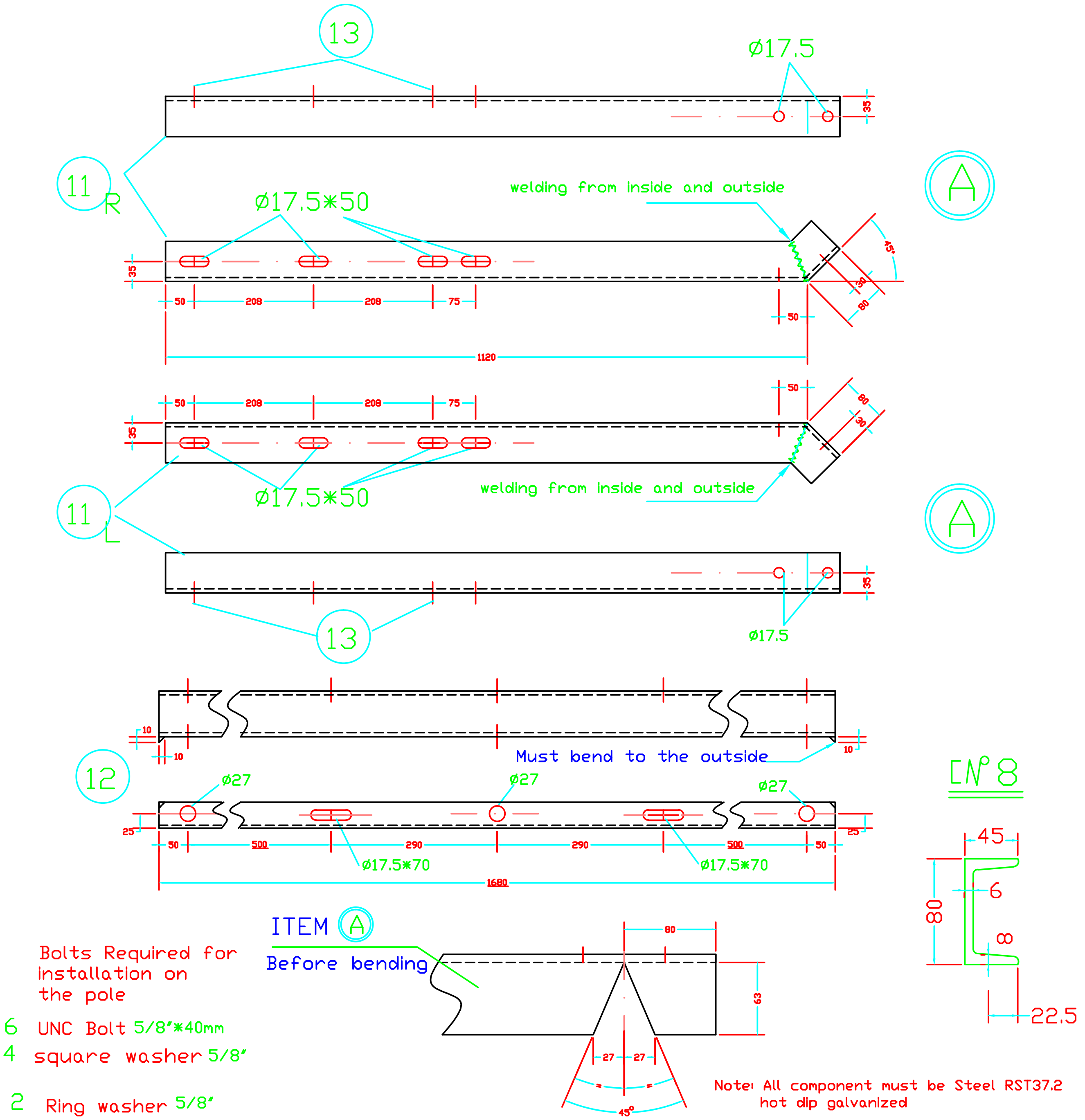
Wieght kg	Total mm mesurment	Unit mm mesurment	Description	Quant.	Item
236	69860	L	L45*45*5	23*4	1-23
177.1	24000	6000	L70*70*7	2+2	29+29A
231.8	24000	6000	L80*80*8	2+2	30+30A
14.5	1076	269	⌀ 290*6	4	32
11.6	1200	300	L80*80*8	4	33
8.7	3600	900	L40*40*4	4	37
UNC Bolt 1/2"*35				8	39
Spring washer 1/2"				8	
Square washer 1/2"				8	
4	1184	296	L45*45*5	4	45
10.7	1240	310	CN 8	4	52
12.4	1440	360	CN 8	4	53
15.8	1824	456	CN 8	4	54
723kg Total Weight					

شركة توزيع كهرباء محافظات غزة
GEDCo
Prepared:Eng. ziad ALHoussaini

M.V. Lattice
Steel Pole
70/80 long
12m

K2102

K1743



Weight Kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
17.7	2400	1200	L70*70*7	11 L R	1R+1L
14.5	Kg	1680	CN° 8	12	1

شركة توزيع كهرباء محافظات غزة
GEDCo

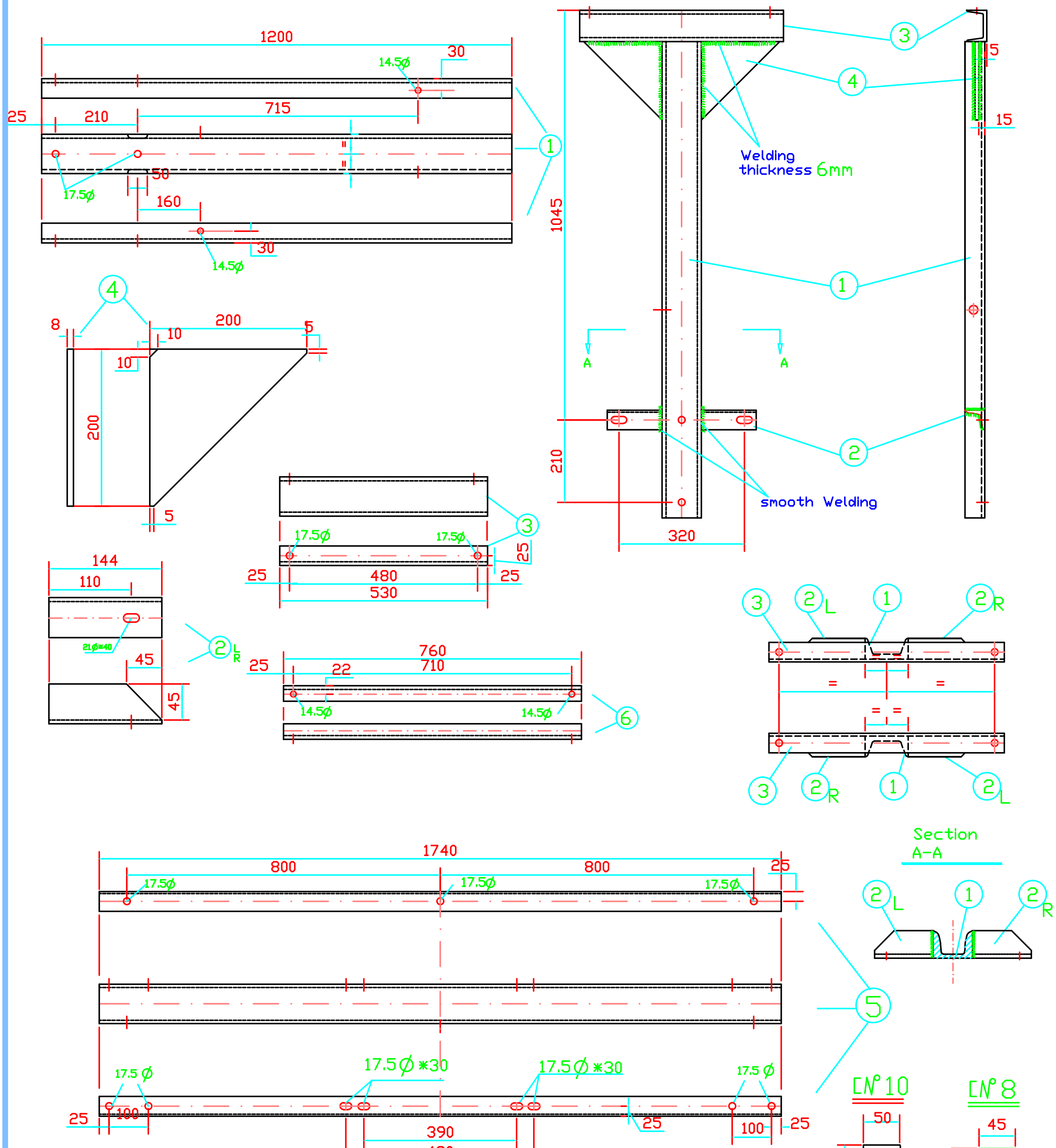
Prepared:Eng. ziad ALHoussaini

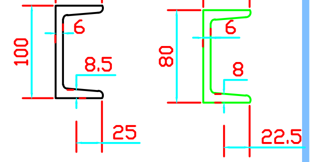
Checked By:Eng. Kamil Rabah

Hot Galvanized

Auxillary Steel Arm K1743

K1562/5





Bolts Required for Installation on the pole

4 UNC Bolt 3/4"*40mm
4 Rounded washer 3/4"
8 UNC Bolt 5/8"*35mm
8 Rounded washer 5/8"
4 UNC Bolt 1/2"*35mm

Total Weight
76 kg

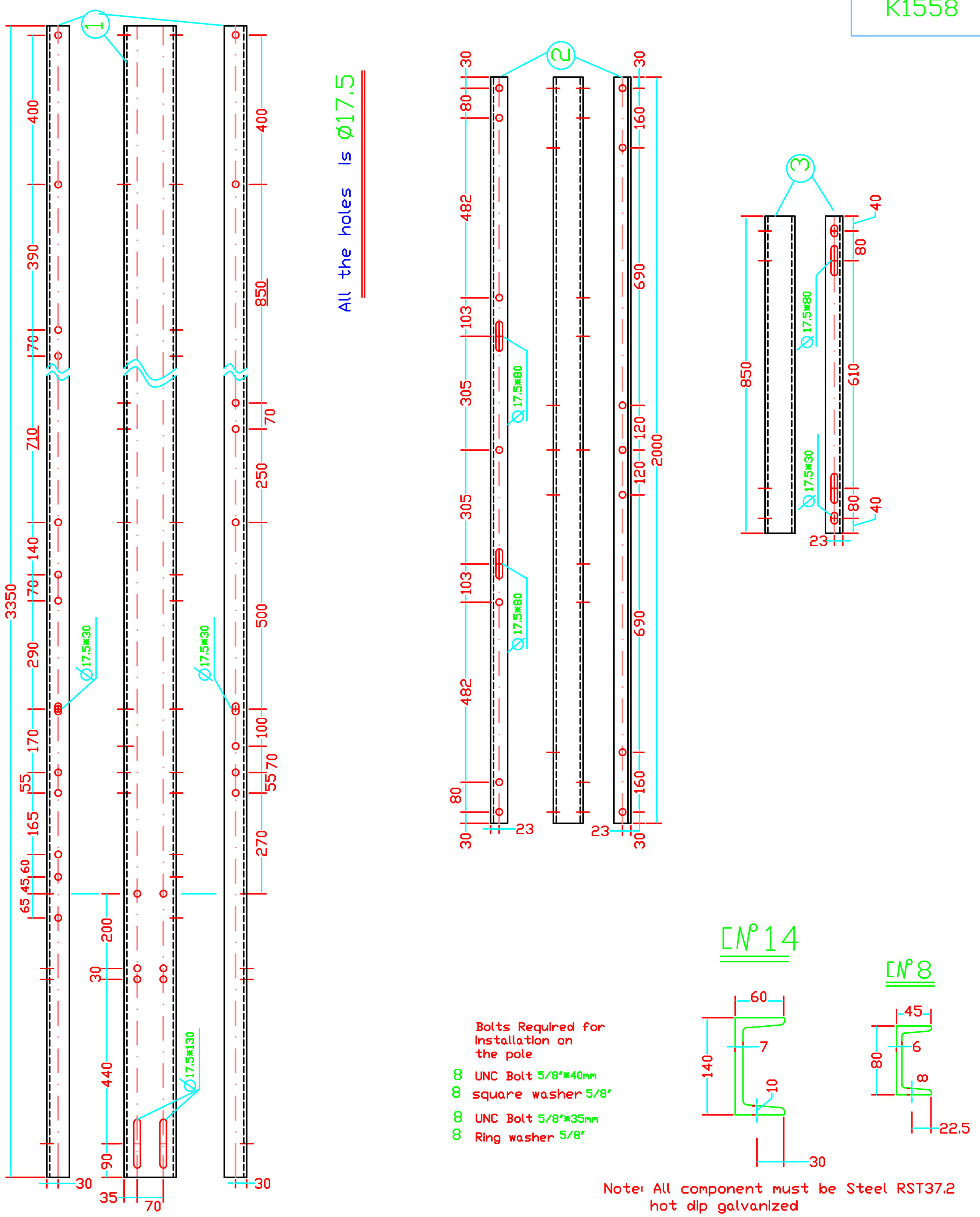
Weight kg	Total mm mesurment	Unit mm mesurment	Material	Quantity	Item
25.4	2400	1200	[N° 10	2	1
2.2	576	144	L50*50*5	2R+2L	2 R/L
9.2	1060	530	[N° 10	2	3
5.3	420		ф 200*8	4	4
30.0	3480	1740	[N° 8	2	5
3.2	1520	760	L40*40*4	2	6

شركة توزيع كهرباء محافظات غزة
GEDCo
Prepared:Eng. ziad ALHoussaini

Hot Galvanized Line Isolator Central Arm K1562 Top

Note: All component must be Steel 37.2 hot dip galvanized

K1558



Bolts Required for installation on the pole

8 UNC Bolt 5/8"*40mm
8 square washer 5/8"
8 UNC Bolt 5/8"*35mm
8 Ring washer 5/8"

Note: All component must be Steel RST37.2 hot dip galvanized

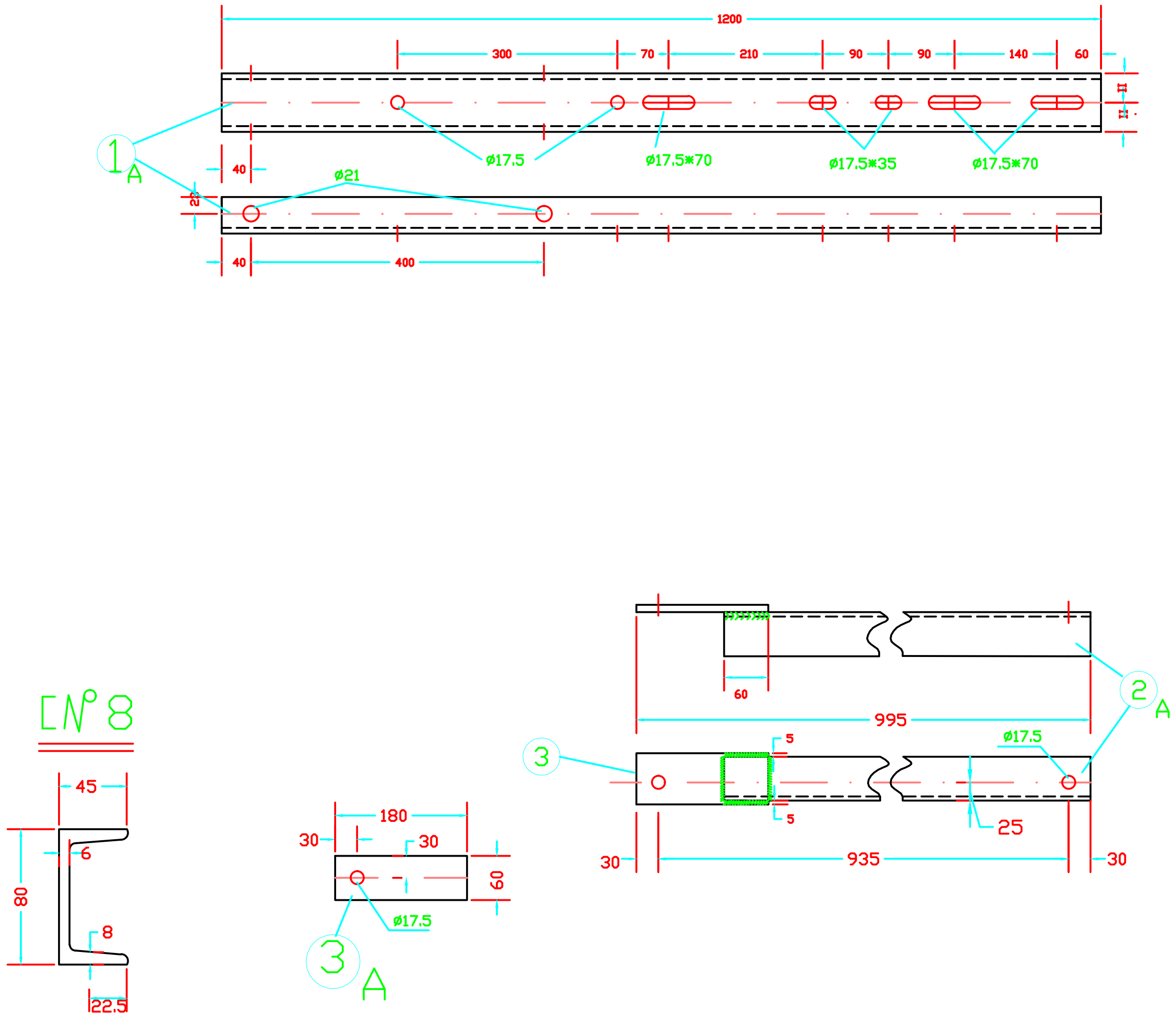
شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

Hot Galvanized Transformer Isolator Side Arm K1558
3.35m long

K.g	mesurment	mesurment	Description	Item	Quant.
107.2	6700	3350	CN° 14	1	2
34.5	4000	2000	CN° 8	2	2
7.3	850	850	CN° 8	3	1
149Kg	Total Weight				

K287-120



Bolts Required for
installation on
the pole

4 UNC Bolt 5/8"*40mm
2 square washer 5/8"
2 Spring washer 5/8"

Note: All component must be Steel 37.2
hot dip galvanized

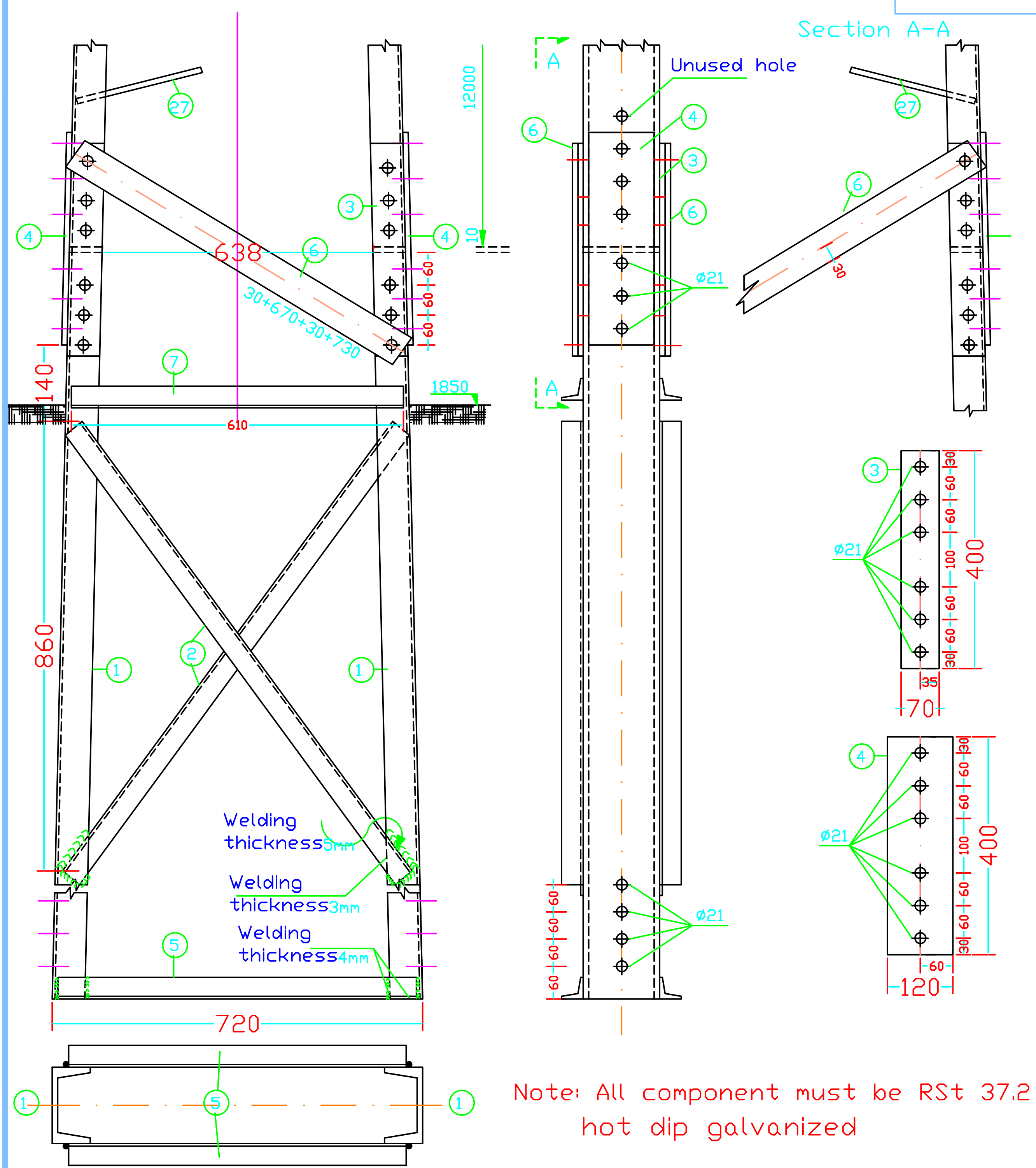
شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

Hot Galvanized
L.V Steel Pole Arm
120cm Long , Single

Weight kg	Total mm mesurment	Unit mm mesurment	Description	Quant.	Item
4.2	1600	1600	[N°8	1	1
13.8	875	875	Plate L50*50*5	1	2
0.8	180	180	Plate ø60*10	1	3

K258/6



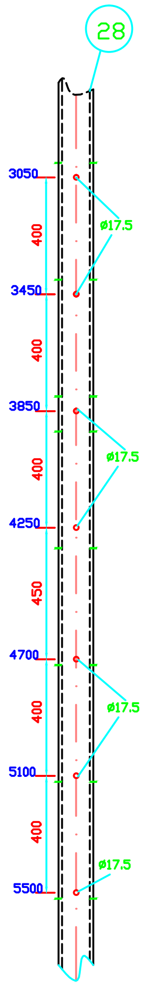
Note: All component must be RSt 37.2 hot dip galvanized

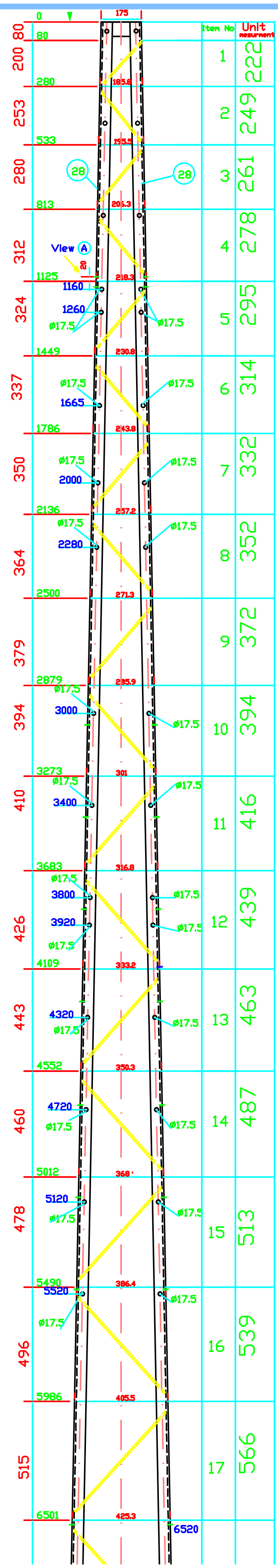
شركة توزيع كهرباء محافظات غزة
GEDCo
Prepared:Eng. ziad ALHoussaini

Steel Base
2.15m long
For C.S.P

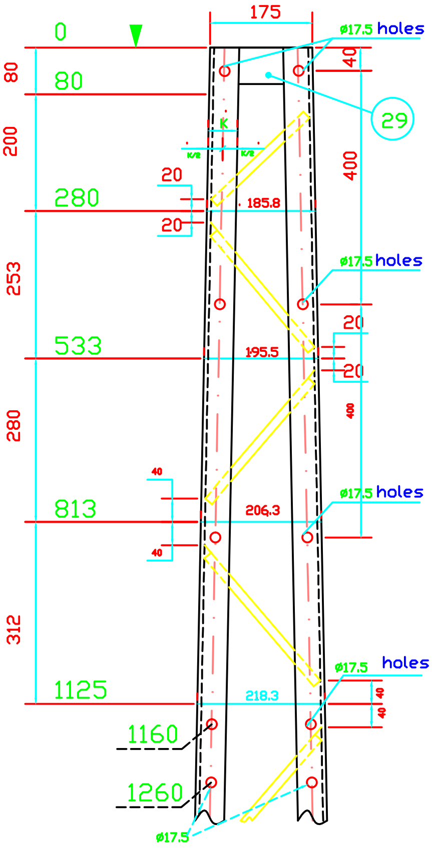
Weight Kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
68.8	4300	2150	CNP 14	1	2
7.1	2104	1052	Strut L45*45*5	2	2
8.8	1600	400	Plate □70*10	3	4
7.5	800	400	Plate □120*10	4	2
3.4	1400	700	Strut L40*40*4	5	2
5.5	1460	730	Plate □60*8	6	2
3.0	1220	610	Strut L40*40*4	7	2
104 Kg Total Weight					

K253

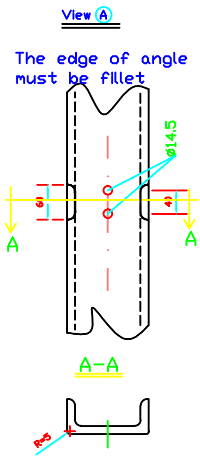




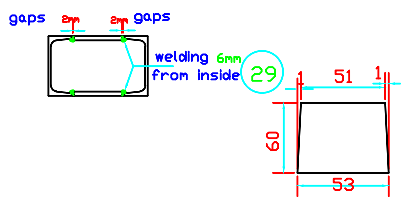
Head of the pole
and location of trusses



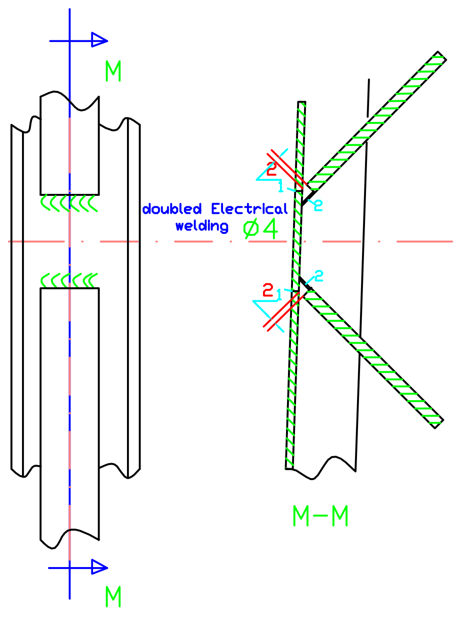
All holes mast fall
between the trusses

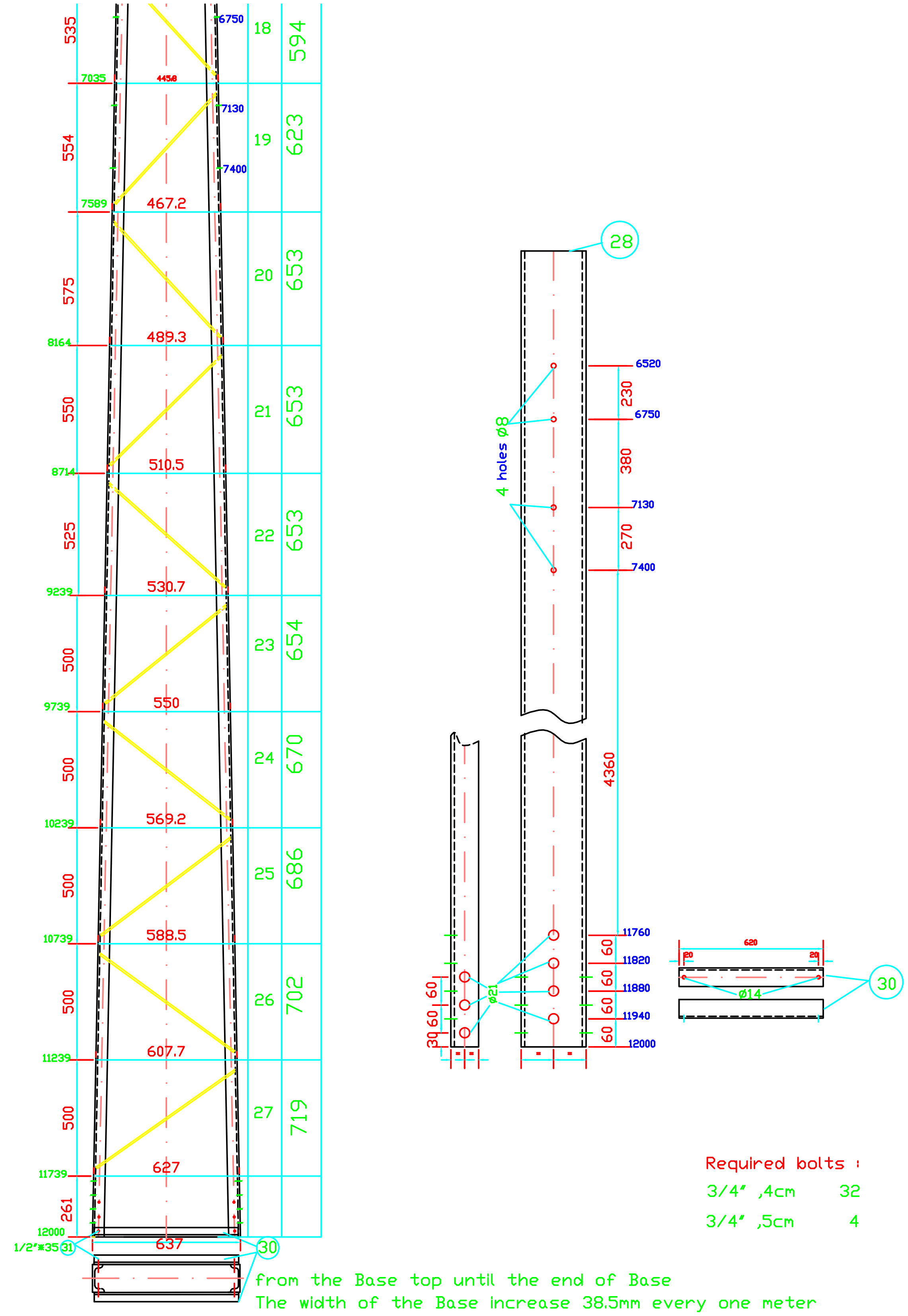


distance between
Trusses from 3 to 27
from main saide angle
Is 40-40mm



Method of welding ribs





شركة توزيع كهرباء محافظات غزة
GEDCo

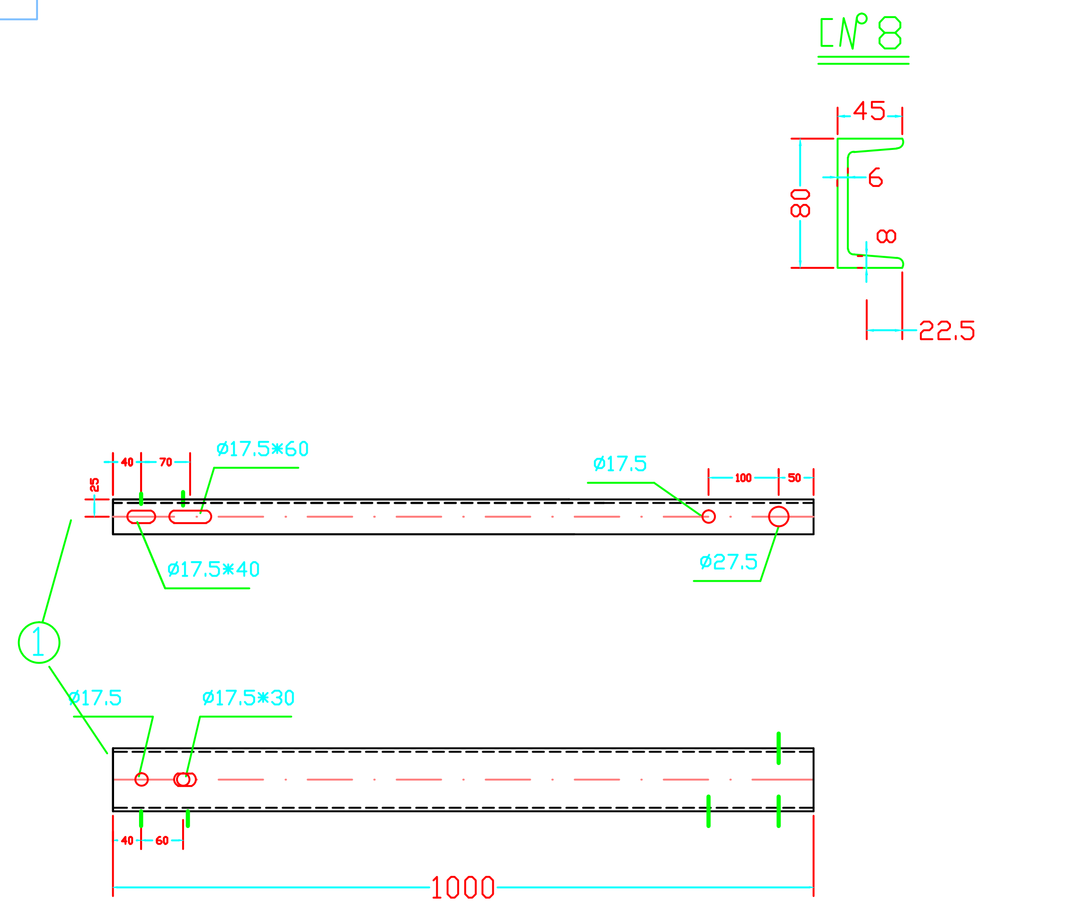
Prepared:Eng. ziad ALHoussaini

M.V. Channel Steel Pole U14 long 12m

Note: All component must be Steel 37.2 hot dip galvanized

kg Wieght	mesurment Total mm	mesurment Unit mm	Description	Quant.	Item
71.6	13124	L	ø70*10	1*27	1-27
384.2	24000	12000	U14	2	28
0.4	106	53	ø60*8	2	29
3	1240	620	L40*40*4	2	30
		UNC Bolt	1/2"*35	4	31
		washer	1/2"	4	32
		Ring washer	1/2"	4	33
460Kg	Total	Wieght			

K166/1



Bolts Required for
installation on
the pole or Arm

2 UNC Bolt 5/8"*40mm
2 square washer 5/8"

Note: All component must be Steel RST37.2
hot dip galvanized

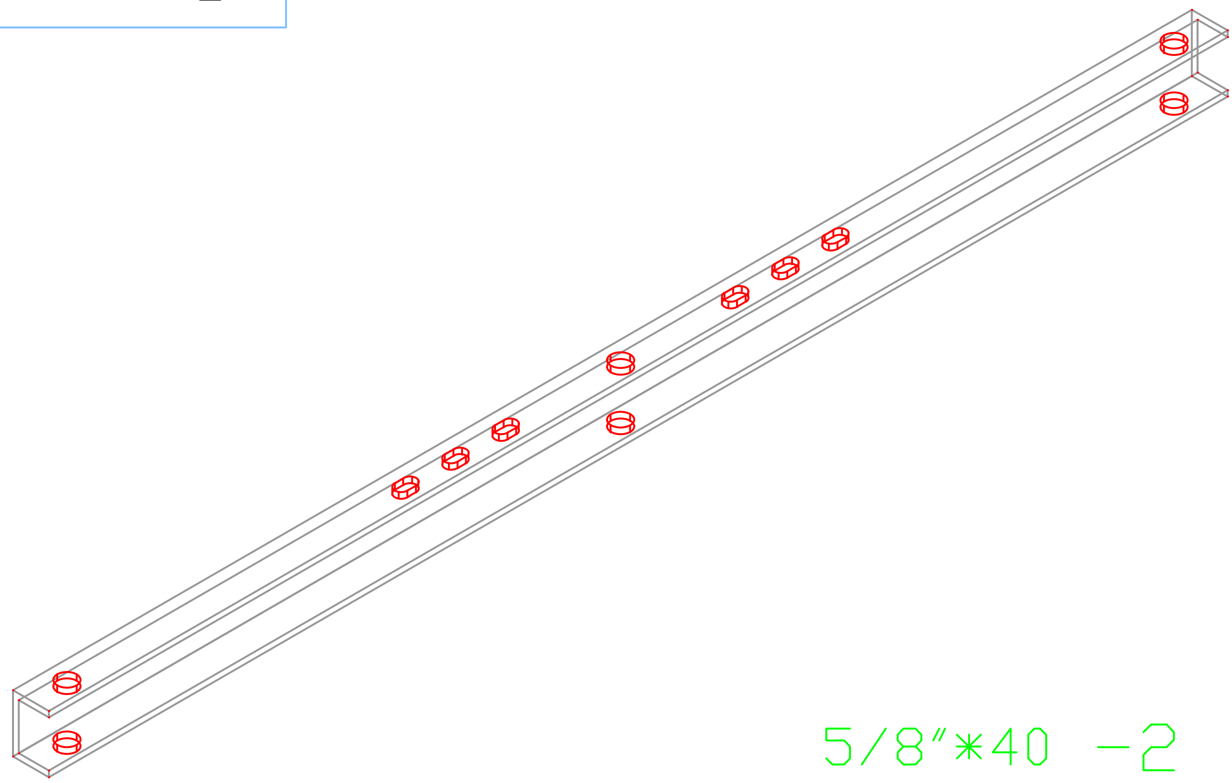
Weight Kg	Unit mm mesurment	Description	Quant.
8.6	1000	CN 8	1

شركة توزيع كهرباء محافظات غزة
GEDCo

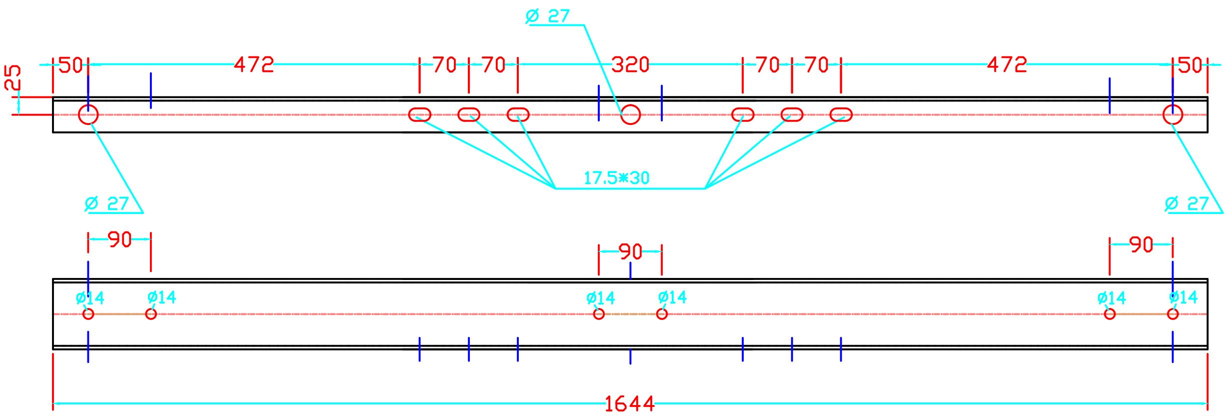
Prepared:Eng. ziad ALHoussaini

Hot Galvanized Auxilliary
Steel Arm K166/1

K160/3_B



5/8"*40 -2



شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

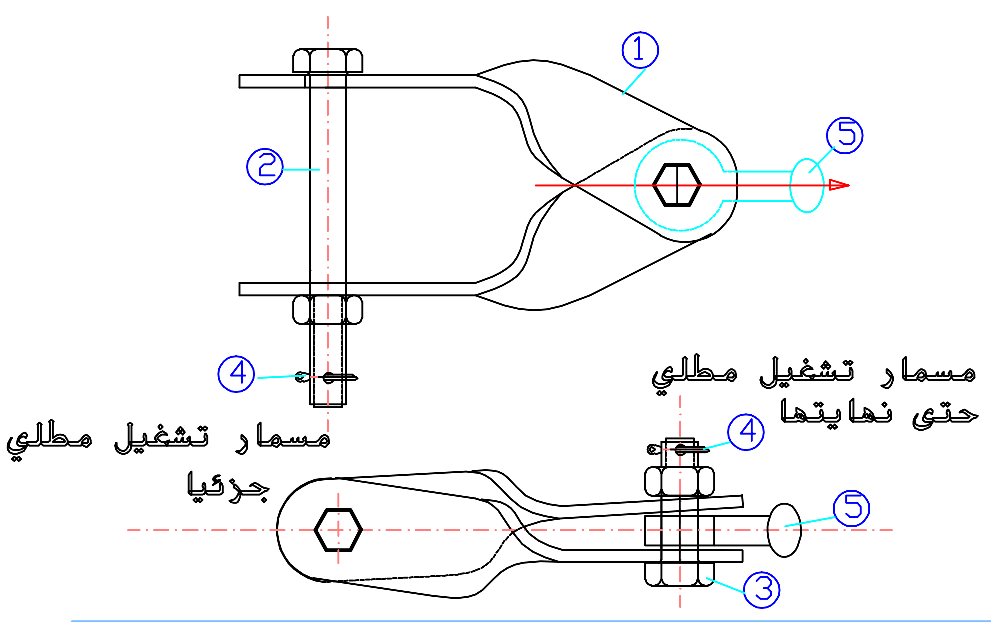
Checked By:Eng. Kamil Rabah

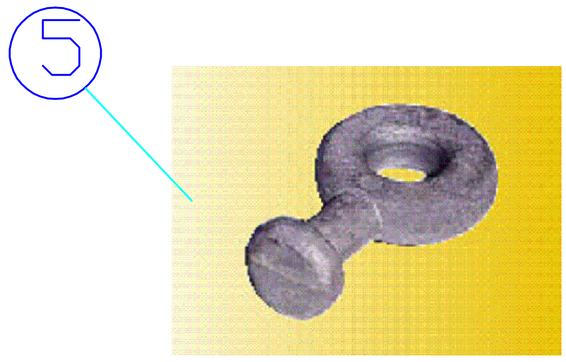
Hot Galvanized Auxilliary
Steel Arm K160/3_B

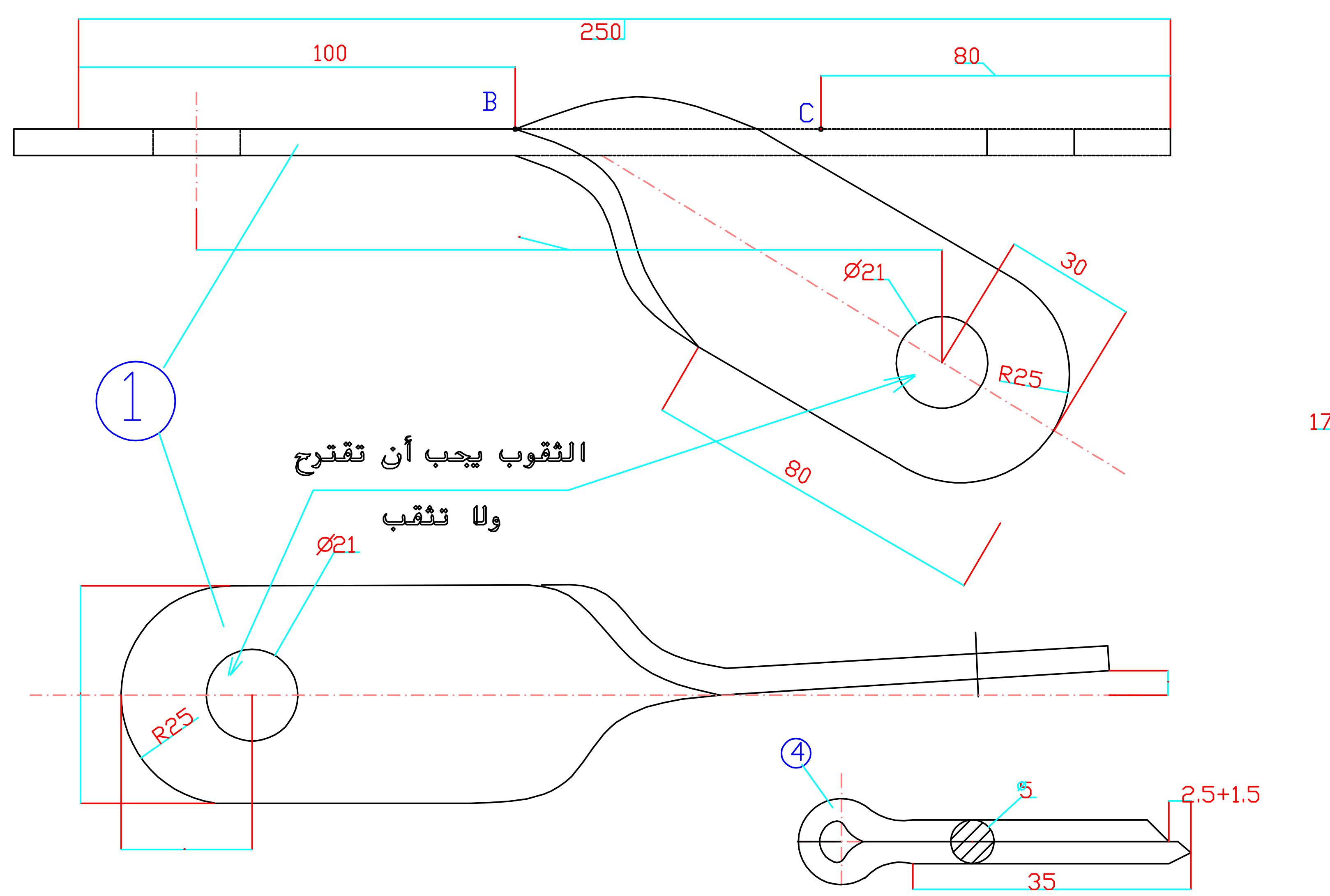
Weight Kg	Unit mm mesurment	Description	Quant.
	1644	CN° 8	1

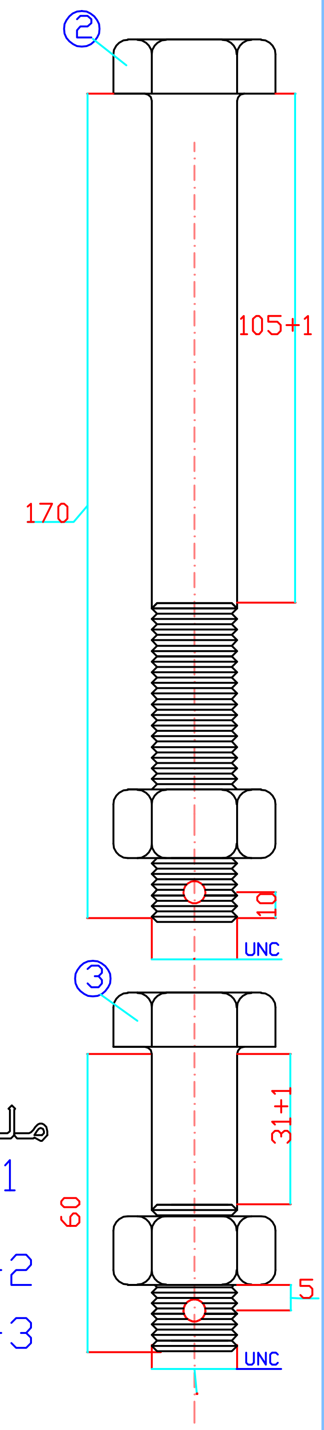
Note: All component must be Steel RST37.2 hot dip galvanized

K151/11









ملاحظات

1- ثني الحديد المبسط في البند ① بزاوية 90° بحيث تكون المسافة بين B و C هي 70mm

يتم علي الساخن في حرارة 950+100C° التبريد في هواء ساكن بدوون تصدعات أو تشوهات

2- المادة ; للبند ① فولاذ RSt37.2 الطلاء ; طلاء ساخن بالزنك

3- المادة , التسنين والطلاء للبنود ②, ③

شركة توزيع كهرباء محافظات غزة

قائمة المواد

Steel Twisted Clamp K151/11 Including ball eyes

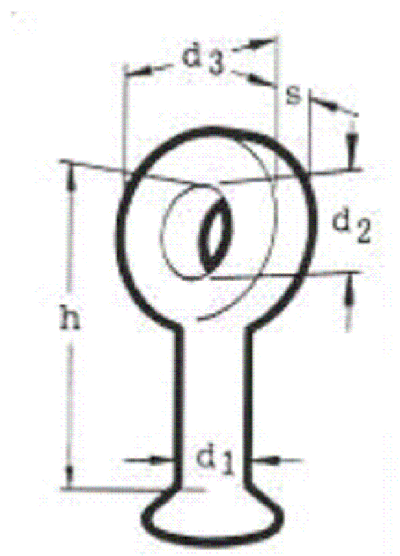
الكمية	اسم الجزء	الجزء	المقاسات	الوحدة	الاجمالى
1	ball eyes	5	K758		
2	مسمار تقسيم	4	5Ø	35	
1	برغي مع صمولة	3	3/4"-60/30		
1	برغي مع صمولة	2	3/4"-170/65		
2	لوحة الرابط	1	ø 50*6	250	250

Ball Eyes

Ball dimensions according to DIN 48064.
Connecting dimensions according to DIN 48074.

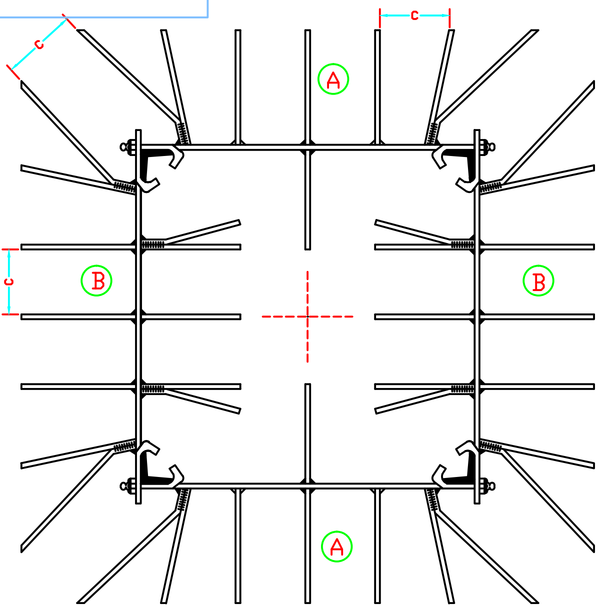
Material:
Heat-treated steel according to DIN 17200, forged.

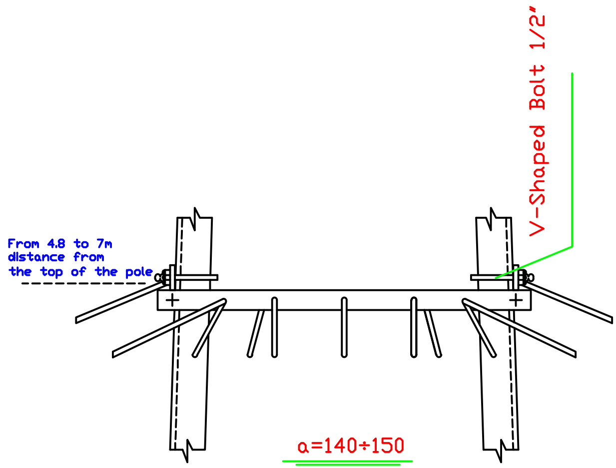
Surface:
Hot-dip galvanized according to DIN 50976.



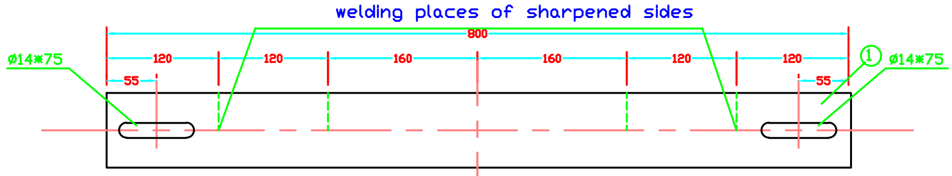
Dimensions mm					Nominal Load kN	I th kA	Weight 1 Piece Kg.
d1	d2	d3	h	s			
16	24	55	76	19	135	14	0.4

K113/8

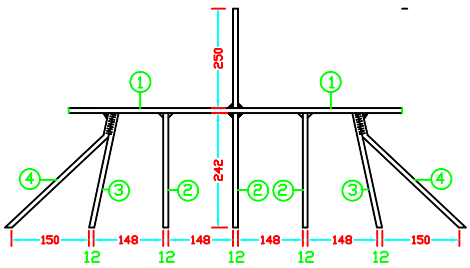


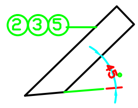


welding places of sharpened sides



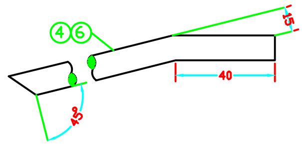
Method of bending and Cutting of the edges

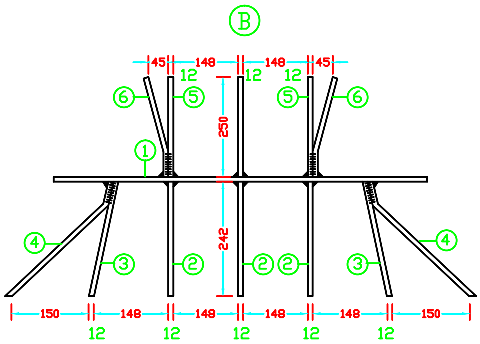


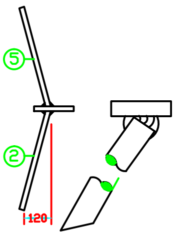


sharpened side from items 2 to 6 should be welding with Item No 1 thickness 5mm

Bending in Cold as specified Standards







Bolts Required for installation on the pole

8 V-Shaped Bolt 1/2" 140mm

Note: All component must be Steel 37.2 hot dip galvanized

GEDCo

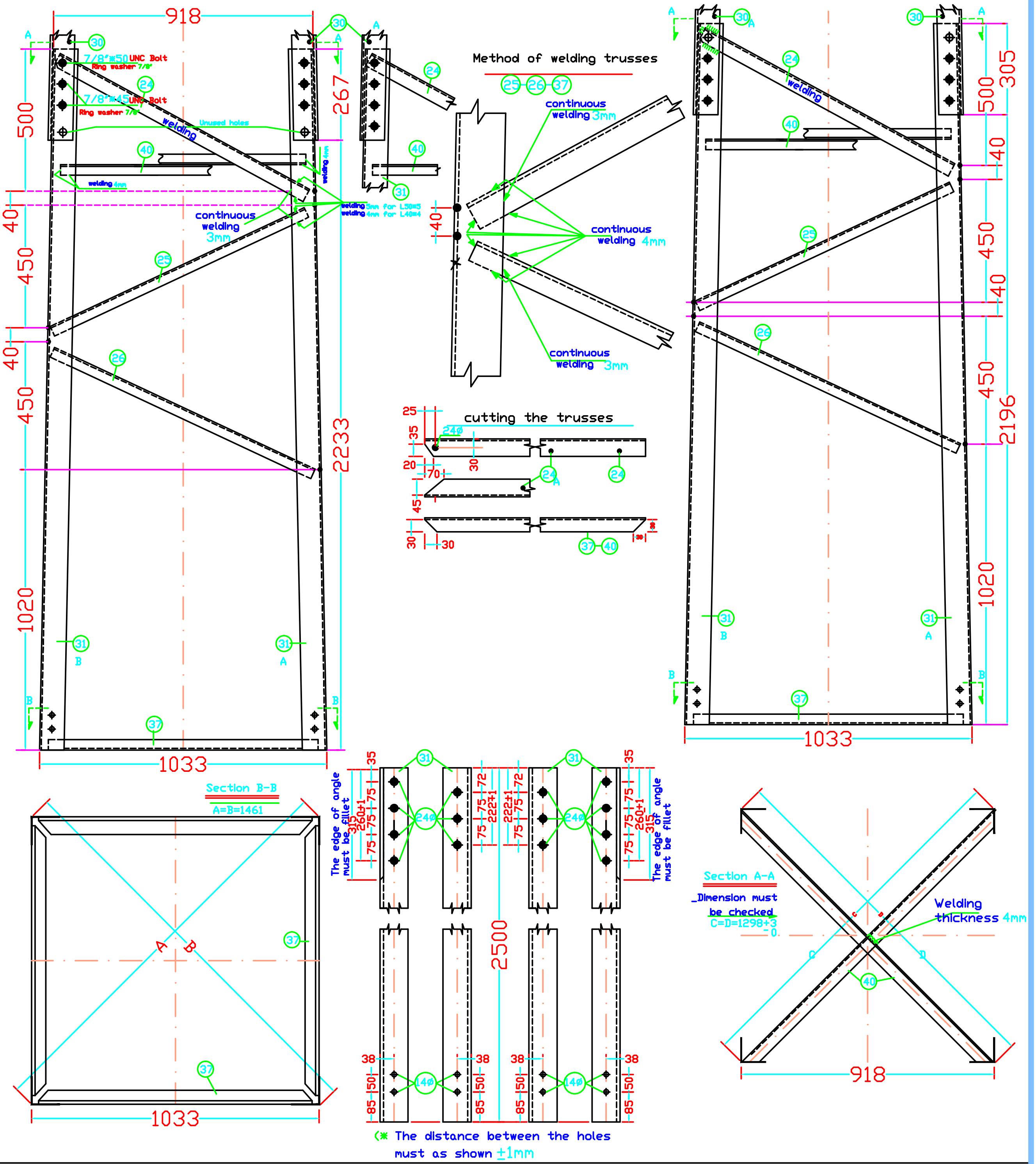
Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

Anti- Climbing Steel Arm K113/8

Weight Kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant
10	3200	800	Plate ⊏50*6	1	4
2.9	3240	270	Ø12	2	12
2.0	2240	280	Ø12	3	8
2.4	2680	335	Ø12	4	8
2.0	2240	280	Ø12	5	8
1.0	1120	280	Ø12	6	4
21kg					

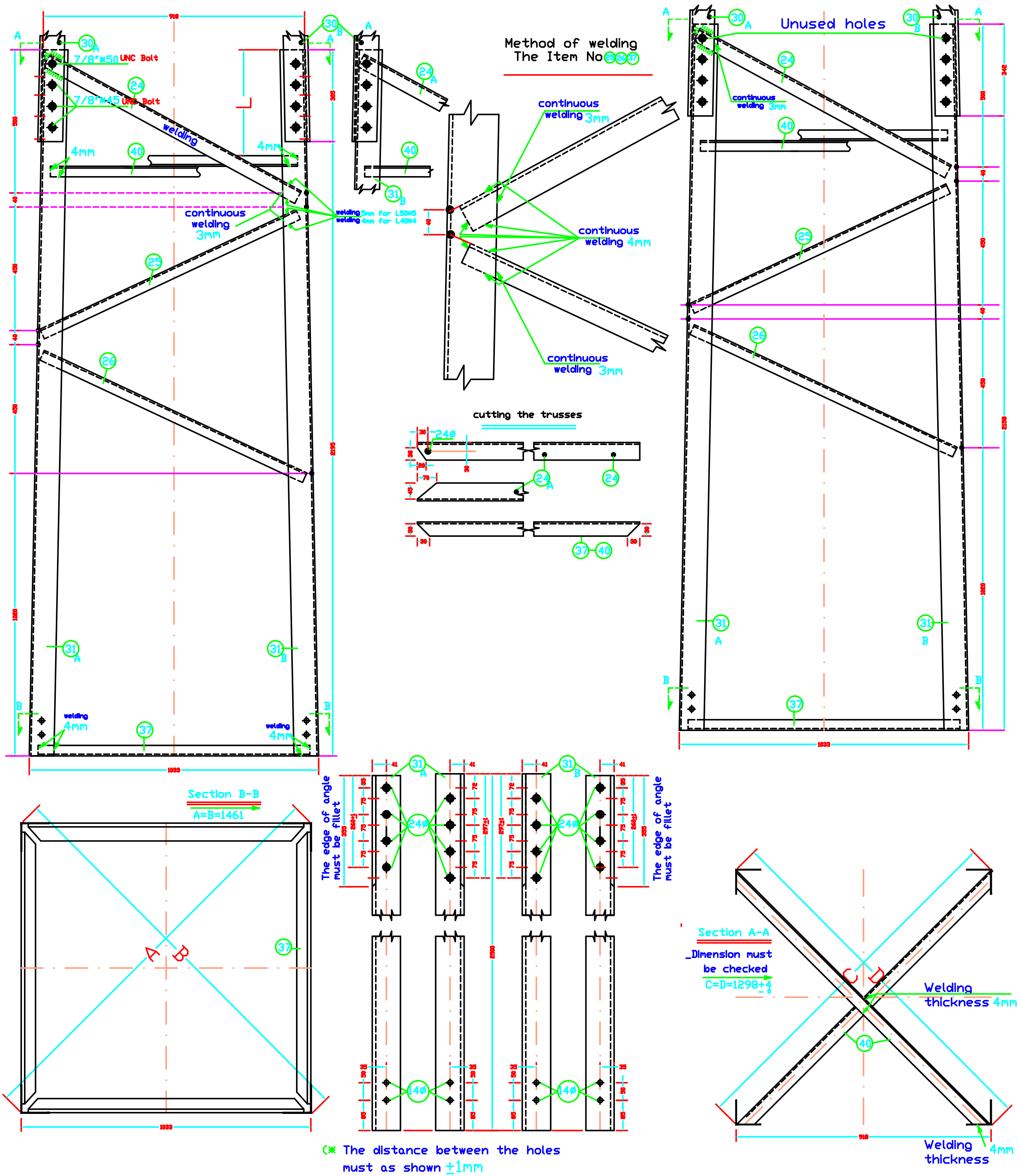
K110



GEDCo	Steel Base 2.25m long	
Prepared:Eng. ziad ALHoussaini	For Lattice Steel pole	
Checked By:Eng. Kamil Rabah	70/80-12m	

Weight kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
8.6	2550	1275	Truss L45*45*5	40	2
9.4	3880	970	Truss L40*40*4	37	4
96.6	10000	2500	L80*80*8	31AB	2+2
9.8	4040	1010	Truss L40*40*4	26	4
9.6	3960	990	Truss L40*40*4	25	4
7.5	1980	990	Truss L50*50*5	24A	2
7.6	2020	1010	Truss L50*50*5	24	2
149 kg Total Weight					

K109



Steel Base 2.25m long

For Lattice Steel pole

80/90-12m

Note: All component must be RSt 37.2
hot dip galvanized

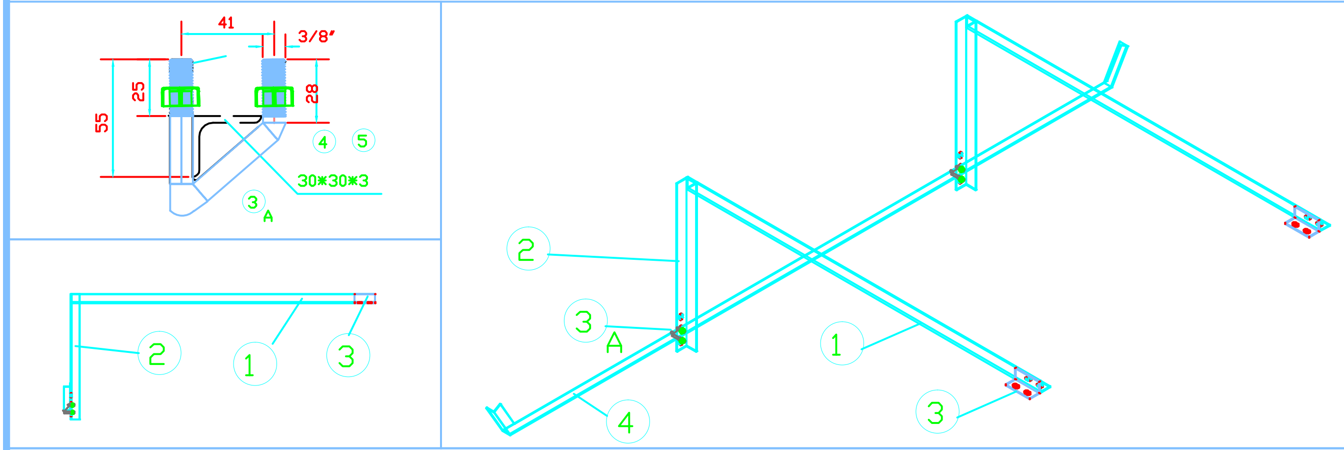
Prepared:Eng. ziad ALHoussaini

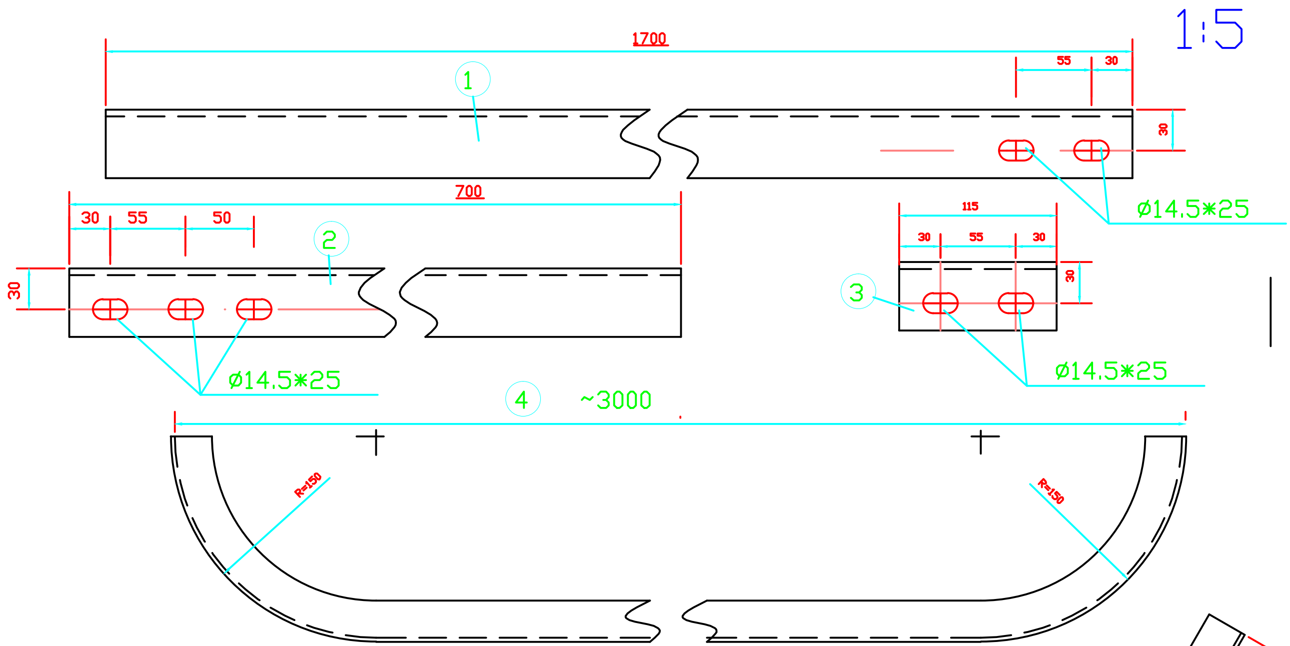
Checked By:Eng. Kamil Rabah

Weight kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
8.7	2570	1285	Truss L45*45*5	40	2
9.5	3920	980	Truss L40*40*4	37	4
122	10000	2500	L90*90*9	31AB	2+2
9.8	4040	1010	Truss L40*40*4	26	4
9.6	3960	990	Truss L40*40*4	25	4
7.4	1970	985	Truss L50*50*5	24A	2
7.5	2000	1000	Truss L50*50*5	24	2

175kg Total Weight

K82/A

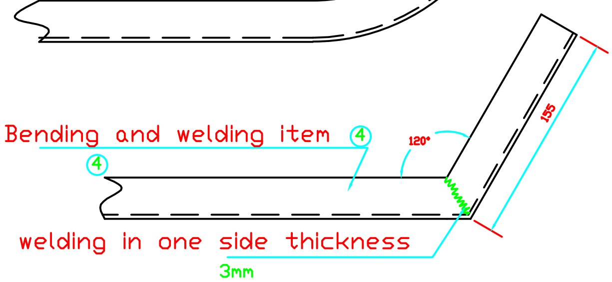




Bolts Required for installation on the Arm

2 U8 or U6.5 1/2"

Note: All component must be Steel 37.2
hot dip galvanized



Weight Kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
		3150	L30*30*3	4	1
	290	145	V-Shape angle Ø3/8"	3A	2
		115	L50*50*5	3	2
19	5030	700	L50*50*5	2	2
		1700	L50*50*5	1	2

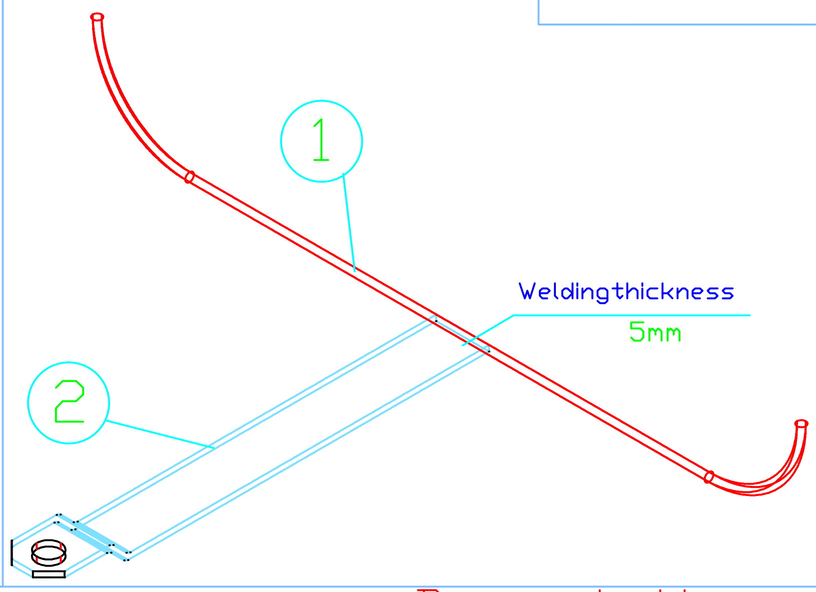
Hot Galvnized
Protection Arm
K82/A

شركة توزيع كهرباء محافظات غزة
GEDCo

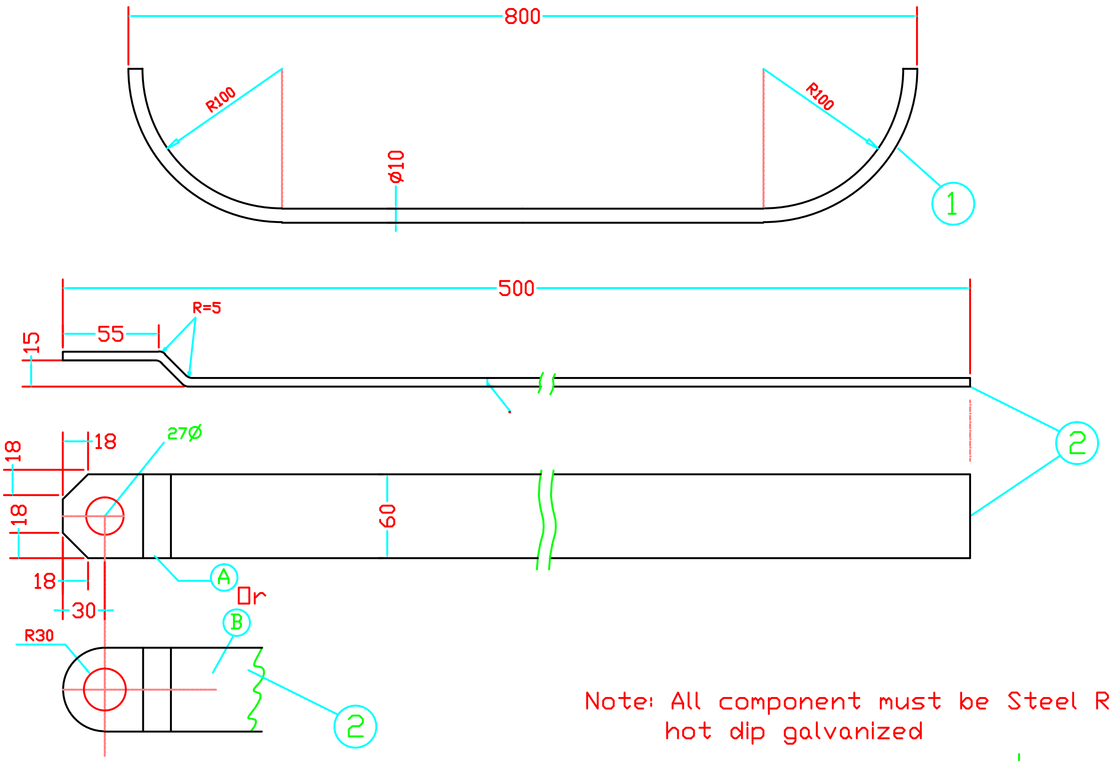
Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

K81



Description



Note: All component must be Steel RST37.2
hot dip galvanized

شركة توزيع كهرباء محافظات غزة
GEDCo

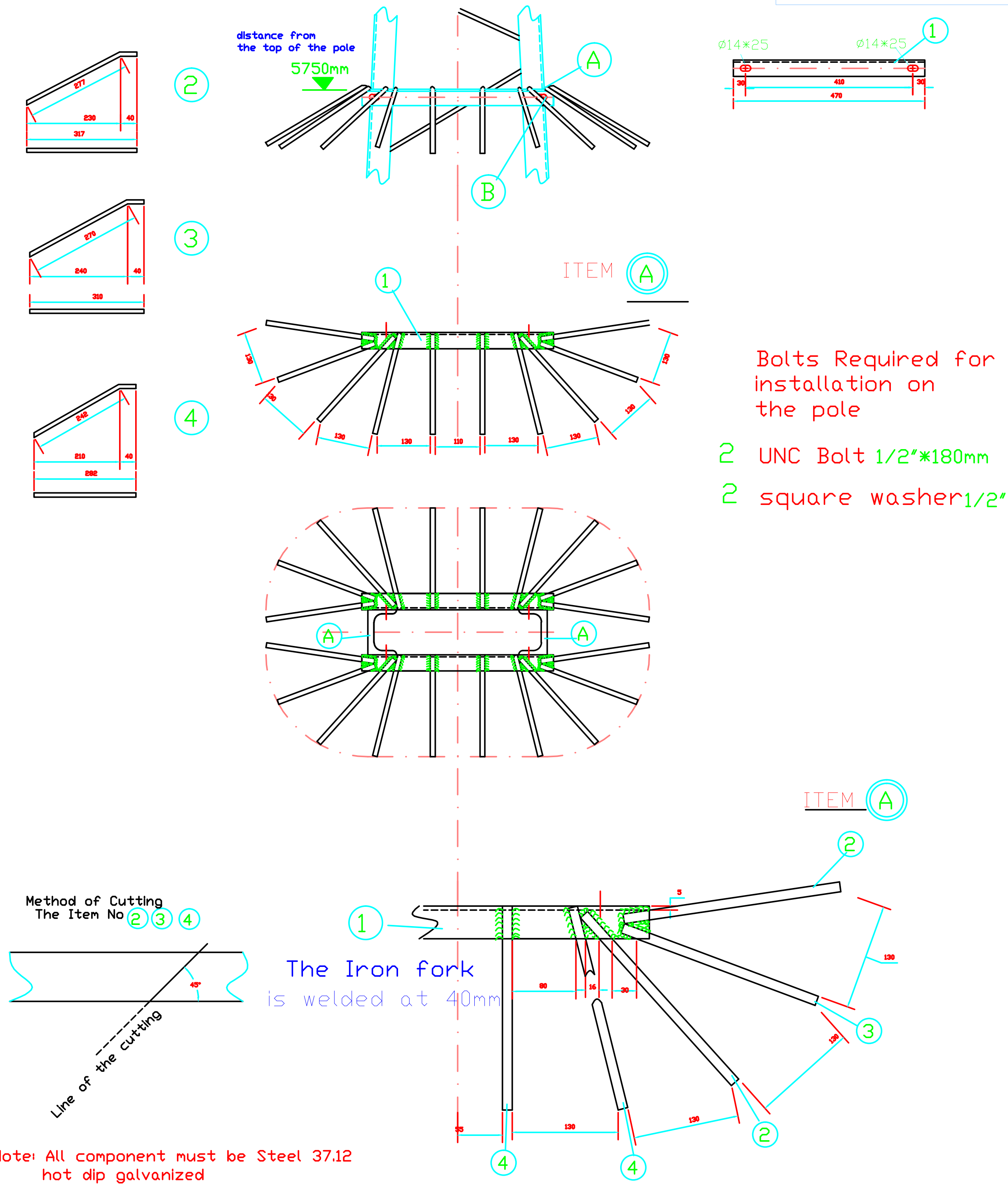
Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

Hot Galvnized
Protection Arm K81

	Unit mm mesurment	Description	Item	Quant.
For one Phase	910	10 Ø	1	1
	510	Plate ф 60*5	2	1

K78/2



Bolts Required for installation on the pole

2 UNC Bolt 1/2"*180mm

2 square washer1/2"

Note: All component must be Steel 37.12
hot dip galvanized

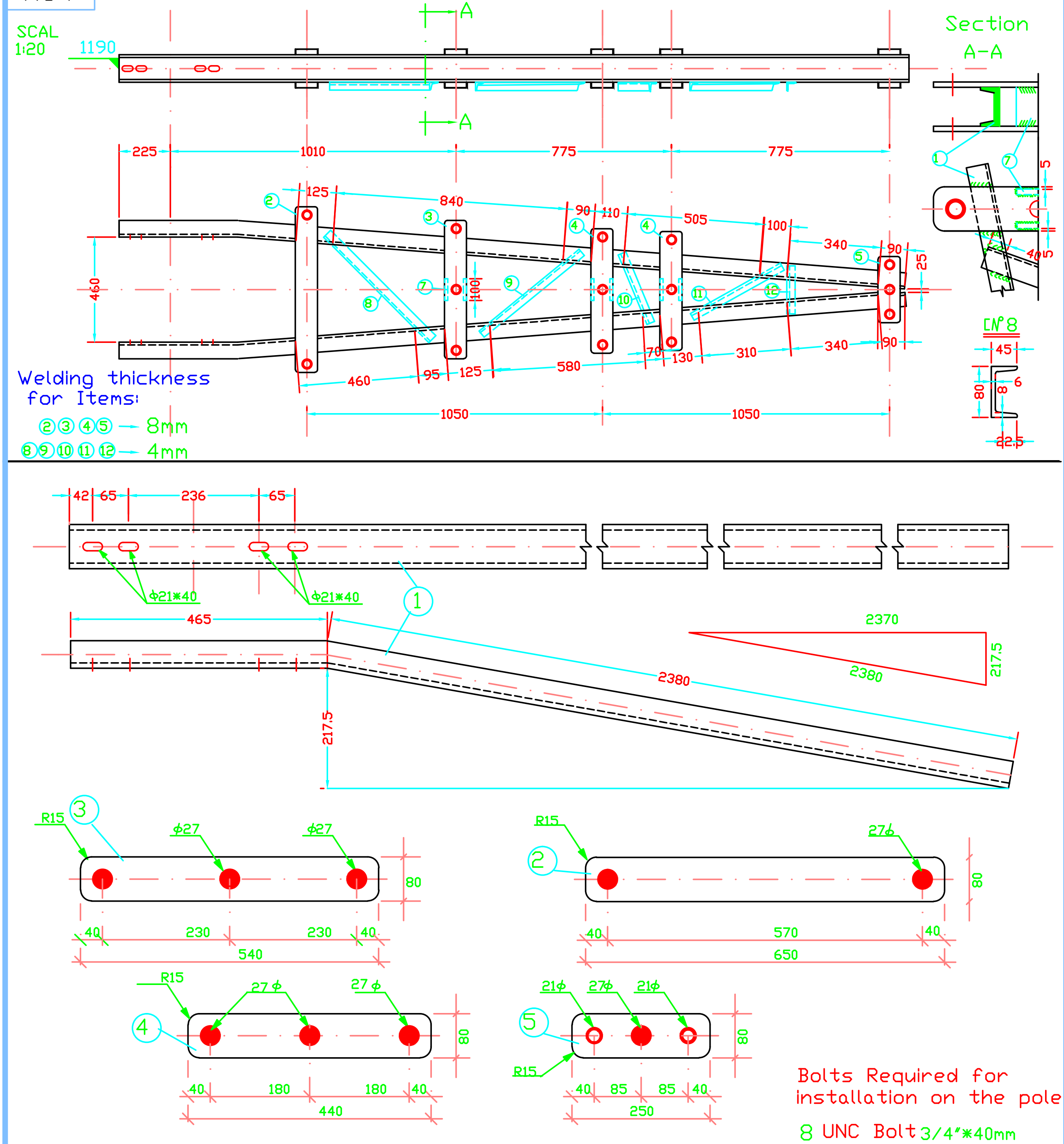
شركة توزيع كهرباء محافظات غزة
GEDCo
Prepared:Eng. ziad ALHoussaini

Anti-Climbing Steel Arm K78/2

Weight Kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
2.3	940	470	L40*40*4	1	2
2.2	2536	317	ø12	2	8
1.1	1240	310	ø12	3	4
2	2256	382	ø12	4	8

7.6 Total Weight

K64



Bolts Required for installation on the pole

8 UNC Bolt 3/4"*40mm

8 square washer 3/4"

Note: All component must be Steel 37.2 hot dip galvanized

Hot Galvanized Lattice steel

Pole Side Arm K64

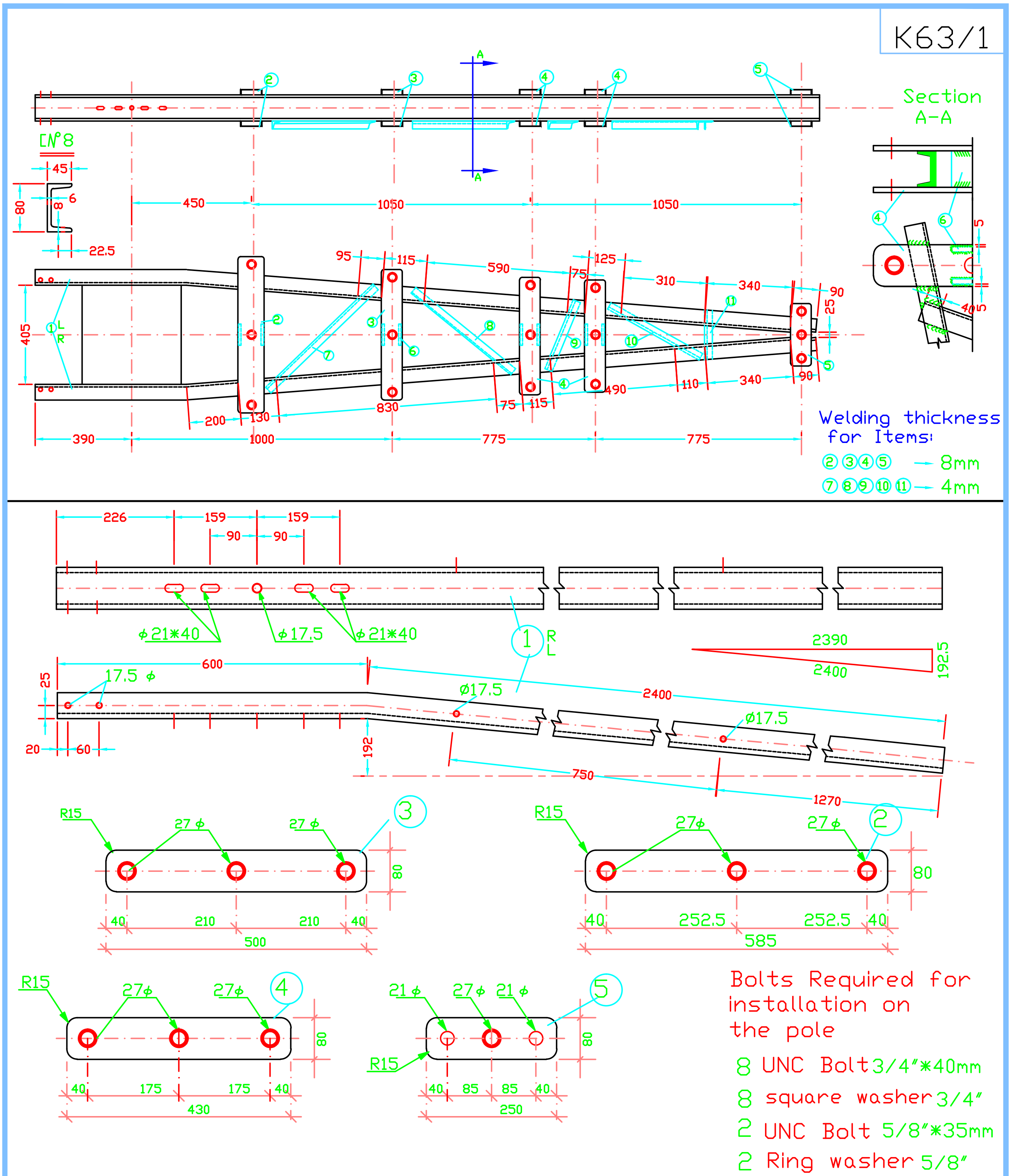
شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

Wieght kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
49.1	5690	2845	CN° 8	1	2
6.5	1300	650	Plate 80*8	2	2
5.4	1080	540	Plate 80*8	3	2
8.8	1760	440	Plate 80*8	4	4
2.5	500	250	Plate 80*8	5	2
3	600	100	Support Plate 80*8	7	6
1.5	605	605	L40*40*4	8	1
1.2	510	510	L40*40*4	9	1
0.7	320	320	L40*40*4	10	1
0.9	375	375	L40*40*4	11	1
0.4	185	185	L40*40*4	12	1

80 Kg Total Wieght



Welding thickness for Items:

②③④⑤ — 8mm

⑦⑧⑨⑩⑪ — 4mm

Bolts Required for installation on the pole

8 UNC Bolt 3/4"*40mm

8 square washer 3/4"

2 UNC Bolt 5/8"*35mm

2 Ring washer 5/8"

Wieght kg	Total mm mesurment	Unit mm mesurment	Description	Item	Quant.
51.8	6000	3000	[N°8	1 [	1R+1L
26.0	1170	585	Plate ⌀80*8	2	2
	1000	500	Plate ⌀80*8	3	2
	1720	430	Plate ⌀80*8	4	4
	500	250	Plate ⌀80*8	5	2
	800	100	Support Plate⌀80*8	6	8
4.5	1870	580	L40*40*4	7	1
		480	L40*40*4	8	1
		290	L40*40*4	9	1
		350	L40*40*4	10	1
		170	L40*40*4	11	1
82.3 Kg Total Wieght					

Hot Galvanized Lattice Pole Side Arm K63

Note: All component must be Steel R37.2 hot dip galvanized

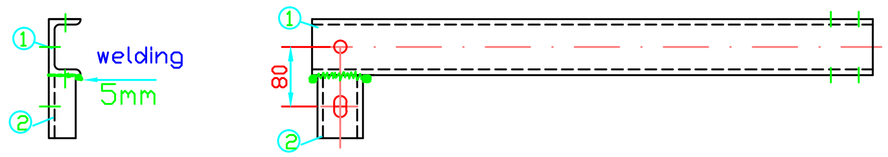
شركة توزيع كهرباء محافظات غزة

GEDCo

Gaza Electricity Distribution Corporation LTD.

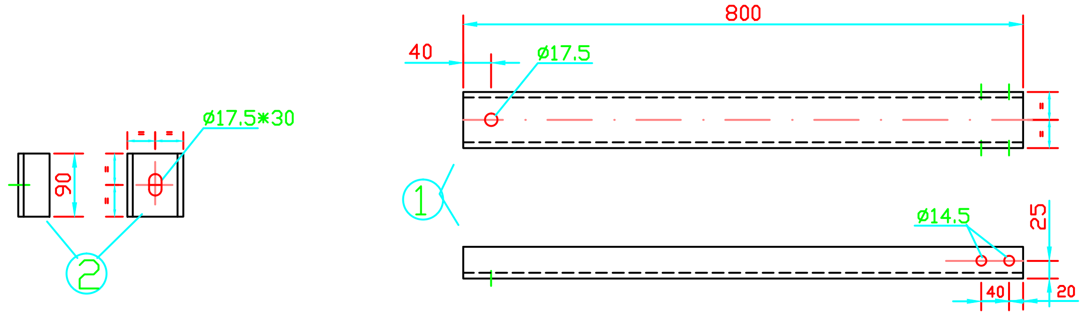
Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah



From Inside: welding

From Outside: Plug continuous and smooth welding



Note: All component must be RSt 37.2
hot dip galvanized

2 UNC Bolt 5/8"*35mm
2 Ring washer 5/8"

Hot Glavanized Auxillary
Steel Arm K18
For Earth Line

Weight Kg	Unit mm mesurment	Description	Item	Quant
5.7	800	CNP 6.5	1	1
0.6	90	Trust CNP 6.5	2	1
6.3 Kg		Total Weight		

شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

Technical Guarantees No. IS_36

36 Kv, 3-phase Outdoor Isolating Switch With Built-In Arc Interruption

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer		ELCO or Equivalent			
2	Country of Origin		ISRAEL			
3	Standards		IEC60129 & IEC60265-1			
4	Rated Voltage	kV	36			
5	Design and Operating		Manual Isolating Switch under load having capability of frequent switching			
6	All Ferrous Parts Material		Hot Galvanized Steel			
7	Pole No.		3			
8	Safe Operating Zone Temperature	^oC	-10 to +55			
9	Rated Frequency	Hz	50			
10	**Arc Interruption**					
	Name of Manufacturer					
	Country of Origin					
	Type		Heavy Duty			
	Operating		without an External Arc or Flame Conforming to IEC 60265			
	Installation		Hard Fixed and not Able to Rotate			
11	**Insulators**					
	Name of Manufacturer					
	Country of Origin					

Technical Guarantees No. IS_36

36 Kv, 3-phase Outdoor Isolating Switch With Built-In Arc Interruption

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
	a) Material		Polymer			
	b) Creepage Distance	mm	1050			
12	Continuous Current Capacity	A	630			
13	Rated Peak withstand Current	KA	31.5			
14	Rated Short Time Current (1 sec Duration)	KA	12.5			
15	**Rated Lightning Impulse withstand Voltage**					
	a) Standard Impulse with Stand Voltage to Earth (1.2/50 µs Full Wave)	kV	170			
	b) Between Poles Across Isolating Distance	kV	190			
16	**Rated One Minute Power Frequency withstand Voltage in Dry and Wet Conditions**					
	a) Power Frequency Test Voltage to Earth	kV	75			
	b) Between Poles Across Isolating Distance	kV	100			
17	Minimum Clearance Between Phase and earth	mm	shall be filled by manufacturer			
18	Minimum Clearance Between Phases	mm	shall be filled by manufacturer			
19	Mechanical Operations	C/O	≥1000			
20	Electrical Operations Under 400A load	C/O	shall be filled by manufacturer			
21	Short Circuit Electrical Operations	C/O	shall be filled by manufacturer			
22	Installation and operating accessories		Required			

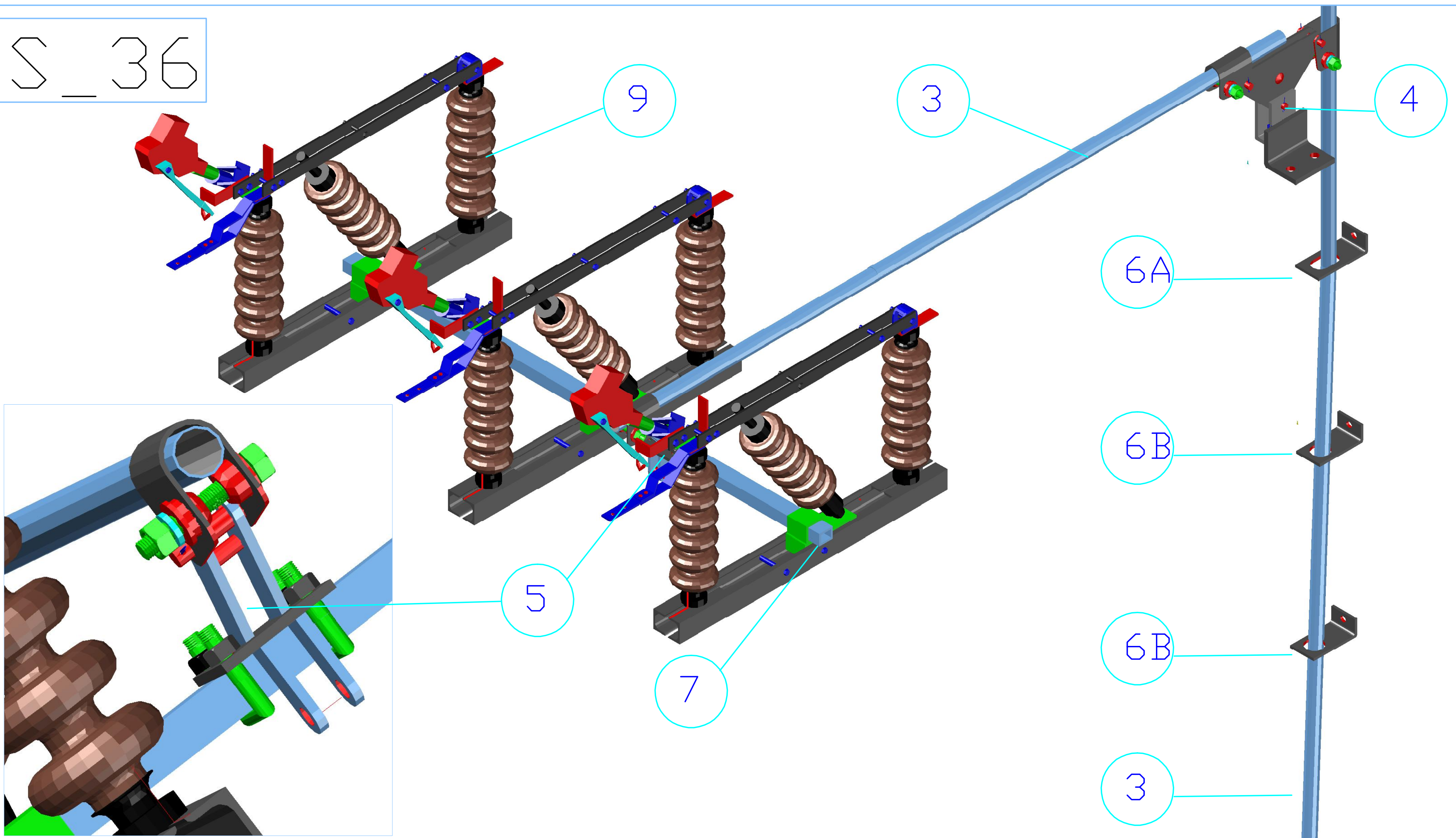
Technical Guarantees No. IS_36

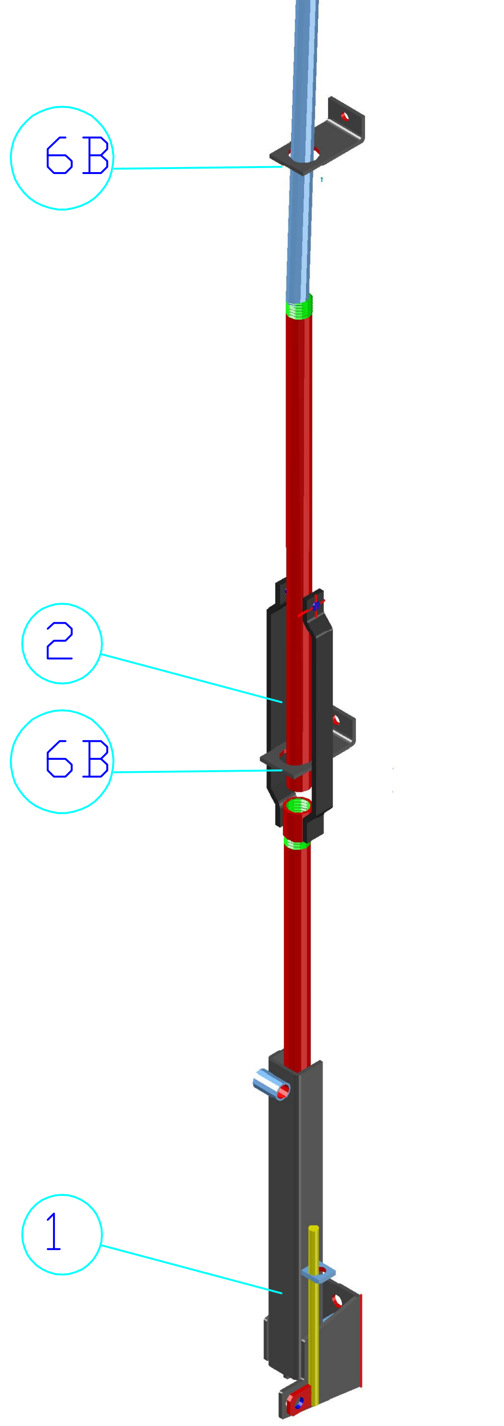
36 Kv, 3-phase Outdoor Isolating Switch With Built-In Arc Interruption

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
23	Master Key Lock Body		Chrome-plated solid brass			
24	Master Key Lock U-Shackle		Boron-steel alloy			
25	Type Test Certificates/Reports from internationally reputed testing agency (According IEC 694 and IEC 265-1)		Required			
26	Acceptance & Routine tests witnessed by Beneficiary		Required			
27	Switch Parts, Accessories and All Dimensions		As Attached Drawing No IS_36			

Tenderer's Signature : ……………………..… Date: ………………………………

IS_36





Itm	Description	Q.
1	Operating Handle	1
2	Adjusting Device	1
3	Glav. operating Pipe 1 1/4"	12m
4	Crank	1
5	Control Operating Lever	1
6A	Pipe guide model A	1
6B	Pipe guide model B	4
6C	Pipe guide model C	1
7	Interphase Shaft 35*35*3.5mm	3m
8	'U' Bolt Clamps 1/2"	12
9	36Kv Insulator Polymer	9

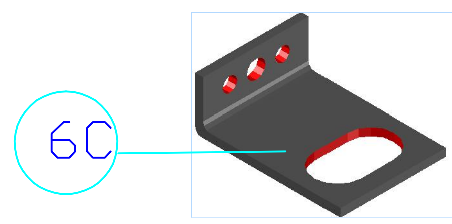
Gaza Electricity Distribution Corporation LTD.

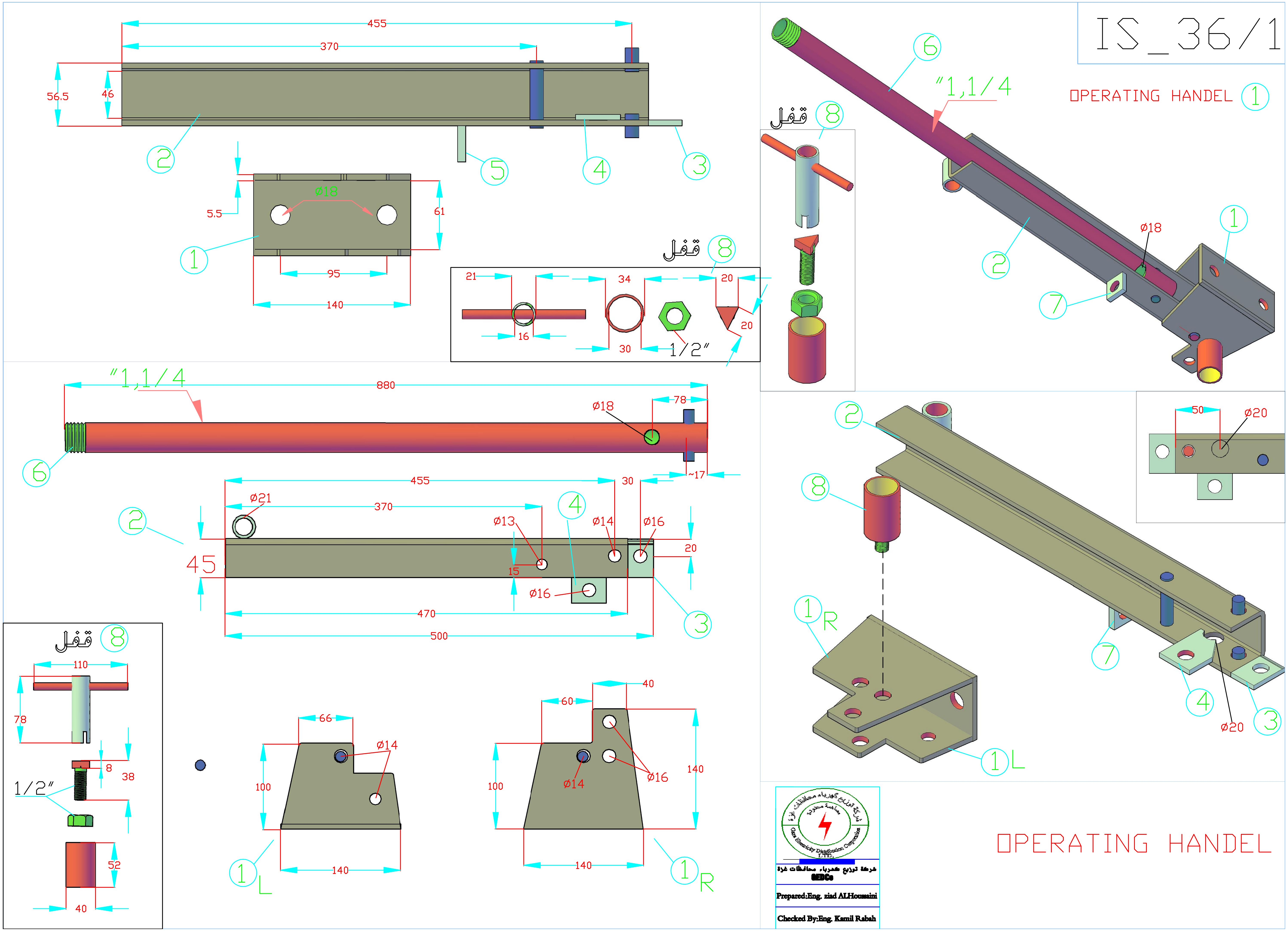
GEDCo

Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

36KV Load Break Switch
With Built-in arc interrupter

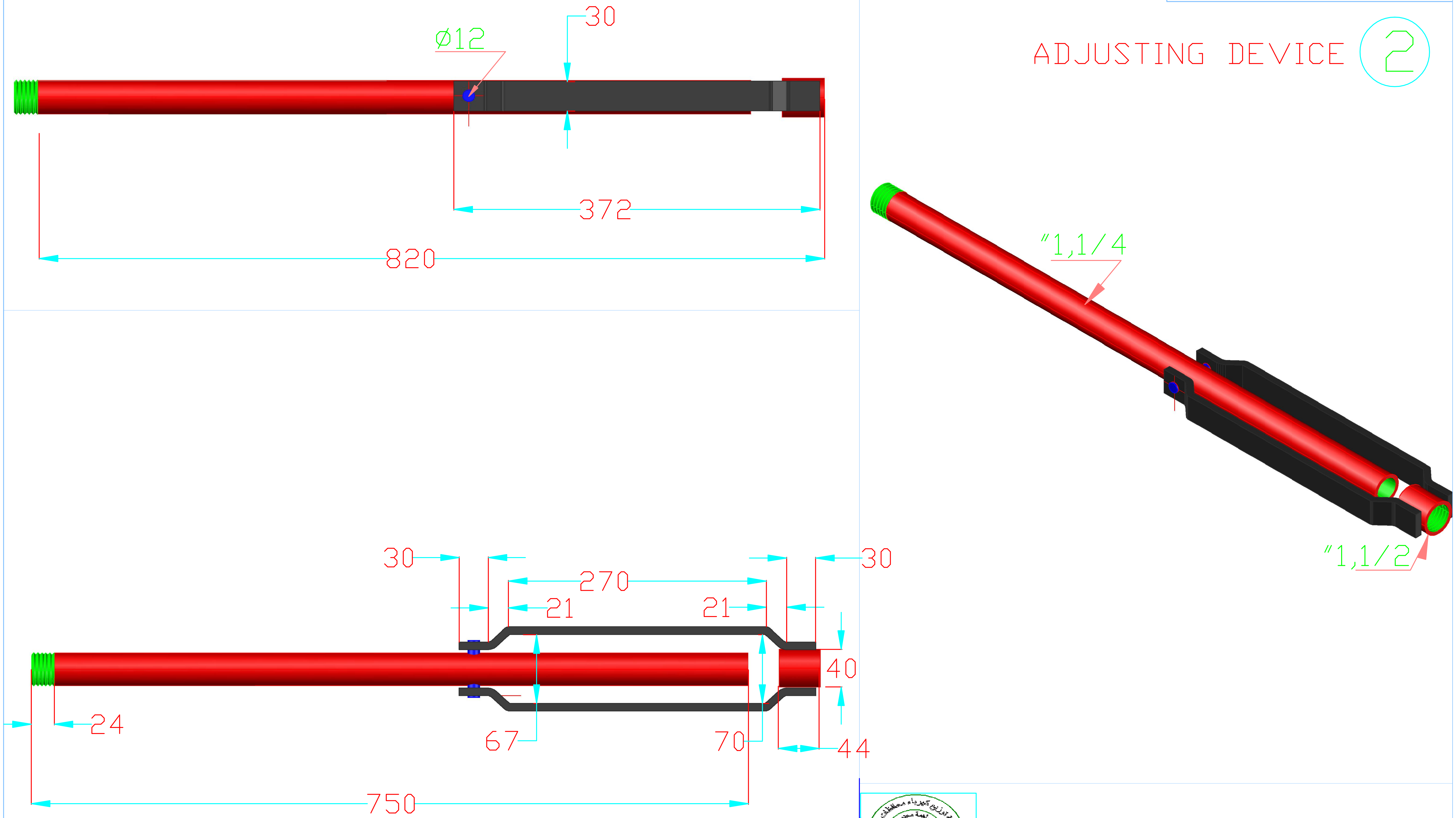




IS_36/1
OPERATING HANDEL 1
OPERATING HANDEL
قفل 8
"1,1/4
455
370
56.5
46
5.5
ø18
61
95
140
21
16
34
30
1/2"
20
880
78
~17
ø21
ø13
ø14
ø16
15
45
470
500
110
8
38
52
40
66
100
60
1 L
1 R
ø20
50
Prepared:Eng. ziad ALHoussaini
Checked By:Eng. Kamil Rabah

IS_36/2

ADJUSTING DEVICE 2



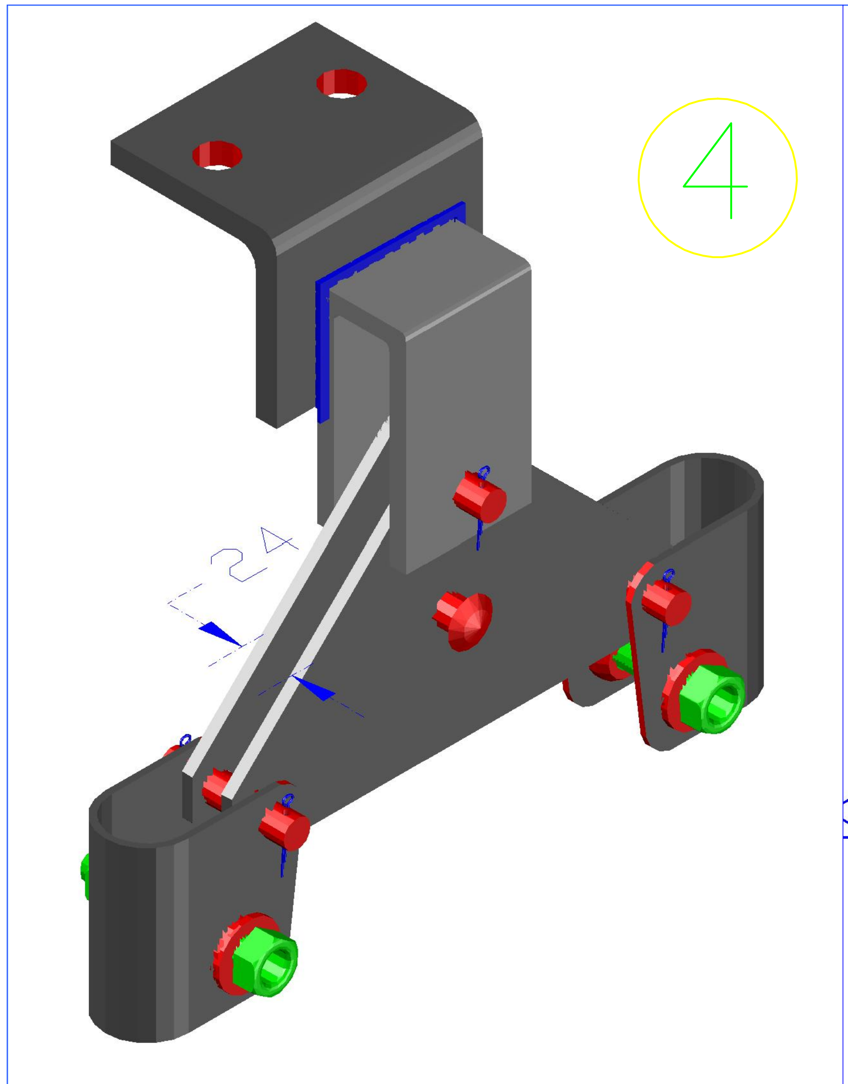
شركة توزيع كهرباء محافظات غزة
GEDCo

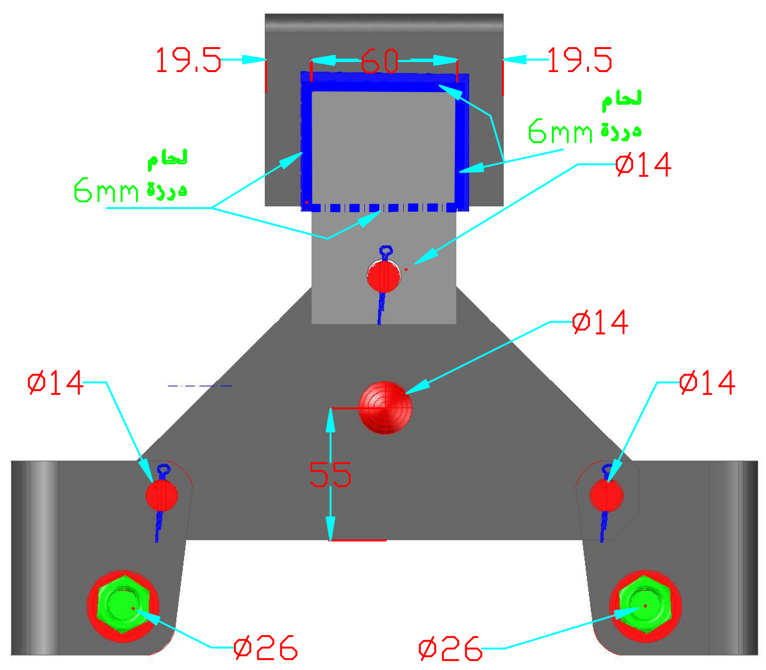
Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

ADJUSTING DEVICE

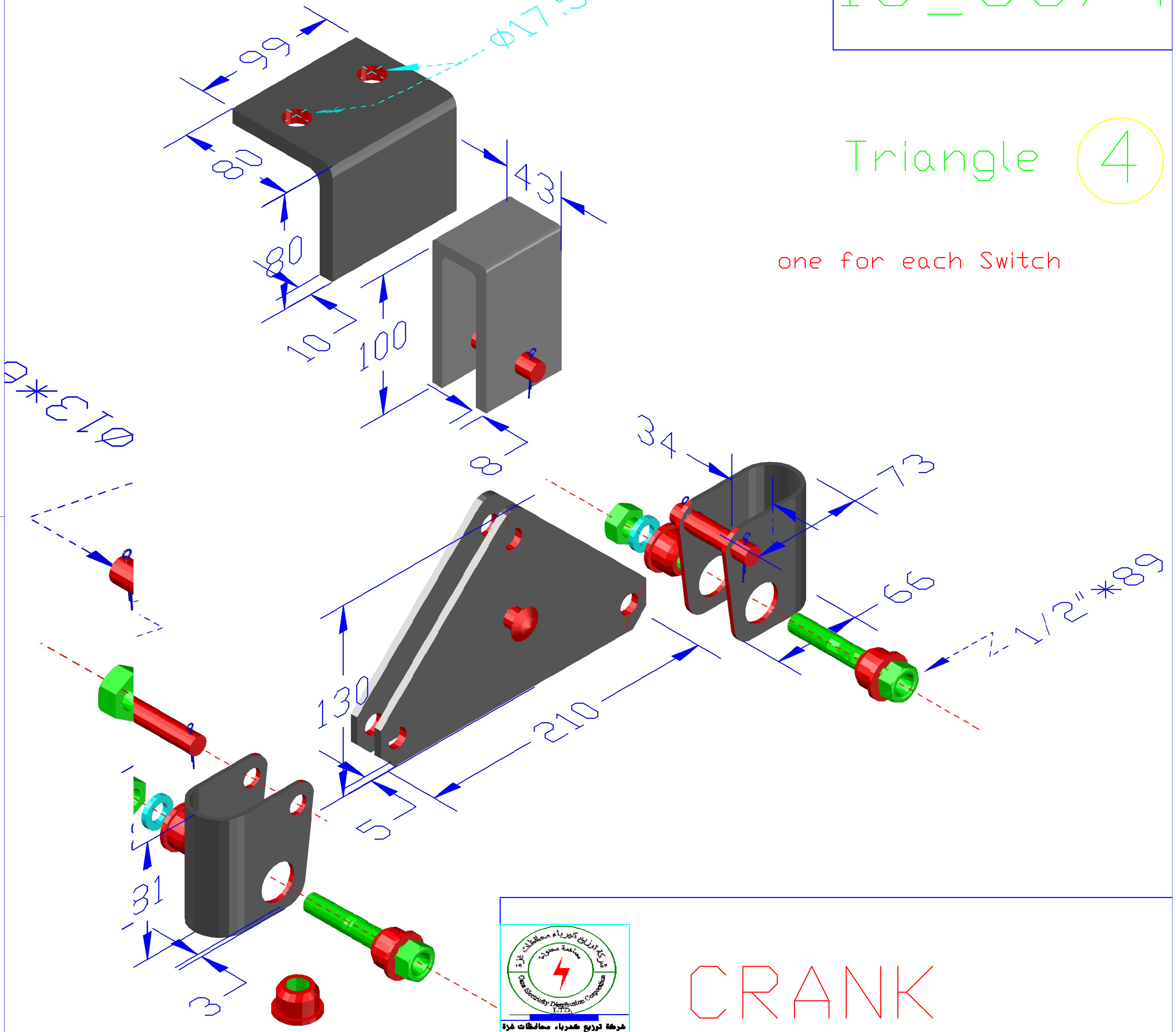
IS_36/4





Triangle 4

one for each Switch



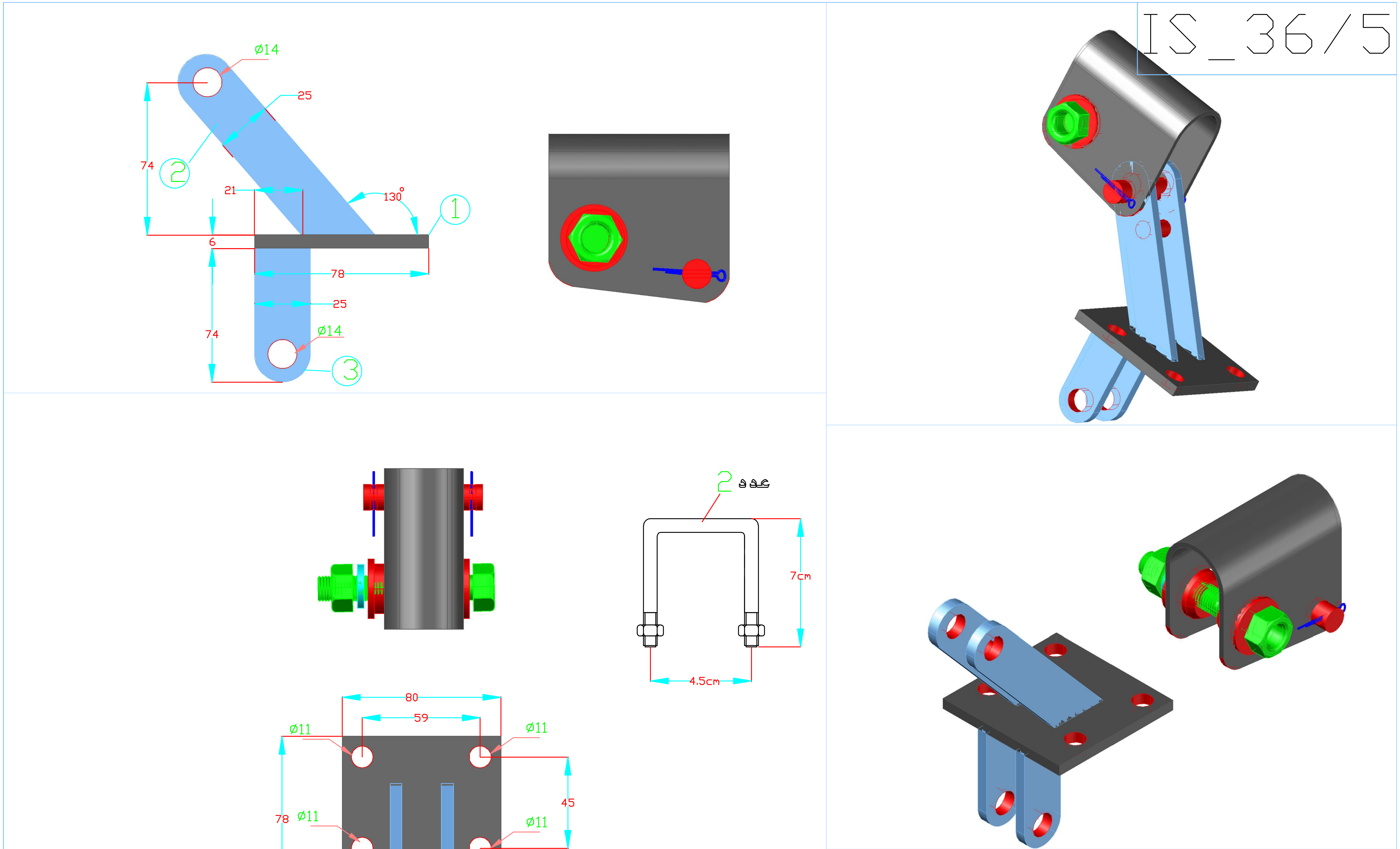
CRANK

شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

IS_36/5



شركة توزيع كهرباء محافظات غزة
GEDCo

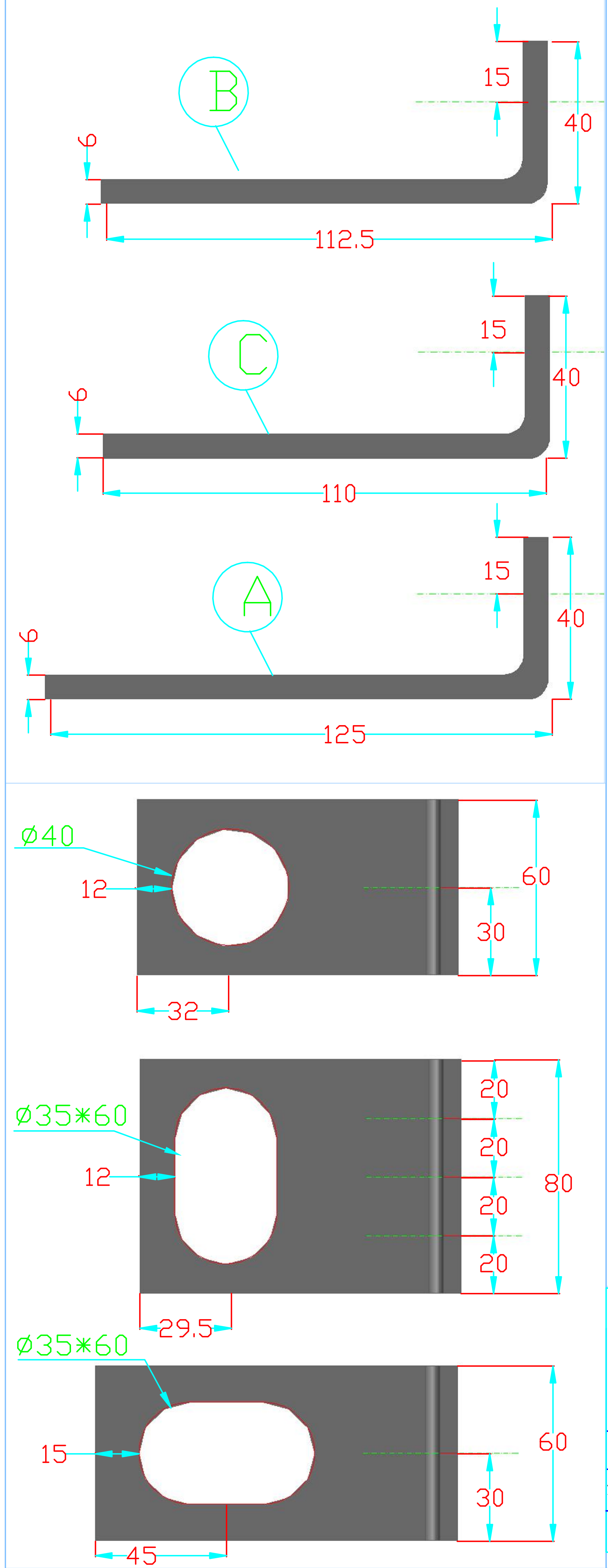
Prepared:Eng. ziad ALHoussaini

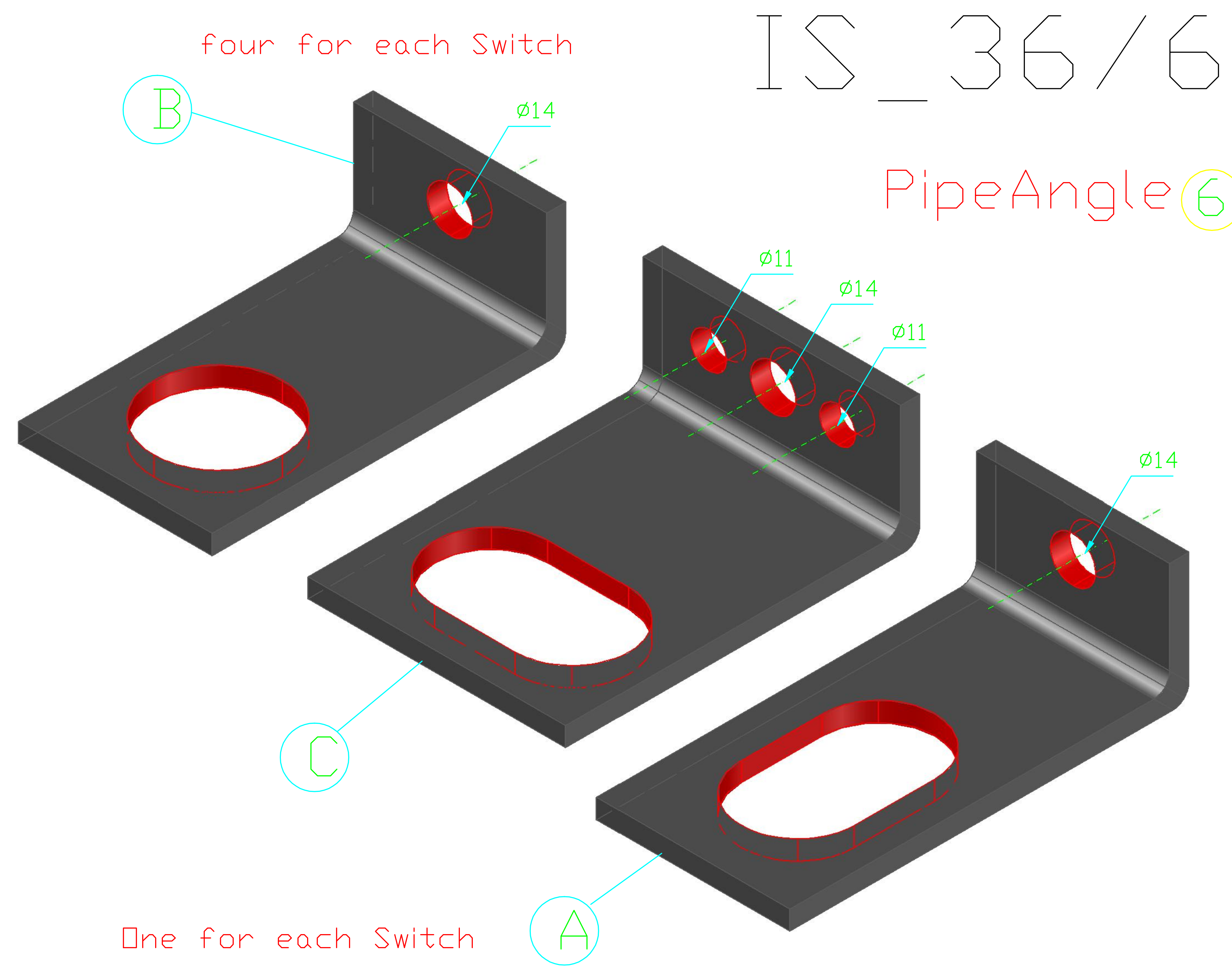
Checked By:Eng. Kamil Rabah

Control Operating lever

IS_36/6

PipeAngle 6





شركة توزيع كهرباء محافظات غزة
GEDCo

Prepared:Eng. ziad ALHoussaini

Checked By:Eng. Kamil Rabah

Pipe Guide

Technical Guarantees No. HST_50/16 Colour

Flame Retardant Heat Shrinkable Tube with Shrink Ratio 3:1

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		IEC243 , IEC251			
4	Description		Environment friendly flame retardant heat shrinkable tube			
5	Operating Temperature	C^o	-55 to+125 C			
6	Rated Voltage	kv	0.6/1			
7	Material		High Quality Polymer			
8	Min. / Max. Cable Outer Diameter	mm	16/48			
9	Cable Outer Sheath	mm	PVC or LDPE			
10	Dielectric strength	KV/mm	≥20			
11	Tensile strength	Mpa	≥13			
12	Tensile strength after aging	Mpa	≥11			
13	Ultimate Elongation	%	≥300			
14	Shrink Ratio		3:1			
15	Tube Size Before Heating	mm	50			
16	Tube Size after Heating	mm	16			
17	Tube Min. Thickness	mm	1.2			
18	Colour		Red, Yellow, Blue and Black			

Tenderer's Signature : ……………………..… Date: ………………………………

Technical Guarantees No. HMC_01

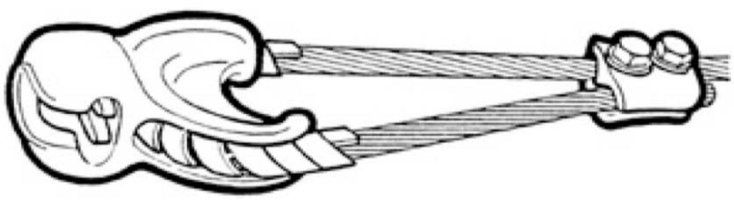
Strain Thimbles with Socket (Half Moon Clamp)

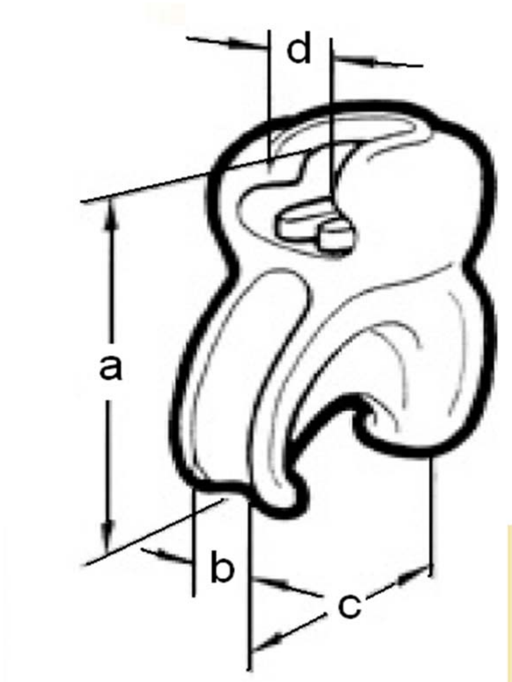
No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Connecting Dimensions Standards		DIN 48064			
4	Material Standards		DIN 1692			
5	Surface Standards		DIN 50976			
6	Material		Malleable cast iron GTS-45			
7	Surface		Hot-dip Galvanized			
8	Nominal Load	KN	110			

Technical Guarantees No. HMC_01

Strain Thimbles with Socket (Half Moon Clamp)

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
9	thermal overload current	KA	14			
10	Construction and Dimensions	mm	As Below Drawing			





DIMENSIONS mm			
a	b	c	d
92	19	70	16

Tenderer's Signature : ……………………..…   Date: ………………………………

Technical Guarantees No. HDC_120

Hard Drawn Stranded Copper Conductor 120 mm2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		BS7884 & DIN 48201			
4	Conductor Material		Copper			
5	Conductor Construction		Hard Drawn Stranded			
6	Nominal Cross-Sectional Area of Conductor	mm^2	120			
7	Number Copper Strands	No.	19			
8	Diameter of Copper Strand	mm	2.8			
9	Overall Diameter of Conductor	mm	14			
10	Max. Conductor DC Resistance at 20 °C	Ω/km	0.1578			
11	Minimum Breaking Load	Newton	42830			
12	Current Rating in Free Air	Amps	440			
13	Conductor Geometric Mean radius	mm	shall be filled by manufacturer			
14	Modulus of Elasticity	kg/mm^2	shall be filled by manufacturer			
15	Coefficient of Thermal Elongation , per ^oC		shall be filled by manufacturer			
16	Conductor Nominal mass per unit Length	kg/km	1055			
17	Drum Material		New Wood			
18	Cable Protection on Drum		Wooden Batten			

Technical Guarantees No. HDC_120

Hard Drawn Stranded Copper Conductor 120 mm2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
19	Drum Dimensions		shall be filled by manufacturer			
20	Conductor Length on Drum	m	1000			
21	Total mass of Conductor with Drum	Kg	shall be filled by manufacturer			
22	Type Test Certificates/Reports from internationally reputed testing agency		Required			
23	Acceptance & Routine tests witnessed by Beneficiary		Required			

Tenderer's Signature : ……………………..… Date: ………………………………

Technical Guarantees No. HDC_35

Hard Drawn Stranded Copper Conductor 35 mm2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		BS7884 & DIN 48201			
4	Conductor Material		Copper			
5	Conductor Construction		Hard Drawn Stranded			
6	Nominal Cross-Sectional Area of Conductor	mm^2	35			
7	Number Copper Strands	No.	7			
8	Diameter of Copper Strand	mm	2.5			
9	Overall Diameter of Conductor	mm	7.5			
10	Max. Conductor DC Resistance at 20 °C	Ω/km	0.5337			
11	Minimum Breaking Load	Newton	12860			
12	Current Rating in Free Air	Amps	200			
13	Conductor Geometric Mean radius	mm	shall be filled by manufacturer			
14	Modulus of Elasticity	kg/mm^2	shall be filled by manufacturer			
15	Coefficient of Thermal Elongation , per ^oC		shall be filled by manufacturer			
16	Conductor Nominal mass per unit Length	kg/km	308			
17	Drum Material		New Wood			

Technical Guarantees No. HDC_35

Hard Drawn Stranded Copper Conductor 35 mm2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
18	Cable Protection on Drum		Wooden Batten			
19	Drum Dimensions		shall be filled by manufacturer			
20	Conductor Length on Drum	m	1000			
21	Total mass of Conductor with Drum	Kg	shall be filled by manufacturer			
22	Type Test Certificates/Reports from internationally reputed testing agency		Required			
23	Acceptance & Routine tests witnessed by Beneficiary		Required			

Tenderer’s Signature : ……………………..… Date: ………………………………

Technical Guarantees No. GDI_320

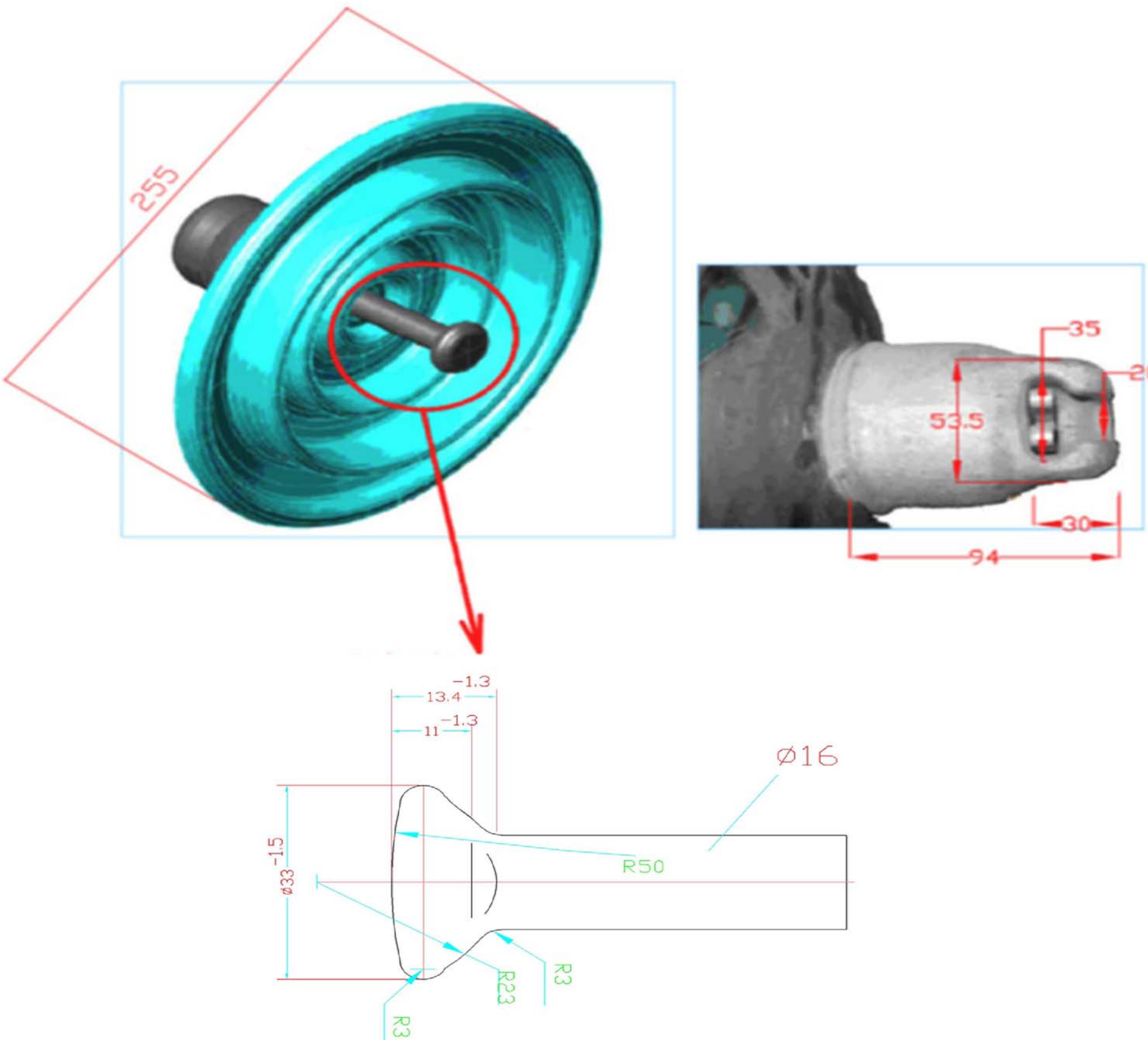
22kv Overhead Line Toughened Tension Glass Disk Insulator with Ball and Socket

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Design Standards		BS137& IEC60120			
5	Insulator material		Glass			
6	Min. Mechanical Failing Load	kN	70			
8	Weight	Kg				
9	Creepage Distance	mm	320			
10	Diameter	mm	255			
11	Ball Size	mm	Φ16			
12	Dimensions		as Below Drawing			
13- Power Frequency withstand Voltage (1min)						
13.1	a)Dry	kV	70			
13.2	b)Wet	kV	40			
13.3	c)Positive Dry Impulse +VE	kV	100			
13.4	d)Negative Dry Impulse -VE	kV	103			
14	Min Puncture Voltage in Oil	kV	130			
15	Phosphorous Bronze Security Clip (BS 3288 Part 4)		W-CLIP			

Technical Guarantees No. GDI_320

22kv Overhead Line Toughened Tension Glass Disk Insulator with Ball and Socket

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
16	Accessories		Hot Galvanized Ball and Socket			



Tenderer's Signature : ……………………..… Date: ………………………………

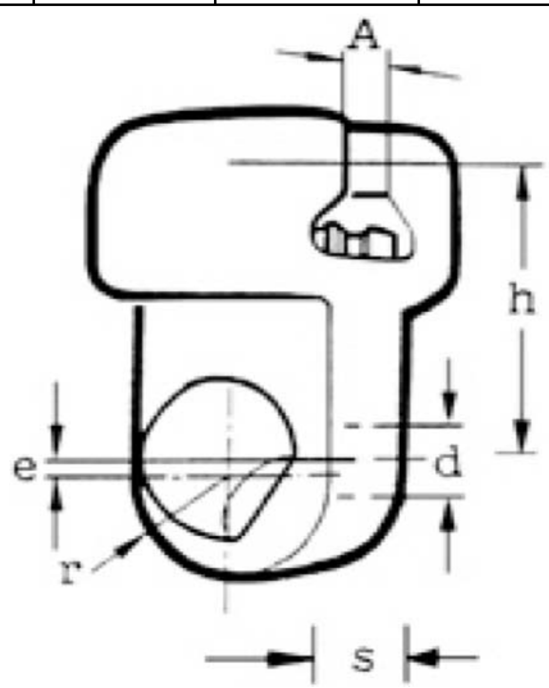
Technical Guarantees No. FBH_16

Fork Ball Hook 16mm (SOCKET EYES-TYPE-A)

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Connecting Dimensions Standards		DIN 48064			
4	Material Standards		DIN 1692			
5	Surface Standards		DIN 50976			
6	Material		Malleable cast iron GTS-45			
7	Surface		Hot-dip Galvanized			
8	Upper Slot Dimension (A)	mm	16			
9	Nominal Load	KN	160			
10	Ball Eyes thermal overload current	KA	14			
11	Construction and Dimensions	mm	As Below Drawing			

DIMENSIONS
mm

d	e	h	r	s
20	3	69	28	19

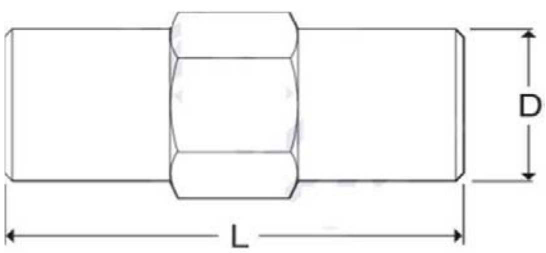


Tenderer's Signature : ……………………..… Date: ………………………………

Technical Guarantees No. ERJ_15

Earth Rod Joint

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Standards					
4	Material		high strength copper content Aluminium Bronze alloy			
5	Size		5/8"			
6	Length (L)	mm	70			
7	Outside Diameter (D)	mm	20			

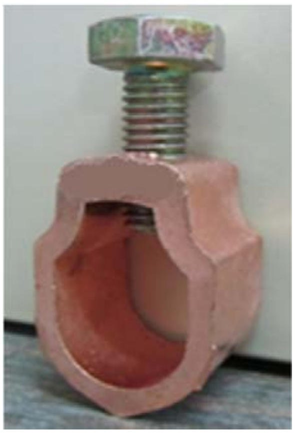


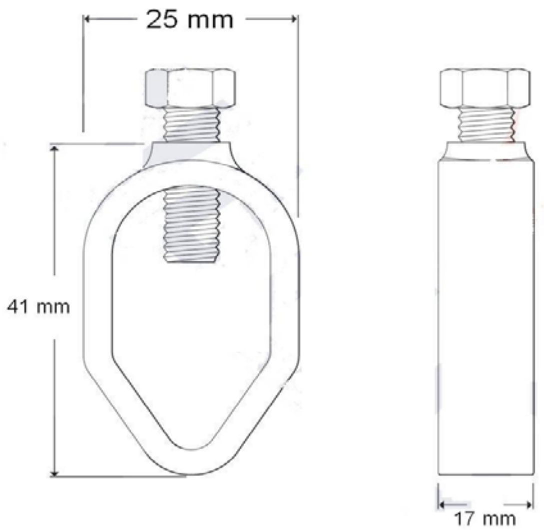
Tenderer's Signature : ……………………..….   Date: ………………………………

Technical Guarantees No. ERC_15

Earth Rod Connection Clamp

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards					
5	Design		Suitable for earth rod 15 mm Dia to used for connection between Rod and cable			
4	Material		Brass			
6	Earth Rod Diameter	mm	15			
7	Copper Cable Cross Section	mm^2	35-70			



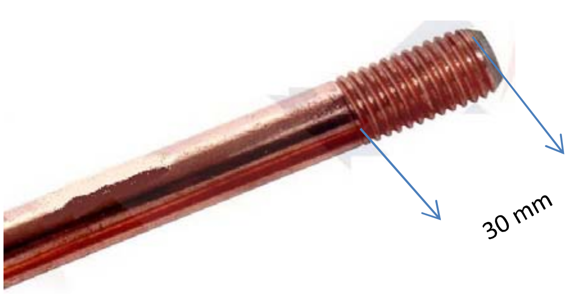


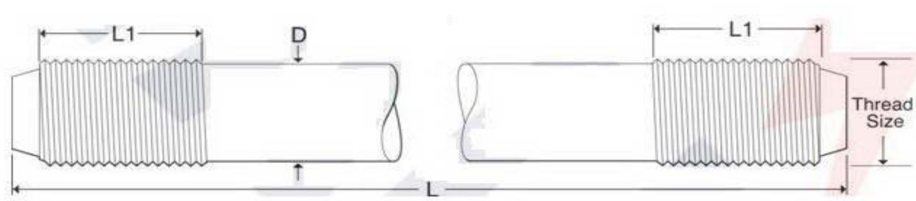
Tenderer's Signature : ……………………..…. Date: ………………………………

Technical Guarantees No. ER_15

Earth Rod 15 mm Diameter , 1.5 m

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Standards					
4	Material		low carbon steel core St-60			
5	Coating		Copper shrink jacket			
6	Coating thickness		Min. 0.3 mm			
7	Threaded Size		5/8"			
8	Threaded Part Length (L1)	mm	30			
9	Length (L)	mm	1500			
10	Shank Diameter (D)	mm	15			
11	Quality Certification		Required			





Tenderer’s Signature : ……………………..….   Date: ………………………………

Technical Guarantees No. EBT_20

Electrical Insulation Black Tape

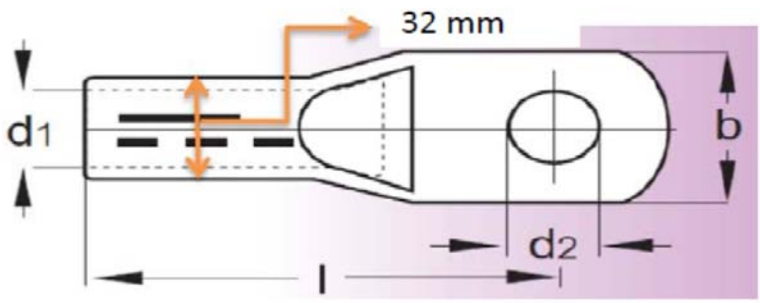
No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Standards		UL 510, ASTM D1000			
4	Material		Flame Retardant Vinyl			
5	Color		Black			
6	Width	mm	20			
7	Length	m	20			
8	Thickness	mm	0.18			
9	Max. Voltage	V	600			
10	Tensile Strength	Kg/cm	3.2			
11	Elongation	%	200			
12	Adhesive		Rubber Resin			
13	Dielectric Breakdown	Volts	9000			
14	UV Resistance		Yes			

Tenderer’s Signature : ……………………..…. Date: ………………………………

Technical Guarantees No. CLC_300

Compression Terminal Lug with 13 mm Hole for 300 mm^2 Copper Conductor

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Standards		DIN 46235			
4	Description		Copper Compression Lug with 13mm Hole			
5	Material		E-Cu, DIN 40500/2, F-25			
6	Surface		Tin-plated			
7	Type		Compression, Longitudinally Sealed			
8	Conductor Cross Section	mm^2	300			
9	Conductor Diameter	mm	22.5			
10	No. of Hyd. Compression		2			
11	Dimensions		as below Drawing			



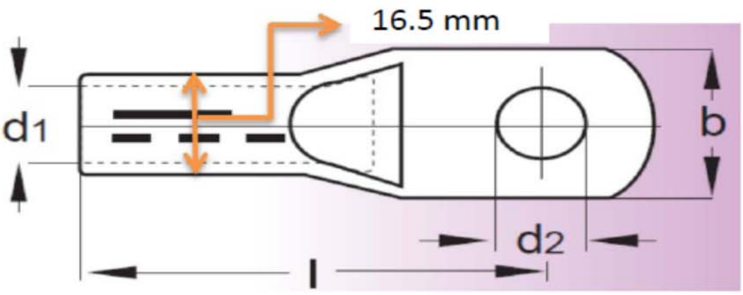
d1= 24.5 mm
d2= 13 mm
b= 48 mm
l = 100 mm

Tenderer's Signature : ………………………..…   Date: ………………………………

Technical Guarantees No. CLC_70

Compression Terminal Lug with 13 mm Hole for 70 mm^2 Copper Conductor

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		DIN 46235			
4	Description		Copper Compression Lug with 13mm Hole			
5	Material		E-Cu, DIN 40500/2, F-25			
6	Surface		Tin-plated			
7	Type		Compression, Longitudinally Sealed			
8	Conductor Cross Section	mm^2	70			
9	Conductor Diameter	mm	10.7			
10	No. of Mech. Compression		3			
11	Dimensions		as Below Drawing			



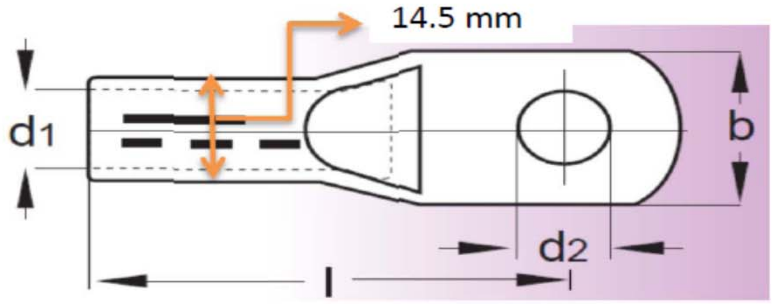
d1= 11.5 mm
d2= 13 mm
b= 24 mm
l = 55 mm

Tenderer's Signature : ……………………..….   Date: ………………………………

Technical Guarantees No. CLC_50

Compression Terminal Lug with 13 mm Hole for 50 mm^2 Copper Conductor

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		DIN 46235			
4	Description		Copper Compression Lug with 13mm Hole			
5	Material		E-Cu, DIN 40500/2, F-25			
6	Surface		Tin-plated			
7	Type		Compression, Longitudinally Sealed			
8	Conductor Cross Section	mm^2	50			
9	Conductor Diameter	mm	9			
10	No. of Mech. Compression		3			
11	Dimensions		as Below Drawing			



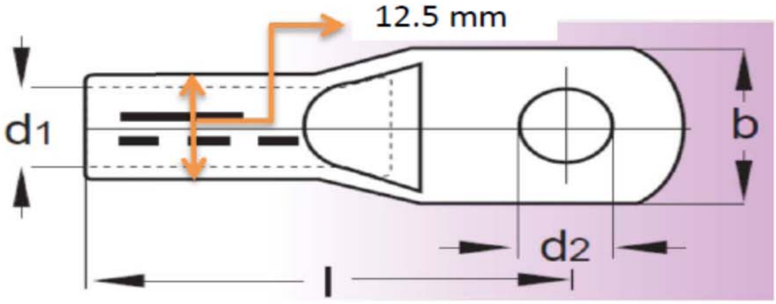
d1= 10 mm
d2= 13 mm
b= 22 mm
l = 52 mm

Tenderer's Signature : ……………………..… Date: ………………………………

Technical Guarantees No. CLC_35

Compression Terminal Lug with 13 mm Hole for 35 mm^2 Copper Conductor

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		DIN 46235			
4	Description		Copper Compression Lug with 13mm Hole			
5	Material		E-Cu, DIN 40500/2, F-25			
6	Surface		Tin-plated			
7	Type		Compression, Longitudinally Sealed			
8	Conductor Cross Section	mm^2	35			
9	Conductor Diameter	mm	7.5			
10	No. of Mech. Compression		2			
11	Dimensions		as Below Drawing			



d1= 8.2 mm
d2= 13 mm
b= 21 mm
l = 42 mm

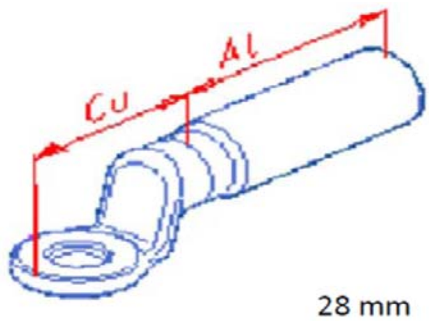
Tenderer's Signature : ……………………..…. Date: ………………………………

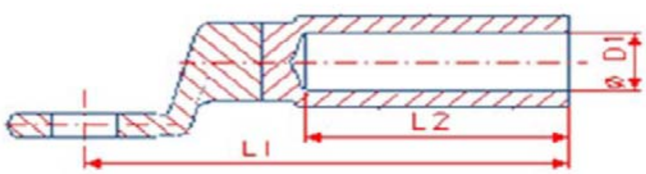
Technical Guarantees No. CLAC_185

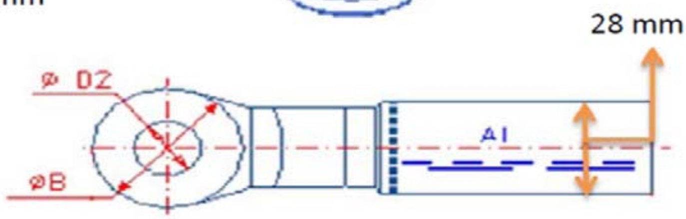
Aluminium / Copper Compression Terminal Lug with 13 mm Hole for 185 mm^2 Aluminium Conductor

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Standards					
4	**Material**					
	a) Barrel Part		Aluminium of Purity Equal to or Greater than 99.5%			
	b) Palm Part		Electrolytic Copper			
	c) Barrel		Capped and Filled with Grease to Avoid Oxidation			
5	Surface		Uncoated			
6	Type		Resistant to high temperature Connection Between CU and AL sides and the Barrel Compression, Longitudinally Sealed			
7	Conductor Cross Section	mm^2	185			
8	Conductor Diameter	mm	17.5			
9	Dimensions		as below Drawing			

D1= 18.5 mm
D2= 13 mm
B = 25 mm
L1= 91 mm
L2= 70 mm







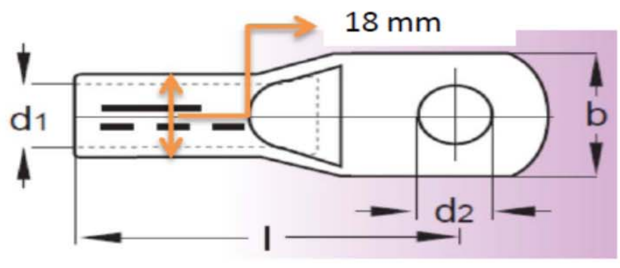
Tenderer's Signature : ………………………..… Date: ………………………………

Technical Guarantees No. CLA_70

Compression Terminal Lug with 13 mm Hole for 70 mm2 Aluminium Conductor

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Reference Manufacturing Standards		DIN 46329			
4	Description		Aluminium Compression Lug with 13mm Hole			
5	Material		Al 99.5			
6	Surface		Tin-plated			
7	Type		Compression, Longitudinally Sealed			
8	Conductor Cross Section	mm^2	70			
9	Conductor Diameter	mm	10.5			
10	Barrel		Capped and Filled with Grease to Avoid Oxidation			
11	No. of Mech. Compression		6			
12	Dimensions		as Below Drawing			

d1= 11.2 mm
d2= 13 mm
b= 28 mm
l = 88 mm

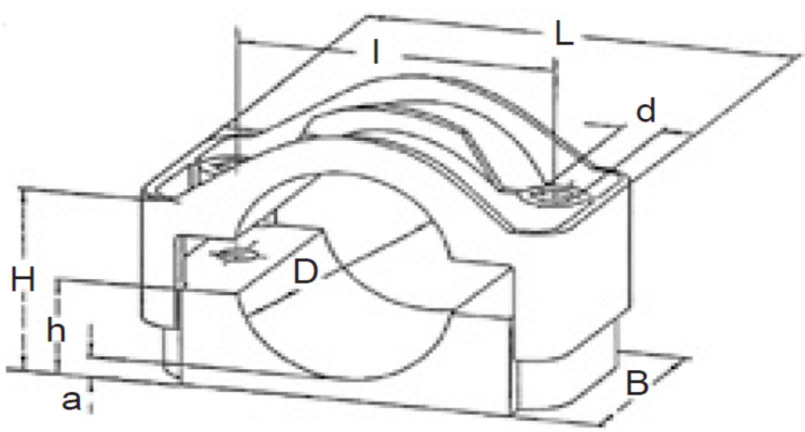


Tenderer's Signature : ……………………..…   Date: ……………………………….

Technical Guarantees No. CC_52

Clamp to Holder the Cable (Single , Large)

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Description		Cable Clamps			
4	Cable Outer Diameter	mm	36-52			
5	No. of Cables		1			
6	Material		Polyamide, Glass Fiber Reinforced			
7	Tensile strength	N/mm^2	120			
8	Flexural Strength	N/mm^2	200			
9	Thermal Expansion		0.02% / 1°C			
10	Fire Resistance		UL 94 , VDE 0304, Part 3			
11	Accessories		2 Hot Galvanized Bolt with nuts and washers			
12	Dimensions		As Drawing			



DIMENSIONS mm				
L	B	l	Ød	H
108	60	75	12.4	40 - 57

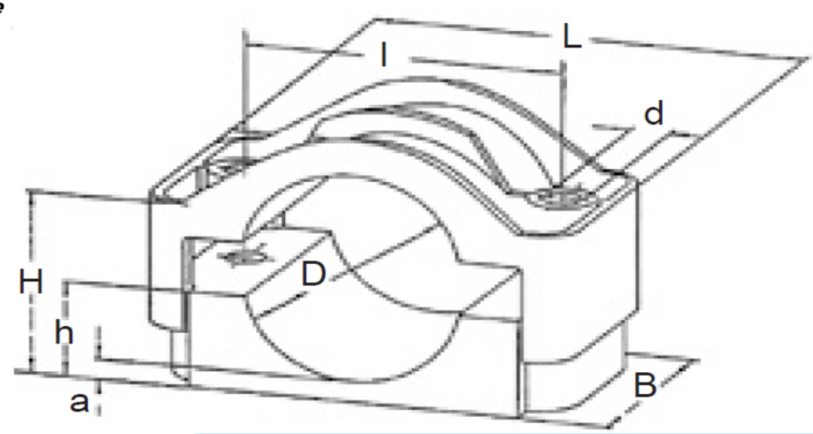
Tenderer's Signature : ……………………..….   Date: ………………………………

Technical Guarantees No. CC_51

Clamp to Holder the Cable (Single , Small)

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer					
2	Country of Origin					
3	Description		Cable Clamps			
4	Cable Outer Diameter	mm	26-38			
5	No. of Cables		1			
6	Material		Polyamide, Glass Fiber Reinforced			
7	Tensile strength	N/mm^2	120			
8	Flexural Strength	N/mm^2	200			
9	Thermal Expansion		0.02% / 1°C			
10	Fire Resistance		UL 94 , VDE 0304, Part 3			
11	Accessories		2 Hot Galvanized Bolt with nuts and washers			
12	Dimensions		As Drawing			

Including 2 Hot Galvanized Bolts for fixing with the Plate



DIMENSIONS mm				
L	**B**	**l**	**Ød**	**H**
92	60	60	12.4	32 - 44

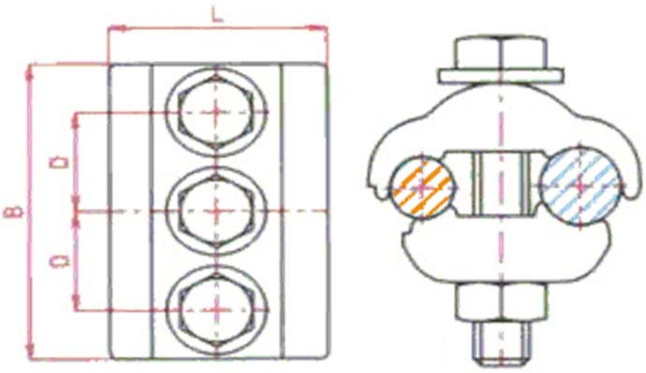
Tenderer's Signature : ………………………..   Date: ………………………………

Technical Guarantees No. BPGC_185

Bimetallic Parallel Groove Clamp 35-185 mm2 AL /35-185 mm2 CU

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer		Kfar Menachm or Equivalent			
2	Country of Origin					
3	Reference Standards					
4	**Material**					
	a) Body		High strength, corrosion-resistant, aluminium alloy (AlMgSi1) with hot forged bimetallic sheet, for copper tap-off			
	b) Bolts		Steel 8.8, DIN 933, hot-dip galvanized			
	c) Nuts		Steel 8, DIN 934 hot-dip galvanized			
	d) Conical Washers		According to DIN 6796 corrosion-protected			
5	ACSR or Aluminium Conductor Diameter	mm	7.5-17.5			
6	Copper Conductor Diameter	mm	7.5-17.5			
7	Bolts (No. x Size x Length)		3 x M10 x 60			
8	Bolt Torque Moments		46Nm			
9	Metal Stamping		Required including manufacturer Logo and the Size of the Clamp			

L = 97mm
D = 33 mm
B = 58 mm

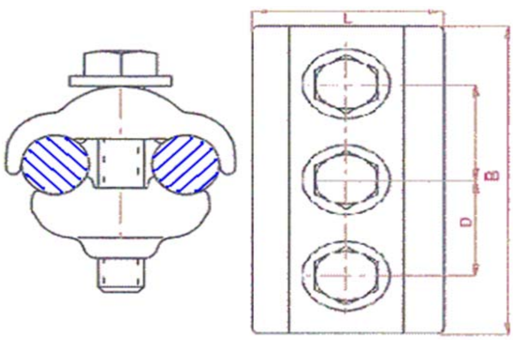


Tenderer's Signature : ……………………..…   Date: ………………………………

Technical Guarantees No. APGC_300

Aluminium Parallel Groove Clamp 35-300 mm2 / 35-300 mm2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer		Kfar Menachem or Equivalent			
2	Country of Origin					
3	Reference Manufacturing Standards		DIN 48072-1			
4	**Material**					
	a) Body		High strength, corrosion-resistant, aluminium alloy (AlMgSi1)			
	b) Bolts		DIN 933, steel 8.8, hot-dip galvanized			
	c) Nuts		DIN 934, steel hot−dip galvanized, pressed into lower clamp body			
	d) Washers (6 each)		DIN 6796, corrosion-protected			
5	Conductor Cross Sectional Area	mm^2	35-240 AL and 35/6-265/35 ACSR			
6	Conductor Diameter	mm	7.5-21.6			
7	Bolts (No. x Size x Length)		3 x M10 x 70			
8	Bolt Torque Moments		46Nm			
9	Metal Stamping		Required including manufacturer Logo and the Size of the Clamp			
10	Total Weight	gr	520			



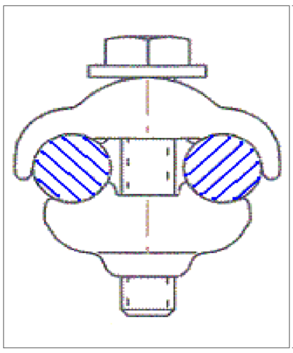
L = 67 mm
D = 35 mm
B = 105 mm

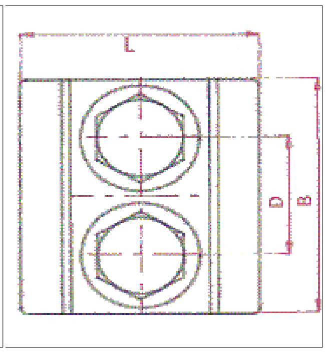
Tenderer's Signature : ……………………..…. Date: ………………………………

Technical Guarantees No. APGC_70

Aluminium Parallel Groove Clamp 16-70 mm2 / 16-70 mm2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer		Kfar Menachem or Equivalent			
2	Country of Origin					
3	Reference Manufacturing Standards		DIN 48072-1			
4	**Material**					
	a) Body		High strength, corrosion-resistant, aluminium alloy (AlMgSi1)			
	b) Bolts		DIN 933, steel 8.8, hot-dip galvanized			
	c) Nuts		DIN 934, steel hot−dip galvanized, pressed into lower clamp body			
	d) Washers (6 each)		DIN 6796, corrosion-protected			
5	Conductor Cross Sectional Area	mm^2	16-120 AL , 16/2.5- 70/12 ACSR			
6	Conductor Diameter	mm	5.1-11.7			
7	Bolts (No. x Size x Length)		2 x M8 x 40			
8	Bolt Torque Moments		23Nm			
9	Metal Stamping		Required including manufacturer Logo and the Size of the Clamp			
10	Total Weight	gr	90			





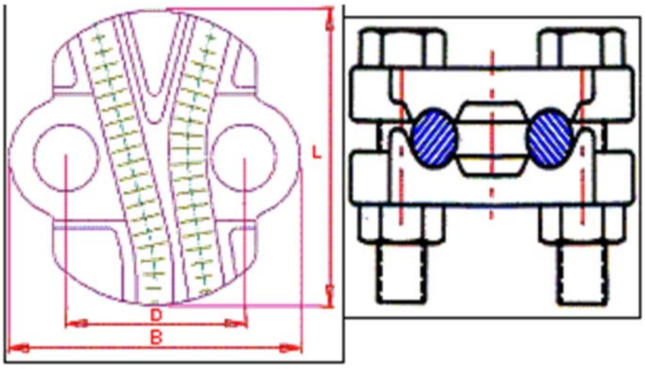
L = 36 mm
D = 20 mm
B = 40 mm

Tenderer’s Signature : ……………………..… Date: ………………………………

Technical Guarantees No. ADEC_70

Aluminium Dead End Clamp , 50/70 mm^2

No	Description	Unit	Requirements	Offered Data	Notes, Remarks , Ref to Documentation	Evaluation Committee Comments
1	Name of Manufacturer		Kfar Menachem or Equivalent			
2	Country of Origin					
3	Standards					
4	**Material**					
	a) Body		High strength, corrosion-resistant, aluminium alloy (AlMgSi1)			
	b) Bolts		Steel, 8.8,DIN 933 hot-dip galvanized			
	c) Nuts		Steel, 8, DIN 934 hot-dip galvanized			
5	Conductor Cross Sectional Area	mm^2	50-70 AL and 50/8 ACSR			
6	Conductor Diameter	mm	9-11.7			
7	Bolts (No. x Size x Length)		2 x M10 x 35			
8	Bolt Torque Moments		46Nm			
9	Metal Stamping		Required including manufacturer Logo and the Size of the Clamp			
10	Total Weight	gr	200			



L = 60 mm
D = 42 mm
B = 64 mm

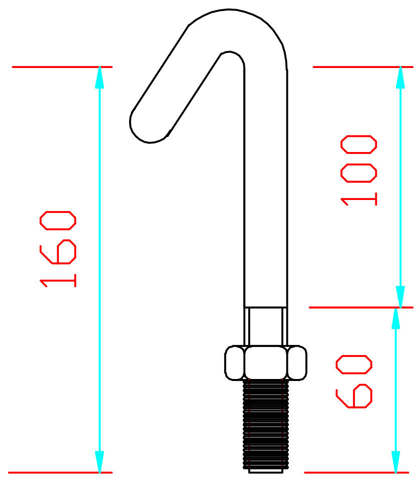
Tenderer's Signature : ……………………..…   Date: ………………………………

A-3

-UNC-V-Bolt-

Using : For fixing Outdoor L.V switch box and Anti-climbing arm K113/8 on lattice steel poles
Description

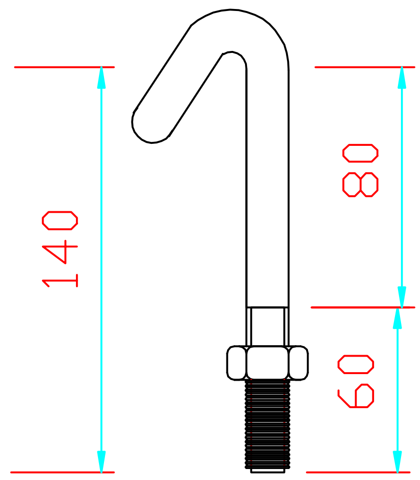
1-UNC-V-Bolt 1/2"*160mm. with nut, Spring wesher and Ring washer.



A-2

-UNC-V-Bolt-

Using : For fixing Outdoor L.V switch box and Anti-climbing arm K113/8 on lattice steel poles
Description

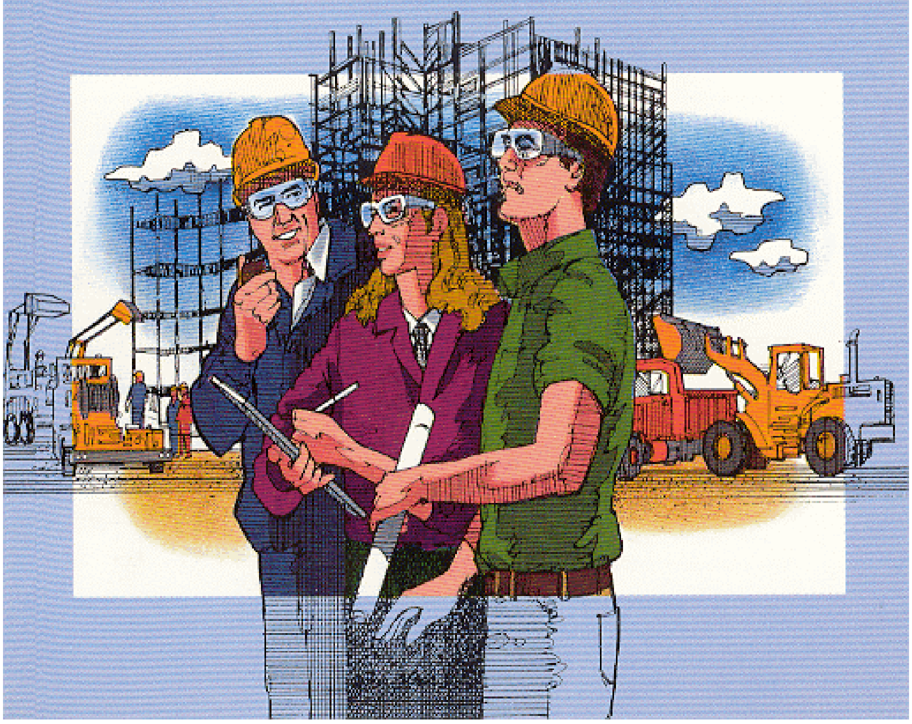
1-UNC-V-Bolt 1/2"*140mm. with nut, Spring wesher and Ring washer.	

PART 2 – SAFETY GUIDELINES:

SAFETY AND HEALTH IN CONSTRUCTION: AN ILO CODE OF PRACTICE
SAFETY, HEALTH AND WELFARE ON CONSTRUCTION SITES: A TRAINING MANUAL

Safety and health in construction

International Labour Office Geneva



The International Programme for the Improvement of Working Conditions and Environment (PIACT) was launched by the International Labour Organisation in 1976 at the request of the International Labour Conference and after extensive consultations with member States.
PIACT is designed to promote or support action by member States to set and attain definite objectives aiming at "making work more human". The Programme is thus concerned with improving the quality of working life in all its aspects: for example, the prevention of occupational accidents and diseases, a wider application of the principles of ergonomics, the arrangement of working time, the improvement of the content and organisation of work and of conditions of work in general, a greater concern for the human element in the transfer of technology. To achieve these aims, PIACT makes use of and co-ordinates the traditional means of ILO action, including:

- the preparation and revision of international labour standards;
- operational activities, including the dispatch of multidisciplinary teams to assist member States on request;
- tripartite meetings between representatives of governments, employers and workers, including industrial committees to study the problems facing major industries, regional meetings and meetings of experts;
- action-oriented studies and research; and
- clearing-house activities, especially through the International Occupational Safety and Health Information Centre (CIS) and the Clearing-house for the Dissemination of Information on Conditions of Work.

This publication is the outcome of a PIACT project.

The cover design is based on an original drawing by Ms. Noha Karanouh.

Safety and health in construction

An ILO code of practice

Safety and health in construction

International Labour Office Geneva

First published 1992

ILO

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Preface

In accordance with the decision taken by the Governing Body of the ILO at its 244th Session (November 1989), a meeting of experts was convened in Geneva from 12 to 19 March 1991 to draw up a code of practice on safety and health in construction. The meeting was composed of 21 experts, seven appointed following consultations with governments, seven following consultations with the Employers' group and seven following consultations with the Workers' group of the Governing Body.[1] After

[1] *Experts appointed following consultations with governments:*

Mr. J.-P. Clément, Ministry of Labour, Employment and Vocational Training, Paris (France).
Mr. D. G. Kibara, Ministry of Labour, Nairobi (Kenya).
Mr. W. Kukulski, Institute for Building Technology, Warsaw (Poland).
Mr. S. S. Msangi, Ministry of Labour and Youth Development, Dar es Salaam (United Republic of Tanzania).
Ms. M. H. Negrão, Ministry of Labour and Social Welfare, São Paulo (Brazil).
Mr. A. Sanchez, Director, Department of Labour and Employment, Manila (Philippines).
Mr. H. Wong Kok Choy, Ministry of Labour, Singapore (Singapore).

Experts appointed following consultations with the Employers' group:

Mr. J. A. DeVries, Canadian Construction Association, Ottawa, Ontario (Canada).
Mr. H. Georget, National Union for Small and Medium Industrial Enterprises in the Niger (SYNAPEMEIN), Niamey (Niger).
Mr. W. M. Nasr, Fana Investment and Trading Inc., Beirut (Lebanon).
Dr. E. J. Ríos Márquez, Uruguayan Construction League, Montevideo (Uruguay).
Mr. J. Skau-Jacobsen, Associated General Contractors of Norway, Oslo (Norway), replaced in the second part of the meeting by Mr. G. Berglund, Swedish Construction Federation, Stockholm (Sweden).
Mr. P. M. Walsh, National Authority for Health and Safety, G T Crampton Ltd., Dublin (Ireland).
Mr. Wan Hock Leong, Sato Kogyo Co. Ltd., Kuala Lumpur (Malaysia).

Experts appointed following consultations with the Workers' group:

Mr. T. Escorial Clemente, State Federation for Wood, Construction and Related Industries (FEMCAUGT), Madrid (Spain).
Mr. B. Laguna, Workers' Federation for the Construction Industry in Venezuela (FETRACONSTRUCCION), Caracas (Venezuela).
Mr. J. Martins, Union for Technicians and Employees in Civil Engineering, Public Works and Related Industries (SETACOOP), Lisbon (Portugal).
Mr. A. Russ, New Zealand Building Trades Union, Wellington (New Zealand).
Mr. M. F. Sissoko, National Workers' Union of Mali (UNTM), Bamako (Mali).
Mr. N. Tobiassen, Trade Safety Council Workers' Secretariat, Copenhagen (Denmark).
Mr. A. Zverev, Building Workers' Federation, c/o General Confederation of Soviet Trade Unions, Moscow (USSR).

International governmental and non-governmental organisations represented:

World Health Organization.
Commission of European Communities.
International Organization for Standardization.
International Social Security Association.
International Organisation of Employers.
International Confederation of Free Trade Unions.
World Confederation of Labour.
World Federation of Trade Unions.
International Federation of Building and Woodworkers.

examining and finalising the text, based on a draft prepared by the Office, the experts adopted this code.

The practical recommendations of this code of practice are intended for the use of all those, both in public and the private sectors, who have responsibility for safety and health in construction. The code is not intended to replace national laws or regulations or accepted standards. It has been drawn up with the object of providing guidance to those who may be engaged in the framing of provisions of this kind; in particular, governmental or other public authorities, committees, management or employers' and workers' organisations in this industrial sector.

Local circumstances and technical possibilities will determine how far it is practicable to follow its provisions. Furthermore, these provisions should be read in the context of conditions in the country proposing to use this information, the scale of operation involved and technical facilities.

The text of the code was approved for publication by the Governing Body of the ILO at its 250th Session (May-June 1991).

Trade Unions International of Workers in the Building, Wood and Building Materials Industry.

ILO representatives:

Dr. K. Kogi, Chief, Occupational Safety and Health Branch.
Dr. J. Serbitzer, Safety Engineer, Occupational Safety and Health Branch.

ILO consultants:

Mr. K. C. Gupta, Director-General, Directorate General, Factory Advice Service and Labour Institutes, Bombay (India).

Mr. J. Hinksman, Regional Director of Field Operations, Health and Safety Executive, London (United Kingdom).

Contents

1. General provisions

1.1. Objective

1.1.1. The objective of this code is to provide practical guidance on a legal, administrative, technical and educational framework for safety and health in construction with a view to:

(a) preventing accidents and diseases and harmful effects on the health of workers arising from employment in construction;

(b) ensuring appropriate design and implementation of construction projects;

(c) providing means of analysing from the point of view of safety, health and working conditions, construction processes, activities, technologies and operations, and of taking appropriate measures of planning, control and enforcement.

1.1.2. This code also provides guidance in the implementation of the provisions of the Safety and Health in Construction Convention, 1988 (No. 167), and the Safety and Health in Construction Recommendation, 1988 (No. 175).

1.2. Application

1.2.1. This code applies to:

(a) construction activities which cover:

- (i) building, including excavation and the construction, structural alteration, renovation, repair, maintenance (including cleaning and painting) and demolition of all types of buildings or structures;
- (ii) civil engineering, including excavation and the construction, structural alteration, repair, maintenance and demolition of, for example, airports, docks, harbours, inland waterways, dams, river and avalanche and sea defence works, roads and highways, railways, bridges, tunnels, viaducts and works related to the provision of services such as communications, drainage, sewerage, water and energy supplies;
- (iii) the erection and dismantling of prefabricated buildings and structures, as well as the manufacturing of prefabricated elements on the construction site;

(b) the fabrication and erection of oil rigs and of offshore installations while under construction on shore.

1.2.2. The provisions of this code should be considered as the basic requirements for protecting workers' safety and health.

1.2.3. The provisions of this code should be applied to self-employed persons as may be specified by national laws or regulations.

1.3. Definitions

In this code, the following terms have the meanings hereby assigned to them:

Adequate, appropriate or suitable are used to describe qualitatively or quantitatively the means or method used to protect the worker.

Bearer: see *putlog.*

Brace: A structural member that holds one point in a fixed position with respect to another point; bracing is a system of structural members designed to prevent distortion of a structure.

By hand: The work is done without the help of a mechanised tool.

Cartridge-operated: A device in which an explosive drives a projectile such as a nail or a stud into materials; they are of three types:

(i) *"high-velocity type",* in which the projectile is driven directly by the gases from the explosive charge;

(ii) *"low-velocity piston type",* in which the gases from the explosive charge drive a piston which propels the projectile;

(iii) *"hammer-operated low-velocity piston type",* in which the piston is driven by a hammer blow in addition to the gases from the explosive charge.

Client: Any natural or legal person for whom a project is carried out.

Code of practice: A document offering practical guidance on the policy and standard setting in occupational safety and health for use by governments, employers, workers and any other persons involved in the construction process in order to promote safety and health at the national level and at the level of the enterprise.

Competent authority: A minister, government department, or other public authority having the power to issue regulations, orders or other instructions having the force of law.

Competent person: A person possessing adequate qualifications, such as suitable training and sufficient knowledge, experience and skill for the safe performance of the specific work. The competent authorities may define appropriate criteria for the designation of such persons and may determine the duties to be assigned to them.

Construction: Those activities as defined in paragraph 1.2.1.

Construction site: Any site at which any of the processes or operations described in paragraph 1.2.1. are carried on.

Danger: Danger of accident or injury to health.

Employer:

(i) Any physical or legal person who employs one or more workers on a construction site; and

(ii) as the context requires, the principal contractor, the contractor or the subcontractor.

Guard-rail: An adequately secured rail erected along an exposed edge to prevent persons from falling.

Hazard: Danger or potential danger.

Hoist: A machine which lifts materials or persons by means of a platform which runs on guides.

Ledger: A scaffold member which extends longitudinally and horizontally parallel to the face of a structure, at right angles to the putlogs and which supports the putlogs, forms a tie between the posts, and becomes a part of the scaffold bracing; ledgers which do not support putlogs are also called stringers.

Lifting appliance: Any stationary or mobile appliance used for raising or lowering persons or loads.

Lifting gear: Any gear or tackle by means of which a load can be attached to a lifting appliance but which does not form an integral part of the appliance or load.

Means of access or egress: Passageways, corridors, stairs, platforms, ladders and any other means to be used by persons for normally entering or leaving the workplace or for escaping in case of danger.

Putlog or *bearer:* A scaffold member upon which the platform rests. In a single pole scaffold the outer end of the putlog rests on a ledger and the inner end rests in the wall; in an independent pole scaffold each end of the putlog rests on a ledger; in an independent pole scaffold a putlog is known as a bearer.

Raker: An inclined load-bearing tube or pole.

Safety extra-low voltage: A nominal voltage not exceeding 42 V between conductors, or, in the case of phase circuits, not exceeding 24 V between conductors and neutral, the no-load voltage of the circuit not exceeding 50 V and 29 V respectively.

Scaffold: Any temporary structure, fixed, suspended or mobile, and its supporting components which is used for supporting workers and materials or to gain access to any such structure, and which is not a "lifting appliance" as defined above.

Sound or good construction: Construction conforming to any relevant standards issued by a national standardising institution or other body recognised by the competent authority, or to generally accepted international engineering practices or other technical standards.

Sound or good material: Material of a quality conforming to any relevant standards issued by a national standardising institution or other body recognised by the competent authority or to generally accepted international engineering practices or other technical standards.

Standard (upright or post): In relation to a scaffold, a vertical or near vertical tube which bears the weight of a scaffold and its load and includes a through tie or a reveal tie or a bore tie; a through tie is a tie assembly through a window or other opening in a wall; a reveal tie is an assembly of a reveal tube with wedges or screwed fittings or pads fixed between the opposing faces of an opening in a wall together with the tie tube.

Toe-board: A barrier placed along the edge of a scaffold platform, runway, etc., and secured there to guard against the slipping of persons or the falling of material.

Transom: A tube spanning across ledger to form the support for boards forming the working platform or to connect the outer standards to the inner standards.

Worker: Any person engaged in construction.

Workplace: All places where workers need to be or to go by reason of their work and which are under the control of an employer as defined in "employer".

2. General duties

2.1. General duties of competent authorities

2.1.1. The competent authorities should, on the basis of an assessment of the safety and health hazards involved and in consultation with the most representative organisation of employers and workers, adopt and maintain in force national laws or regulations to ensure the safety and health of workers employed in construction projects and to protect persons at, or in the vicinity of, a construction site from all risks which may arise from such site.

2.1.2. The national laws and regulations adopted in pursuance of paragraph 2.1.1 above should provide for their practical application through technical standards or codes of practice, or by other appropriate methods consistent with national conditions and practices.

2.1.3. In giving effect to paragraphs 2.1.1 and 2.1.2 above, each competent authority should have due regard to the relevant standards adopted by recognised international organisations in the field of standardisation.

2.1.4. The competent authority should provide appropriate inspection services to enforce or administer the application of the provisions of the national laws and regulations and provide these services with the resources necessary for the accomplishment of their task, or satisfy itself that appropriate inspection is carried out.

2.1.5. The measures to be taken to ensure that there is organised co-operation between employers and workers to promote safety and health at construction sites should be prescribed by national laws or regulations or by the competent authority. Such measures should include:

(a) the establishment of safety and health committees representative of employers and workers with such powers and duties as may be prescribed;

(b) the election or appointment of workers' safety delegates with such powers and duties as may be prescribed;

(c) the appointment by the employer of suitably qualified and experienced persons to promote safety and health;

(d) the training of safety delegates and safety and health committee members.

2.1.6. National laws or regulations should provide for the notification by the client to the competent authority of construction sites of such size, duration or characteristics in accordance with such time schedule as may be prescribed.

2.1.7. National laws or regulations should provide for general duties of clients, designers, engineers and architects to take into consideration the safety and health aspects in the designing of buildings, structures or construction projects.

2.2. General duties of employers

2.2.1. Employers should provide adequate means and organisation and should establish a suitable programme on the safety and health of workers consistent with national laws and regulations and should comply with the prescribed safety and health measures at the workplace.

2.2.2. Employers should so provide and maintain workplaces, plant, equipment, tools and machinery and so organise construction work that as far as is reasonably practicable there is no risk of accident or injury to health of workers. In particular, construction work should be so planned, prepared and undertaken that:

(a) dangers liable to arise at the workplace are prevented as soon as possible;

(b) excessively or unnecessarily strenuous work positions and movements are avoided;

(c) organisation of work takes into account the safety and health of workers;

(d) materials and products are used which are suitable from a safety and health point of view;

(e) working methods are employed which protect workers against the harmful effects of chemical, physical and biological agents.

2.2.3. Employers should establish committees with representatives of workers and management or make other suitable arrangement consistent with national laws and regulations for the participation of workers in ensuring safe working conditions.

2.2.4. Employers should take all appropriate precautions to protect persons present at, or in the vicinity of, a construction site from all risks which may arise from such site.

2.2.5. Employers should arrange for regular safety inspections by competent persons at suitable intervals of all buildings, plant, equipment, tools, machinery, workplaces and systems of work under the control of the employer at construction sites in accordance with national laws, regulations, standards or codes of practice. As appropriate, the competent person should examine and test by type or individually to ascertain the safety of construction machinery and equipment.

2.2.6. When acquiring plant, equipment or machinery, employers should ensure that it takes account of ergonomic principles in its design and conforms to relevant national laws, regulations, standards or codes of practice and, if there are none, that it is so designed or protected that it can be operated safely and without risk to health.

2.2.7. Employers should provide such supervision as will ensure that workers perform their work with due regard to their safety and health.

2.2.8. Employers should assign workers only to employment for which they are suited by their age, physique, state of health and skill.

2.2.9. Employers should satisfy themselves that all workers are suitably instructed in the hazards connected with their work and environment and trained in the precautions necessary to avoid accidents and injury to health.

2.2.10. Employers should take all practicable steps to ensure that workers are made aware of the relevant national or local laws, regulations, standards, codes of practice, instructions and advice relating to prevention of accidents and injuries to health.

2.2.11. Buildings, plant, equipment, tools, machinery or workplaces in which a dangerous defect has been found should not be used until the defect has been remedied.

2.2.12. Where there is an imminent danger to the safety of workers, the employer should take immediate steps to stop the operation and evacuate workers as appropriate.

2.2.13. On dispersed sites and where small groups of workers operate in isolation, employers should establish a checking system by which it can be ascertained that all the members of a shift, including operators of mobile equipment, have returned to the camp or base at the close of work.

2.2.14. Employers should provide appropriate first aid, training and welfare facilities to workers and, whenever collective measures are not feasible or are insufficient, provide and maintain personal protective equipment and clothing. Employers should also ensure access for workers to occupational health services.

2.3. General duties of self-employed persons

2.3.1. Self-employed persons should comply with the prescribed safety and health measures at the workplace according to national laws or regulations.

2.4. Co-operation and co-ordination

2.4.1. Whenever two or more employers undertake activities at one construction site, they should co-operate with one another as well as with the client or client's representative and with other persons participating in the construction work being undertaken in the application of the prescribed safety and health measures.

2.4.2. Whenever two or more employers undertake activities simultaneously or successively at one construction site, the principal contractor, or other person or body with actual control over or primary responsibility for overall construction site activities, should be responsible for planning and co-ordinating safety and health measures and, in so far as is compatible with national laws and regulations, for ensuring compliance with such measures.

2.4.3. In so far as is compatible with national laws and regulations, where the principal contractor, or other person or body with actual control over or primary responsibility for overall construction site activities, is not present at the site, they should nominate a competent person or body at the site with the authority and means necessary to ensure on their behalf co-ordination and compliance with safety and health measures.

2.4.4. Employers should remain responsible for the application of the safety and health measures in respect of the workers placed under their authority.

2.4.5. Employers and self-employed persons undertaking activities simultaneously at a construction site should co-operate fully in the application of safety and health measures.

2.4.6. Employers and designers should liaise effectively on factors affecting safety and health.

2.5. General rights and duties of workers

2.5.1. Workers should have the right and the duty at any workplace to participate in ensuring safe working conditions to the extent of their control over the equipment and methods of work and to express views on working procedures adopted as they may affect safety and health.

2.5.2. Workers should have the right to obtain proper information from the employer regarding safety and health risks and safety and health measures related to the work processes. This information should be presented in forms and languages which the workers easily understand.

2.5.3. Workers should have the right to remove themselves from danger when they have good reason to believe that there is an imminent and serious danger to their safety or health. They should have the duty so to inform their supervisor immediately.

2.5.4. In accordance with national legislation, workers should:

(a) co-operate as closely as possible with their employer in the application of the prescribed safety and health measures;

(b) take reasonable care for their own safety and health and that of other persons who may be affected by their acts or omissions at work;

(c) use and take care of personal protective equipment, protective clothing and facilities placed at their disposal and not misuse anything provided for their own protection or the protection of others;

(d) report forthwith to their immediate supervisor, and to the workers' safety representative where one exists, any situation which they believe could present a risk and which they cannot properly deal with themselves;

(e) comply with the prescribed safety and health measures;

(f) participate in regular safety and health meetings.

2.5.5. Except in an emergency, workers, unless duly authorised, should not interfere with, remove, alter or displace any safety device or other appliance furnished for their protection or the protection of others, or interfere with any method or process adopted with a view to avoiding accidents and injury to health.

2.5.6. Workers should not operate or interfere with plant and equipment that they have not been duly authorised to operate, maintain or use.

2.5.7. Workers should not sleep or rest in dangerous places such as scaffolds, railway tracks, garages, or in the vicinity of fires, dangerous or toxic substances, running machines or vehicles and heavy equipment.

2.6. General duties of designers, engineers, architects

2.6.1. Those concerned with the design and planning of a construction project should receive training in safety and health and should integrate the safety and health of the construction workers into the design and planning process in accordance with national laws, regulations and practice.

2.6.2. Care should be exercised by engineers, architects and other professional persons, not to include anything in the design which would necessitate the use of dangerous structural or other procedures or materials hazardous to health or safety which could be avoided by design modifications or by substitute materials.

2.6.3. Those designing buildings, structures or other construction projects should take into account the safety problems associated with subsequent maintenance and upkeep where maintenance and upkeep would involve special hazards.

2.6.4. Facilities should be included in the design for such work to be performed with the minimum risk.

2.7. General duties of clients

2.7.1 Clients should:

(a) co-ordinate or nominate a competent person to co-ordinate all activities relating to safety and health on their construction projects;

(b) inform all contractors on the project of special risks to health and safety of which the clients are or should be aware;

(c) require those submitting tenders to make provision for the cost of safety and health measures during the construction process.

2.7.2. In estimating the periods for completion of work stages and overall completion of the project, clients should take account of safety and health requirements during the construction process.

3. Safety of workplaces

3.1. General provisions

3.1.1. All appropriate precautions should be taken:

(a) to ensure that all workplaces are safe and without risk of injury to the safety and health of workers;

(b) to protect persons present at or in the vicinity of a construction site from all risks which may arise from such site.

3.1.2. All openings and other areas likely to pose danger to workers should be clearly indicated.

3.2. Means of access and egress

3.2.1. Adequate and safe means of access to and egress from all workplaces should be provided, indicated where appropriate and maintained in a safe condition.

3.3. Housekeeping

3.3.1. A suitable housekeeping programme should be established and continuously implemented on each construction site which should include provisions for:

(a) the proper storage of materials and equipment;

(b) the removal of scrap, waste and debris at appropriate intervals.

3.3.2. Loose materials which are not required for use should not be placed or allowed to accumulate on the site so as to obstruct means of access to and egress from workplaces and passageways.

3.3.3. Workplaces and passageways that are slippery owing to ice, snow, oil or other causes should be cleaned up or strewn with sand, sawdust, ash or the like.

3.4. Precautions against the fall of materials and persons, and collapse of structures

3.4.1. Adequate precautions should be taken such as the provision of fencing, look-out men or barriers to protect any person who might be injured by the fall of materials, or tools or equipment being raised or lowered.

3.4.2. Where necessary to prevent danger, guys, stays or supports should be used or other effective precautions should be taken to prevent the collapse of structures or parts of structures that are being erected, maintained, repaired, dismantled or demolished.

3.4.3. All openings through which workers are liable to fall should be kept effectively covered or fenced and indicated in the most appropriate manner.

3.4.4. As far as practicable, guard-rails and toe-boards in accordance with national laws and regulations should be provided to protect workers from falling from elevated work places. Wherever the guard-rails and toe-boards cannot be provided:

(a) adequate safety nets or safety sheets should be erected and maintained; or

(b) adequate safety harnesses should be provided and used.

3.5. Prevention of unauthorised entry

3.5.1. Construction sites in built-up areas and alongside vehicular and pedestrian traffic routes should be fenced to prevent the entry of unauthorised persons.

3.5.2. Visitors should not be allowed access to construction sites unless accompanied by or authorised by a competent person and provided with the appropriate protective equipment.

3.6. Fire prevention and fire fighting

3.6.1. All appropriate measures should be taken by the employer to:

(a) avoid the risk of fire;

(b) control quickly and efficiently any outbreak of fire;

(c) bring about a quick and safe evacuation of persons.

3.6.2. Sufficient and suitable storage should be provided for flammable liquids, solids and gases.

3.6.3. Secure storage areas should be provided for flammable liquids, solids and gases such as liquefied petroleum gas cylinders, paints and other such materials in order to deter trespassers.

3.6.4. Smoking should be prohibited and "No Smoking" notices be prominently displayed in all places containing readily combustible or flammable materials.

3.6.5. In confined spaces and other places in which flammable gases, vapours or dusts can cause danger:

(a) only suitably protected electrical installations and equipment, including portable lamps, should be used;

(b) there should be no naked flames or similar means of ignition;

(c) there should be notices prohibiting smoking;

(d) oily rags, waste and clothes or other substances liable to spontaneous ignition should be removed without delay to a safe place;

(e) adequate ventilation should be provided.

3.6.6. Combustible materials such as packing materials, sawdust, greasy/oily waste and scrap wood or plastics should not be allowed to accumulate in workplaces but should be kept in closed metal containers in a safe place.

3.6.7. Regular inspections should be made of places where there are fire risks. These include the vicinity of heating appliances, electrical installations and conductors, stores of flammable and combustible materials, hot welding and cutting operations.

3.6.8. Welding, flame cutting and other hot work should only be done on the orders of a competent supervisor after appropriate precautions, as required, are taken to reduce the risk of fire.

3.6.9. Places where workers are employed should, if necessary to prevent the danger of fire, be provided as far as practicable with:

(a) suitable and sufficient fire-extinguishing equipment, which should be easily visible and accessible;

(b) an adequate water supply at ample pressure.

3.6.10. Fire-extinguishing equipment should be properly maintained and inspected at suitable intervals by a competent person. Access to fire-extinguishing equipment such as hydrants, portable extinguishers and connections for hoses should be kept clear at all times.

3.6.11. All supervisors and a sufficient number of workers should be trained in the use of fire-extinguishing equipment, so that adequate trained personnel are readily available during all working periods.

3.6.12. Where necessary to guard against danger, workers should be suitably trained in the action to be taken in the event of fire, including the use of means of escape.

3.6.13. Where appropriate, suitable visual signs should be provided to indicate clearly the direction of escape in case of fire.

3.6.14. Means of escape should be kept clear at all times. Escape routes should be frequently inspected particularly in high structures and where access is restricted, as in tunnel workings.

3.6.15. Sufficient and suitable means to give warning in case of fire should be provided where this is necessary to prevent danger. Such warning should be clearly audible in all parts of the site where persons are liable to work. There should be an effective evacuation plan so that all persons are evacuated speedily without panic and accounted for and all plant and processes shut down.

3.6.16. Notices should be posted at conspicuous places indicating:

(a) the nearest fire alarm;

(b) the telephone number and address of the nearest emergency services.

3.7. Lighting

3.7.1. Where natural lighting is not adequate to ensure safe working conditions, adequate and suitable lighting, including portable lighting where appropriate, should be provided at every workplace and any other place on the construction site where a worker may have to pass.

3.7.2. Artificial lighting should, as far as practicable, not produce glare or disturbing shadows.

3.7.3. Where necessary to prevent danger, lamps should be protected by suitable guards against accidental breakage.

3.7.4. The cables of portable electrical lighting equipment should be of adequate size and characteristics for the power requirements and of adequate mechanical strength to withstand severe conditions in construction operations.

4. Scaffolds and ladders

4.1. General provisions

4.1.1. Where work cannot safely be done on or from the ground or from part of a building or other permanent structure, a safe and suitable scaffold should be provided and maintained or other equally safe and suitable provision should be made.

4.1.2. Scaffolds should be provided with safe means of access, such as stairs, ladders or ramps. Ladders should be secured against inadvertent movement.

4.1.3. All scaffolds and ladders should be constructed, erected and used in accordance with national laws and regulations.

4.1.4. Every scaffold should be properly designed, constructed, erected and maintained so as to prevent collapse or accidental displacement when properly used.

4.1.5. Every scaffold and part thereof should be:

(a) designed so as to prevent hazards for workers during erection and dismantling;

(b) designed so that guard rails and other protective devices, platforms, putlogs, rakers, transoms, ladders, stairs or ramps can be easily put together;

(c) of suitable and sound material and of adequate size and strength for the purpose for which it is to be used and maintained in a proper condition.

4.1.6. The competent authority should establish and enforce laws, regulations or standards covering detailed technical provisions for the design, construction, erection, use, maintenance, dismantling and inspection of the different kinds of scaffolds and ladders used in construction work.

4.2. Materials

4.2.1. Sufficient suitable and sound material should be provided and used in the construction of scaffolds.

4.2.2. Timber used in the construction of scaffolds should be straight-grained, sound, and free from large knots, dry rot, worm holes and other defects likely to affect its strength.

4.2.3. No rope which is defective whether through contact with acids or other corrosive substances or otherwise should be used on scaffolds.

4.2.4. Where necessary, boards and planks used for scaffolds should be protected against splitting.

4.2.5. Ladders, boards and planks used in scaffolds should not be painted so that any defects are visible.

4.2.6. Materials used in the construction of scaffolds should be stored under good conditions and apart from any material unsuitable for scaffolds.

4.2.7. Fastenings on wooden scaffolds should conform with the national laws and regulations or be approved by the competent authority.

4.2.8. All tubes, couplers and fittings used in metal tubular scaffolding should be of a standard and type approved by the competent authority. All couplers and fittings should be free from damage and distortion, and should be maintained in an oiled condition.

4.2.9. Couplers should not cause deformation in tubes. Couplers should be made of drop forged steel or equivalent material.

4.2.10. Tubes should be free from cracks, splits and excessive corrosion and be straight to the eye, and tube ends cut cleanly square with the tube axis.

4.2.11. Alloy and steel tubing should not be intermixed on the same scaffold.

4.3. Design and construction

4.3.1. Scaffolds should be designed for their maximum load and with a safety factor of at least 4, or as prescribed by the competent authority.

4.3.2. Scaffolds should be adequately braced.

4.3.3. Scaffolds which are not designed to be independent should be rigidly connected to the building at suitable vertical and horizontal distances.

4.3.4. A scaffold should never extend above the highest anchorage to an extent which might endanger its stability and strength.

4.3.5. Sufficient putlogs and transoms should remain in position and securely fastened to the ledgers, uprights or standards, as the case may be, to ensure the stability of the scaffold until it is finally dismantled.

4.3.6. All scaffolds and appliances used as supports for working platforms should be of sound construction, have a firm footing, and be adequately strutted and braced to maintain their stability.

4.3.7. Loose bricks, drainpipes, chimney-pots or other unsuitable material should not be used for the construction or support of any part of a scaffold.

4.3.8. When necessary to prevent danger from falling objects, working platforms, gangways and stairways of scaffolds should be provided with overhead screens of adequate strength and dimensions.

4.3.9. Nails should be driven full length, and not driven part way and then bent over, and should not be subject to direct pull.

4.3.10. Scaffolding materials should not be thrown from scaffolds or from heights. Other materials should only be thrown from scaffolds or heights where the landing area has been designated, protected, appropriate notices displayed, and is under the supervision of a person on the landing level.

4.3.11. Metal scaffolds should not be erected in closer proximity than 5 m to overhead electricity transmission lines equipment except in accordance with safety distances laid down by the competent authority or after the electrical transmission line or equipment has been rendered electrically dead.

4.3.12. As far as practicable, every part of a working platform, gangway or stairway of a scaffold from which a person is liable to fall a distance of 2 m or as prescribed in the national laws or regulations, should be provided with guard-rails and toe-boards complying with the relevant national standards.

4.3.13. Platforms on scaffolds should be of adequate dimension, especially in width, for the tasks performed from the scaffold.

4.4. Inspection and maintenance

4.4.1. Scaffolds as prescribed by national laws or regulations should be inspected, and the results recorded by a competent person:

(a) before being taken into use;

(b) at periodic intervals thereafter as prescribed for different types of scaffolds;

(c) after any alteration, interruption in use, exposure to weather or seismic conditions or any other occurrence likely to have affected their strength or stability.

4.4.2. Inspection by the competent person should more particularly ascertain that:

(a) the scaffold is of suitable type and adequate for the job;

(b) materials used in its construction are sound and of sufficient strength;

(c) it is of sound construction and stable;

(d) that the required safeguards are in position.

4.4.3. A scaffold should not be erected, substantially altered or dismantled except by or under the supervision of a competent person.

4.4.4. Every scaffold should be maintained in good and proper condition, and every part should be kept fixed or secured so that no part can be displaced in consequence of normal use.

4.4.5. No scaffold should be partly dismantled and left so that it is capable of being used, unless it continues to be safe for use.

4.5. Lifting appliances on scaffolds

4.5.1. When a lifting appliance is to be used on a scaffold:

(a) the parts of the scaffold should be carefully inspected by a competent person to determine the additional strengthening and other safety measures required;

(b) any movement of the putlogs should be prevented;

(c) if practicable, the uprights should be rigidly connected to a solid part of the building at the place where the lifting appliance is erected.

4.6. Prefabricated scaffolds

4.6.1. In the case of prefabricated scaffold systems the instructions provided by the manufacturers or suppliers should be strictly adhered to. Prefabricated scaffolds should have adequate arrangements for fixing bracing.

4.6.2. Frames of different types should not be intermingled in a single scaffold.

4.7. Use of scaffolds

4.7.1. The employer should provide competent supervision to ensure that all scaffolds are used appropriately and only for the purpose for which they are designed or erected. In transferring heavy loads on or to a scaffold a sudden shock should not be transmitted to the scaffold.

4.7.2. When necessary to prevent danger, loads being hoisted on or to scaffolds should be controlled, e.g. by a hand rope (tag line), so that they cannot strike against the scaffold.

4.7.3. The load on the scaffold should be evenly distributed, as far as practicable, and in any case should be so distributed as to avoid disturbance of the stability of the scaffold.

4.7.4. During the use of a scaffold care should constantly be taken that it is not overloaded or otherwise misused.

4.7.5. Scaffolds should not be used for the storage of material except that required for immediate use.

4.7.6. Workers should not be employed on external scaffolds in weather conditions that threaten their safety.

4.8. Suspended scaffolds

4.8.1. In addition to the requirements for scaffolds in general as regards soundness, stability and protection against the risk of falls, suspended scaffolds should meet the following specific requirements in so far as such requirements are applicable:

(a) platforms should be designed and built with dimensions that are compatible with the stability of the structure as a whole, especially the length;

(b) the number of anchorages should be compatible with the dimensions of the platform;

(c) the safety of workers should be safeguarded by an extra rope having a point of attachment independent of the anchorage arrangements of the scaffold;

(d) the anchorages and other elements of support of the scaffold should be designed and built in such a way as to ensure sufficient strength;

(e) the ropes, winches, pulleys or pulley blocks should be designed, assembled, used and maintained according to the requirements established for lifting gear adapted to the lifting of persons according to national laws and regulations;

(f) before use, the whole structure should be checked by a competent person.

5. Lifting appliances and gear

5.1. General provisions

5.1.1. Employers should have a well-planned safety programme to ensure that all the lifting appliances and lifting gear are selected, installed, examined, tested, maintained, operated and dismantled:

(a) with a view to preventing the occurrence of any accident;

(b) in accordance with the requirements laid down in the national laws, regulations and standards.

5.1.2. Every lifting appliance including its constituent elements, attachments, anchorages and supports should be of good design and construction, sound material and adequate strength for the purpose for which it is used.

5.1.3. Every lifting appliance and every item of lifting gear should be accompanied at the time of purchase with instructions for use and with a test certificate from a competent person or a guarantee of conformity with national laws and regulations concerning:

(a) the maximum safe working load;

(b) safe working loads at different radii if the lifting appliance has a variable radius;

(c) the conditions of use under which the maximum or variable safe working loads can be lifted or lowered.

5.1.4. Every lifting appliance and every item of lifting gear having a single safe working load should be clearly marked at a conspicuous place with the maximum safe working load in accordance with national laws and regulations.

5.1.5. Every lifting appliance having a variable safe working load should be fitted with a load indicator or other effective means to indicate clearly to the driver each maximum safe working load and the conditions under which it is applicable.

5.1.6. All lifting appliances should be adequately and securely supported; the weight-bearing characteristics of the ground on which the lifting appliance is to operate should be surveyed in advance of use.

Installation

5.1.7. Fixed lifting appliances should be installed:

(a) by competent persons;

(b) so that they cannot be displaced by the load, vibration or other influences;

(c) so that the operator is not exposed to danger from loads, ropes or drums;

(d) so that the operator can either see over the zone of operations or communicate with all loading and unloading points by telephone, signals or other adequate means.

5.1.8. A clearance of at least 60 cm or more, as prescribed by national laws or regulations, should be provided between moving parts or loads of lifting appliances and:

(a) fixed objects in the surrounding environment such as walls and posts; or

(b) electrical conductors.

The clearance from electrical conductors should be more for high voltages in accordance with the requirements of national laws and regulations.

5.1.9. The strength and stability of lifting appliances should take into account the effect of any wind forces to which they may be exposed.

5.1.10. No structural alterations or repairs should be made to any part of a lifting appliance which may affect the safety of the appliance without the permission and supervision of the competent person.

Examinations and tests

5.1.11. Lifting appliances and items of lifting gear, as prescribed by national laws or regulations, should be examined and tested by a competent person:

(a) before being taken into use for the first time;

(b) after erection on a site;

(c) subsequently at intervals prescribed by national laws and regulations;

(d) after any substantial alteration or repair.

5.1.12. The manner in which the examinations and tests are to be carried out by the competent person and the test loads to be applied for different types of lifting appliances and lifting gear should be in accordance with national laws and regulations.

5.1.13. The results of the examinations and tests on lifting appliances and lifting gear should be recorded in prescribed forms and, in conformity with national laws and regulations, made available to the competent authority and to employers and workers or their representatives.

Controls, control devices and cabins

5.1.14. Controls of lifting appliances should be:

(a) designed and constructed as far as possible in accordance with ergonomic principles;

(b) conveniently situated with ample room for operation and an unrestricted view for the operator;

(c) provided, where necessary, with a suitable locking device to prevent accidental movement or displacement;

(d) in a position free from danger from the passage of the load;

(e) clearly marked to show their purpose and method of operation.

5.1.15. Lifting appliances should be equipped with devices that would prevent the load from over-running and prevent the load from moving if power fails.

5.1.16. The operator of every lifting appliance used outdoors except those used for short periods should be provided with:

(a) a safe cabin with full protection from weather and adverse climatic conditions, and designed and constructed in accordance with ergonomic principles;

(b) a clear and unrestricted view of the area of operation;

(c) safe access to and egress from the cabin, including situations where the operator is taken ill.

Operation

5.1.17. No lifting appliance should be operated by a worker who:

(a) is below 18 years of age;

(b) is not medically fit;

(c) has not received appropriate training in accordance with national laws and regulations or is not properly qualified.

5.1.18. A lifting appliance or item of lifting gear should not be loaded beyond its safe working load or loads, except for testing purposes as specified by and under the direction of a competent person.

5.1.19. Where necessary to guard against danger, no lifting appliance should be used without the provision of suitable signalling arrangements or devices.

5.1.20. No person should be raised, lowered or carried by a lifting appliance unless it is constructed, installed and used for that purpose in accordance with national laws and regulations, except in an emergency situation:

(a) in which serious personal injury or fatality may occur;

(b) for which the lifting appliance can safely be used.

5.1.21. Every part of a load in the course of being hoisted or lowered should be adequately suspended or supported so as to prevent danger.

5.1.22. Every platform or receptacle used for hoisting bricks, tiles, slates or other loose material should be so enclosed as to prevent the fall of any of the material.

5.1.23. Loaded wheelbarrows placed directly on a platform for raising or lowering should be taped or secured so that they cannot move and the platform should be enclosed as necessary to prevent the fall of the contents.

5.1.24. In hoisting a barrow, the wheel should not be used as a means of lifting unless efficient steps are taken to prevent the axle from slipping out of the bearings.

5.1.25. To avoid danger, long objects such as girders should be guided with a tag line while being raised or lowered.

5.1.26. Landings should be so designed and arranged that workers are not obliged to lean out into empty space for loading and unloading.

5.1.27. The hoisting of loads at points where there is a regular flow of traffic should be carried out in an enclosed space, or if this is impracticable (e.g. in the case of bulky objects), measures should be taken to hold up or divert the traffic for the time necessary.

5.2. Hoists

5.2.1. Hoist towers should be designed according to national laws and regulations.

5.2.2. Hoist shafts should be enclosed with rigid panels or other adequate fencing:

(a) at ground level on all sides;

(b) at all other levels at all points at which access is provided;

(c) at all points at which persons are liable to be struck by any moving part.

5.2.3. The enclosure of hoist shafts, except at approaches, should extend where practicable at least 2 m above the floor, platform or other place to which access is provided except where a lesser height is sufficient to prevent any person falling down the hoistway and there is no risk of any person coming into contact with any moving part of the hoist, but in no case should the enclosure be less than 1 m in height.

5.2.4. Approaches to hoists should be provided with substantial gates or the like which:

(a) should be gridded for visibility;

(b) should, where practicable, be at least 2 m high;

(c) when closed prevent access to the hoist platform and any moving part of the hoist.

5.2.5. The guides of hoist platforms should offer sufficient resistance to bending and, in the case of jamming by a safety catch, to buckling.

5.2.6. Where necessary to prevent danger, adequate covering should be provided above the top of hoist shafts to prevent material falling down them.

5.2.7. Outdoor hoist towers should be erected on adequately firm foundations, and securely braced, guyed and anchored.

5.2.8. A suitable ladderway should extend from the bottom to the top of outdoor hoist towers, if no other ladderway exists within easy reach.

5.2.9. Hoisting engines should be of ample capacity to control the heaviest load that they will have to move.

5.2.10. Hoists should be provided with devices that stop the hoisting engine as soon as the platform reaches its highest stopping place.

5.2.11. Winches should be so constructed that the brake is applied when the control handle is not held in the operating position.

5.2.12. It should not be possible to set in motion from the platform a hoist which is not designed for the conveyance of persons.

5.2.13. Winches should not be fitted with pawl and ratchet gears on which the pawl must be disengaged before the platform is lowered.

5.2.14. Hoist platforms should be capable of supporting the maximum load that they will have to carry with a safety factor as laid down in national laws and regulations.

5.2.15. Hoist platforms should be equipped with safety gear that will hold the platform with the maximum load if the hoisting rope breaks.

5.2.16. If workers have to enter the cage or go on the platform at landings there should be a locking arrangement preventing the cage or platform from moving while any worker is in or on it.

5.2.17. On sides not used for loading and unloading, hoist platforms should be provided with toe-boards and enclosures of wire mesh or other suitable material to prevent the fall of parts of loads.

5.2.18. Where necessary to prevent danger from falling objects, hoist platforms should be provided with adequate covering.

5.2.19. Counterweights consisting of an assemblage of several parts should be made of specially constructed parts rigidly connected together.

5.2.20. Counterweights should run in guides.

5.2.21. Suitable platforms should be provided at all landings used by workers.

5.2.22. The following notices should be posted up conspicuously and in very legible characters:

(a) on all hoists:

(i) on the platform: the carrying capacity in kilograms or other appropriate standard unit of weight;

(ii) on the hoisting engine: the lifting capacity in kilograms or other appropriate standard unit of weight;

(b) on hoists authorised or certified for the conveyance of persons:

on the platform or cage: the maximum number of persons to be carried at one time;

(c) on hoists for goods only:

on every approach to the hoist and on the platform: prohibition of use by persons.

5.2.23. Hoists intended for the carriage of persons should be provided with a cage so constructed as to prevent any person from falling out or being trapped between the cage and any fixed part of the structure when the cage gate is shut, or from being struck by the counterbalance weight or by articles or materials falling down the hoistway.

5.2.24. On each side in which access is provided the cage should be fitted with a gate fitted with devices which ensure that the gate cannot be opened except when the cage is at a landing and that the gate must be closed before the cage can move away from the landing.

5.2.25. Every gate in the enclosure of the hoist shaft which gives access from a landing place to the cage should be fitted with devices to ensure that the gate cannot be opened except when the cage is at that landing place, and that the cage cannot be moved away from that landing place until the gate is closed.

5.3. Derricks Stiff-leg derricks

5.3.1. Derricks should be erected on a firm base capable of taking the combined weight of the crane structure and maximum rated load.

5.3.2. Suitable devices should be used to prevent masts from lifting out of their seatings.

5.3.3. Electrically operated derricks should be effectively earthed from the sole-plate or framework.

5.3.4. Counterweights should be so arranged that they do not subject the backstays, sleepers or pivots to excessive strain.

5.3.5. When derricks are mounted on wheels:

(a) a rigid member should be used to maintain the correct distance between the wheels;

(b) they should be equipped with struts to prevent them from dropping if a wheel breaks or the derrick is derailed.

5.3.6. The length of a derrick jib should not be altered without consulting the manufacturer.

5.3.7. The jib of a scotch derrick crane should not be erected within the backstays of the crane.

Guy derricks

5.3.8. The restraint of the guy ropes should be ensured by fitting stirrups or anchor plates in concrete foundations.

5.3.9. The mast of guy derricks should be supported by six top guys spaced approximately equally.

5.3.10. The spread of the guys of a guy derrick crane from the mast should be not more than 45 from the horizontal.

5.3.11. Guy ropes of derricks should be equipped with a stretching screw or turnbuckle or other device to regulate the tension.

5.3.12. Gudgeon pins, sheave pins and foot bearings should be lubricated frequently.

5.3.13. When a derrick is not in use, the boom should be anchored to prevent it from swinging.

5.4. Gin poles

5.4.1. Gin poles should:

(a) be straight;

(b) consist of steel or other suitable metal or straight-grained timber free from knots;

(c) be adequately guyed and anchored;

(d) be vertical or raked slightly towards the load;

(e) be of adequate strength for the loads that they will be required to move.

5.4.2. Gin poles should not be spliced and if a gin pole is composed of different elements, they should be assembled in conformity with their intrinsic material strength.

5.4.3. Gin poles should be adequately fastened at their feet to prevent displacement in operation.

5.4.4. Gin poles that are moved from place to place and re-erected should not be taken into use again before the pole, lifting ropes, guys, blocks and other parts have been inspected, and the whole appliance has been tested under load.

5.4.5. When platforms or skips are hoisted by gin poles, adequate precautions should be taken to prevent them from spinning and to provide for proper landing.

5.5. Tower cranes

5.5.1. Where tower cranes have cabs at high level, persons should only be employed as crane operators who are capable and trained to work at heights.

5.5.2. The characteristics of the various machines available should be considered against the operating requirements and the surroundings in which the crane will operate before a particular type of crane is selected.

5.5.3. Care should be taken in the assessment of wind loads both during operations and out of service. Account should also be taken of the effects of high structures on wind forces in the vicinity of the crane.

5.5.4. The ground on which the tower crane stands should have adequate bearing capacity. Account should be taken of seasonal variations in ground conditions.

5.5.5. Bases for tower cranes and tracks for rail-mounted tower cranes should be firm and level. Tower cranes should only operate on gradients within limits specified by the manufacturer. Tower cranes should only be erected at a safe distance from excavations and ditches.

5.5.6. Tower cranes should be sited where there is clear space available for erection, operation and dismantling. As far as possible, cranes should be sited so that loads do not have to be handled over occupied premises, over public thoroughfares, other construction works and railways or near power cables.

5.5.7. Where two or more tower cranes are sited in positions where their jibs could touch any part of the other crane, there should be direct means of communication between them and a distinct warning system operated from the cab so that one driver may alert the other to impending danger.

5.5.8. The manufacturers' instructions on the methods and sequence of erection and dismantling should be followed. The crane should be tested in accordance with national laws or regulations before being taken into use.

5.5.9. The climbing operation of climbing tower cranes should be carried out in accordance with manufacturers' instructions and national laws or regulations. The free-standing height of the tower crane should not extend beyond what is safe and is permissible in the manufacturers' instructions.

5.5.10. When the tower crane is left unattended, loads should be removed from the hook, the hook raised, the power switched off and the boom brought to the horizontal. For longer periods or at times when adverse weather conditions are expected, out of service procedures should be followed. The main jib should be slewed to the side of the tower away from the wind, put into free slew and the crane immobilised.

5.5.11. A windspeed measuring device should be provided at an elevated position on the tower crane with the indicator fitted in the drivers' cab.

5.5.12. Devices should be provided to prevent loads being moved to a point where the corresponding safe working load of the crane would be exceeded. Name boards or other items liable to catch the wind should not be mounted on a tower crane other than in accordance with the manufacturers' instructions.

5.5.13. Tower cranes should not be used for magnet, or demolition ball service, piling operations or other duties which could impose excessive loadings on the crane structure.

5.6. Lifting ropes

5.6.1. Only ropes with a known and adequate safe working capacity should be used as lifting ropes.

5.6.2. Lifting ropes should be installed, maintained and inspected in accordance with manufacturers' instuctions and national laws or regulations.

5.6.3. Repaired steel ropes should not be used on hoists.

5.6.4. Where multiple independent ropes are used, for the purpose of stability, to lift a work platform, each rope should be capable of carrying the load independently.

6. Transport, earth-moving and materials-handling equipment

6.1. General provisions

6.1.1. All vehicles and earth-moving or materials-handling equipment should:

(a) be of good design and construction taking into account as far as possible ergonomic principles particularly with reference to the seat;

(b) be maintained in good working order;

(c) be properly used with due regard to safety and health;

(d) be operated by workers who have received appropriate training in accordance with national laws and regulations.

6.1.2. The drivers and operators of vehicles and earthmoving or materials-handling equipment should be medically fit, trained and tested and of a prescribed minimum age as required by national laws and regulations.

6.1.3. On all construction sites on which vehicles, earthmoving or materials-handling equipment are used:

(a) safe and suitable access ways should be provided for them;

(b) traffic should be so organised and controlled as to secure their safe operation.

6.1.4. Adequate signalling or other control arrangements or devices should be provided to guard against danger from the movement of vehicles and earth-moving or materials-handling equipment. Special safety precautions should be taken for vehicles and equipment when manoeuvring backwards.

6.1.5. The assistance of a trained and authorised signaller should be available when the view of the driver or operator is restricted. The signalling code should be understood by all involved.

6.1.6. When earth-moving or materials-handling equipment is required to operate in dangerous proximity to live electrical conductors, adequate precautions should be taken, such as isolating the electrical supply or erecting overhead barriers of a safe height.

6.1.7. Preventive measures should be taken to avoid the fall of vehicles and earth-moving or materials-handling equipment into excavations or into water.

6.1.8. Vehicles and earth-moving or materials-handling equipment should not travel on bridges, viaducts, embankments, etc., unless it has been established that it is safe to do so.

6.1.9. Where appropriate, earth-moving or materials-handling equipment should be fitted with structures designed to protect the operator from being crushed, should the machine overturn, and from falling material.

6.1.10. All vehicles and earth-moving or materials-handling equipment should be provided with a plate or the like indicating:

(a) the gross laden weight;

(b) the maximum axle weight or, in the case of caterpillar equipment, ground pressure;

(c) the tare weight.

6.1.11. All vehicles and earth-moving or materials-handling equipment should be equipped with:

(a) an electrically operated acoustic signalling device;

(b) searchlights for forward and backward movement;

(c) power and hand brakes;

(d) tail lights;

(e) silencers;

(f) a reversing alarm.

6.1.12. Operators of vehicles and earth-moving or materials-handling equipment should be adequately protected against the weather or accidents due to impact, crushing or contact with a moving load by a cab:

(a) which is designed and constructed in accordance with ergonomic principles and provides full protection from adverse weather conditions;

(b) which is fully enclosed where dusty conditions are likely to be encountered;

(c) which provides the driver with a clear and unrestricted view of the area of operation;

(d) which is equipped with a direction indicator and a rear-view mirror on both sides.

6.1.13. The cab of vehicles and earth-moving or materials-handling equipment should be kept at least 1 m from a face being excavated.

6.1.14. When cranes and shovels are being moved, out of service, the boom should be in the direction of travel and the scoop or bucket should be raised and without load, except when travelling downhill.

6.1.15. On earth-moving and materials-handling equipment, motors, brakes, steering gear, chassis, blades, blade-holders, tracks, wire ropes, sheaves, hydraulic mechanisms, transmissions, bolts and other parts on which safety depends should be inspected daily.

6.1.16. Vehicles and earth-moving or materials-handling equipment should not be left on a slope with the engine running.

6.1.17. Deck plates and steps of vehicles and equipment should be kept free from oil, grease, mud or other slippery substances.

6.1.18. Dredge-type excavators should not be used on earth walls more than 1 m higher than the reach of the excavator if they are installed at the bottom of the wall.

6.1.19. Bucket excavators should not be used at the top or bottom of earth walls with a slope exceeding 60.

6.2. Power shovels, excavators

6.2.1. If necessary to prevent danger during inspection or repair, the jib of power shovels should be equipped with a ladder protected by a guard-rail and toe-board.

6.2.2. Brake pedals for all motions on power shovels should have two independent locking devices.

6.2.3. Power shovels should be equipped with an emergency quick-acting stop device independent of the controls.

6.2.4. Excavators that are equipped with a unit for deep digging should either be so designed that the bucket teeth cannot come nearer the boom than 40 cm or be provided with a reliable stop that prevents this from happening.

6.2.5. Excavators that are designed to be used for lifting with lifting gear should be provided with a plate in the cabin and on the boom bearing a clearly legible and durable text giving the maximum safe working load of the lifting gear fitted.

6.2.6. Excavators that are equipped for use as mobile cranes should:

(a) be examined and tested in accordance with national laws and regulations for mobile cranes;

(b) be fitted with an automatic safe working load indicator, when practicable.

Steam shovels

6.2.7. National laws and regulations concerning the construction, installation, operation, testing and examination of steam boilers should be followed for the boilers of steam shovels.

Internal combustion engine-operated shovels

6.2.8. Internal combustion engine-powered shovels should be:

(a) earthed or otherwise protected against static electricity;

(b) equipped with a fire extinguisher.

Electric shovels

6.2.9. The connection or disconnection of the electric cable supplying power from the transmission line to or from the electric shovel should only be done by competent persons duly authorised.

6.2.10. Electrical connectors and relays on the shovel should be inspected daily if in operation.

Operation of power shovels

6.2.11. The boom should be prevented from accidentally swinging during operation or transport.

6.2.12. The bucket or grab of a power shovel should be prevented from accidentally dipping, tipping or swinging in operation.

6.2.13. Before leaving the shovel the operator should:

(a) disengage the master clutch;

(b) lower the bucket or grab to the ground.

6.2.14. Buckets and grabs of power shovels should be propped to restrict movement while they are being repaired or teeth are being changed.

6.2.15. When an excavator is at work near a wall or similar construction, persons should be prevented from entering the danger zone in which they may be crushed when the machine turns.

6.2.16. Trucks should not be loaded in any place where there may be danger from materials such as rocks falling from buckets passing overhead; where this cannot be avoided, no person should remain in the cab during loading.

6.2.17. Trucks should be stationed at such a distance from the excavator that there is a clearance of at least 60 cm between the truck and the superstructure of the excavator even when it turns.

6.2.18. While work is being done on hydraulically operated buckets the piston should be fully drawn back in the hydraulic cylinder, and where necessary props provided.

6.3. Bulldozers

6.3.1. Before leaving a bulldozer the operator should:

(a) apply the brakes;

(b) lower the blade and ripper;

(c) put the shift lever in neutral.

6.3.2. At the close of work bulldozers should be left on level ground.

6.3.3. When a bulldozer is moving uphill the blade should be kept low.

6.3.4. Bulldozer blades should not be used as brakes except in an emergency.

6.4. Scrapers

6.4.1. The tractor and scrapers should be joined by a safety line when in operation.

6.4.2. Scraper bowls should be propped while blades are being replaced.

6.4.3. Scrapers moving downhill should be left in gear.

6.5. Mobile asphalt layers and finishers

6.5.1. Wooden floors in front of the sprayers should be covered with corrugated sheet metal.

6.5.2. The mixer elevator should be within a wooden or sheet-metal enclosure which should have a window for observation, lubrication and maintenance.

6.5.3. Bitumen scoops should have adequate covers.

6.5.4. The sprayer should be provided with a fire-resisting shield with an observation window.

6.5.5. To avoid fire risks due to foaming:

(a) boilers should have a device that prevents foam from reaching the burners; or

(b) only non-foaming products should be used.

6.5.6. When asphalt plants are working on public roads, an adequate traffic control system should be established and reflective jackets provided for the workers.

6.5.7. A sufficient number of fire extinguishers should be kept in readiness on the worksite, including at least two on the spreader.

6.5.8. Material should only be loaded on to the elevator after the drying drum has warmed up.

6.5.9. No naked flame should be used for ascertaining the level of asphalt in the tank.

6.5.10. Thinners (cut-backs) should not be heated over an open flame.

6.5.11. If a burner flame is extinguished:

(a) the fuel supply should be cut off,

(b) the heating tube should be thoroughly blown out by the fan so as to prevent a backfire.

6.5.12. Inspection openings should not be opened while there is any pressure in the boiler.

6.6. Pavers

6.6.1. Pavers should be equipped with guards that prevent workers from walking under the skip.

6.7. Road rollers

6.7.1. Before a road roller is used the ground should be examined for bearing capacity and general safety, especially at the edges of slopes such as embankments.

6.7.2. Rollers should not move downhill with the engine out of gear.

6.7.3. When a roller is not in use:

(a) the brakes should be applied;

(b) the engine should be put into bottom gear if the roller is facing uphill;

(c) the engine should be put into reverse if the roller is facing downhill;

(d) the contact should be switched off;

(e) the wheels should be blocked.

7. Plant, machinery, equipment and hand tools

7.1. General provisions

7.1.1. Plant, machinery and equipment, including hand tools, both manual and power-driven, should:

(a) be of good design and construction, taking into account, as far as possible, health and safety and ergonomic principles;

(b) be maintained in good working order;

(c) be used only for work for which they have been designed unless a use outside the initial design purpose has been assessed by a competent person who has concluded that such use is safe;

(d) be operated only by workers who have been authorised and given appropriate training;

(e) be provided with protective guards, shields, or other devices as required by national laws or regulations.

7.1.2. Adequate instructions for safe use should be provided where appropriate by the manufacturer or the employer, in a form understood by the user.

7.1.3. As far as practicable, safe operating procedures should be established and used for all plant, machinery and equipment.

7.1.4. Operators of plant, machinery and equipment should not be distracted while work is in progress.

7.1.5. Plant, machinery and equipment should be switched off when not in use and isolated before any major adjustment, cleaning or maintenance is done.

7.1.6. Where trailing cables or hose pipes are used they should be kept as short as practicable and not allowed to create a safety hazard.

7.1.7. All dangerous moving parts of machinery and equipment should be enclosed or adequately guarded in accordance with national laws and regulations.

7.1.8. Every power-driven machine and equipment should be provided with adequate means, immediately accessible and readily identifiable to the operator, of stopping it quickly and preventing it from being started again inadvertently.

7.1.9. The machines or equipment should be so designed or fitted with a device that the maximum safe speed, which should be indicated on it, is not exceeded. If the speed of the machine is variable, it should only be possible to start it at the lowest speed appropriate.

7.1.10. Operators of plant, machinery, equipment and tools should be provided with personal protective equipment including, where necessary, suitable hearing protection.

7.2. Hand tools

7.2.1. Hand tools and implements should be tempered, dressed and repaired by competent persons.

7.2.2. The cutting edges of cutting tools should be kept sharp.

7.2.3. Heads of hammers and other shock tools should be dressed or ground to a suitable radius on the edge as soon as they begin to mushroom or crack.

7.2.4. When not in use and while being carried or transported sharp tools should be kept in sheaths, shields, chests or other suitable containers.

7.2.5. Only insulated or non-conducting tools should be used on or near live electrical installations if there is any risk of electrical shock.

7.2.6. Only non-sparking tools should be used near or in the presence of flammable or explosive dusts or vapours.

7.3. Pneumatic tools

7.3.1. Operating triggers on portable pneumatic tools should be:

(a) so placed as to minimise the risk of accidental starting of the machine;

(b) so arranged as to close the air inlet valve automatically when the pressure of the operator's hand is removed.

7.3.2. Hose and hose connections for compressed-air supply to portable pneumatic tools should be:

(a) designed for the pressure and service for which they are intended;

(b) fastened securely to the pipe outlet and equipped with a safety chain, as appropriate.

7.3.3. Pneumatic shock tools should be equipped with safety clips or retainers to prevent dies and tools from being accidentally expelled from the barrel.

7.3.4. Pneumatic tools should be disconnected from power and the pressure in hose lines released before any adjustments or repairs are made.

7.4. Cartridge-operated tools

7.4.1. Whenever practicable, a low-velocity tool should be used.

7.4.2. Cartridge-operated tools should have:

(a) a guard or protective shield that cannot be removed without rendering the tool inoperative;

(b) a device that prevents the tool from firing inadvertently, for example if it is dropped or while it is being loaded;

(c) a device that prevents the tool from firing if it is not approximately perpendicular to the working surface;

(d) a device that prevents the tool from firing if the muzzle is not pressed against the working surface.

7.4.3. The recoil of a cartridge-operated tool should not be capable of injuring the user.

7.4.4. The noise of the detonation should not be such as to damage hearing.

7.4.5. A cartridge-operated tool, before each occasion of use, should be inspected to ensure that it is safe to use, and in particular:

(a) that the safety devices are in proper working order;

(b) that the tool is clean;

(c) that all moving parts work easily;

(d) that the barrel is unobstructed.

7.4.6. At intervals recommended by the manufacturer the tool should be completely dismantled and inspected for wear on the safety devices by a competent person.

7.4.7. Cartridge-operated tools should only be repaired by the manufacturer or by competent persons.

7.4.8. Cartridges should not be stored nor cartridge tools operated:

(a) in a place or environment Where these could explode accidentally;

(b) in an explosive atmosphere.

7.4.9. When not required for use, inspection or other purpose, cartridge-operated tools should be kept in a suitable container that:

(a) is made of suitable material;

(b) is clearly marked to indicate its contents;

(c) is kept locked when not in use;

(d) contains nothing except the tools and cartridges.

7.4.10. No cartridge-operated tool should be stored or transported loaded, or left loaded when not in use.

7.4.11. Cartridge-operated tools should be accompanied by instructions for their maintenance and use and should only be operated by persons trained in their safe use.

7.5. Electrical tools

7.5.1. Portable electrical tools should generally be used on reduced voltage to avoid as far as possible the risk of a lethal shock.

7.5.2. All electrical tools should be earthed, unless they are "all insulated" or "double insulated" tools which do not require an earth. Earthing should be incorporated in metallic cases, and as a safeguard against damaged cables where wires enter the tool.

7.5.3. All electrical tools should receive inspection and maintenance on a regular basis by a competent electrician, and complete records kept.

7.6. Woodworking machines

7.6.1. Shavings, sawdust, etc, should not be removed by hand from woodworking machines or in their vicinity while the machines are working.

7.6.2. Where provided, chip and sawdust extraction systems should be maintained in efficient working order.

7.6.3. Mechanical feeding devices should be used whenever practicable.

7.6.4. All cutters and saw blades should be enclosed as far as practicable.

7.6.5. Circular saws should be provided with strong, rigid and easily adjustable hood guards for the saw blades and with riving knives of suitable design matched to the saw blade in use. The width of the opening in the table for the saw blade should be as small as practicable.

7.6.6. Portable circular saws should be so designed that when the blade is running idle it is automatically covered.

7.6.7. On band saws all the blade, except the operating portion, should be enclosed. Band wheels should be enclosed with stout guards.

7.6.8. Band saws should be provided with automatic tension regulators.

7.6.9. Planing machines should be provided with bridge guards covering the full length and breadth of the cutting block and easily adjustable in both horizontal and vertical directions.

7.6.10. Thicknessing machines should be provided with sectional feed rollers or a kick-back preventer which should be kept as free as possible.

7.6.11. Woodworking machines should be properly spaced to avoid accidental injury when handling large boards or long planks.

7.7. Engines

7.7.1. Engines should:

(a) be constructed and installed so that they can be started safely and the maximum safe speed cannot be exceeded;

(b) have remote controls for limiting speed when necessary;

(c) have devices to stop them from a safe place in an emergency.

7.7.2. Internal combustion engines should not run for long periods in confined spaces unless adequate exhaust ventilation is provided.

7.7.3. When internal combustion engines are being fuelled:

(a) the engine ignition should be shut off,

(b) care should be taken to avoid spilling fuel;

(c) no person should smoke or have an open light in the vicinity;

(d) a fire extinguisher should be kept readily available.

7.7.4. Secondary fuel reservoirs should be placed outside the engine room.

7.8. Silos

7.8.1. Silos should:

(a) be erected on adequate foundations;

(b) withstand the stresses to which they are subjected without any deformation of walls, floors and other load-bearing parts.

7.8.2. All places in silos to which workers have to go should be provided with safe means of access such as stairs, fixed ladders or hoists.

7.8.3. Facilities should be provided to enable the quantity of material in the silo to be assessed without entering the silo.

7.8.4. On silos, notices should be conspicuously displayed:

(a) containing details of the requirements for entry;

(b) calling attention to the danger of sinking in fine materials.

7.8.5. If the material in the silo is liable to cause a blockage, agitators, compressed air or other mechanical devices should be preferably provided. To clear blockages, equipment such as poles, long-handled tools, rammers or scraper chains should also be available for emergency use.

7.8.6. Silos for material liable to spontaneous combustion should be provided with fire-extinguishing equipment.

7.8.7. In silos in which explosive mixtures of gases or dusts are liable to form:

(a) all electrical equipment including hand lamps should be flameproof;

(b) only non-sparking tools should be used;

(c) explosion vents should be provided in the walls.

7.8.8. Entrances of silos should be kept closed and locked.

7.8.9. Workers should not enter a silo unless:

(a) the discharge opening is closed and secured against opening and filling is stopped;

(b) they are duly authorised to do so;

(c) they wear safety harnesses with lifelines securely attached to a fixed object;

(d) another authorised person provides constant surveillance and is in attendance with suitable rescue equipment.

7.9. Concrete work equipment

7.9.1. Concrete mixers should be protected by side railings to prevent workers from passing under the skip while it is raised.

7.9.2. Hoppers into which a person could fall, and revolving blades of trough or batch-type mixers, should be adequately guarded by grating.

7.9.3. In addition to the operating brake, skips of concrete mixers should be provided with a device or devices by which they can be securely blocked when raised.

7.9.4. While the drum of a concrete mixer is being cleaned, adequate precautions should be taken to protect the workers inside by locking switches open, removing fuses or otherwise cutting off the power.

7.9.5. Concrete buckets for use with cranes and aerial cableways should be free as far as practicable from projections from which accumulations of concrete could fall.

7.9.6. Loaded concrete buckets should be guided into position by appropriate means.

7.9.7. Concrete buckets positioned by crane or aerial cableways should be suspended by safety hooks.

7.9.8. When concrete is being tipped from buckets, workers should keep out of range of any kick-back due to concrete sticking to the bucket.

7.9.9. Concrete bucket towers and masts with pouring gutters or conveyor belts should:

(a) be erected by competent persons;

(b) be inspected daily.

7.9.10. The winch for hoisting the bucket should be so placed that the operator can see the filling, hoisting, emptying and lowering of the bucket. Where this is not practicable, a banksman should direct the operator.

7.9.11. If the winch operator cannot see the bucket, he should, where practicable, be provided with an adequate means indicating its position.

7.9.12. Guides for the bucket should be correctly aligned and so maintained as to prevent the bucket from jamming in the tower.

7.9.13. Scaffolding carrying a pipe for pumped concrete should be strong enough to support the pipe when filled and all the workers who may be on the scaffold at the same time, with a safety factor of at least 4.

7.9.14. Pipes for carrying pumped concrete should:

(a) be securely anchored at the ends and at curves;

(b) be provided near the top with air release valves;

(c) be securely attached to the pump nozzle by a bolted collar or equivalent means.

7.10. Pressure plant

7.10.1. Pressure plant and equipment should be examined, tested and issued with a certificate by a competent person in cases and at times prescribed by national laws or regulations.

7.10.2. National laws or regulations should be laid down and enforced as regards the materials, design, construction, installation, inspection, testing, maintenance and operation of steam boilers and other pressure plant as necessary.

7.10.3. Only persons tested and certified by the competent authorities should operate steam boilers.

7.10.4. Compressors should be equipped with:

(a) automatic devices that will prevent the maximum safe discharge pressure from being exceeded;

(b) a quick-release valve;

(c) suitable arrangements for preventing contamination where persons are working in confined spaces.

7.10.5. Compressors in which explosive mixtures of gas may form should be protected against sparking.

7.10.6. Where compressor cylinders are equipped with water-cooling jackets it should be possible to observe the water flow.

7.10.7. Intercoolers and aftercoolers should be able to withstand safely the maximum pressure in the air-discharge piping.

7.10.8. Where necessary to prevent danger, air-discharge piping of compressors should be provided with:

(a) a fusible plug;

(b) insulating covers to protect workers against burns, and to prevent fire risks.

7.10.9. Where necessary to prevent danger, an oil separator should be provided between the compressor and the air receiver.

7.10.10. Where stop valves are installed in air-discharge piping:

(a) they should be easily accessible for inspection and cleaning;

(b) one or more safety valves should be installed between the compressor and the stop valve.

7.10.11. All working parts, including speed governors, safety valves and oil separators, should be inspected and cleaned at suitable intervals.

7.10.12. Air receivers should be equipped with:

(a) a safety valve;

(b) a pressure gauge;

(c) a drain cock.

7.10.13. Air receivers should be provided with suitable openings for inspection and cleaning.

7.10.14. Air receivers should be examined and tested at appropriate intervals by a competent person.

7.10.15. The safe working pressure should be marked in a distinctive colour on the pressure gauge.

7.10.16. Where necessary to prevent danger, a pressure-reducing valve or a stop valve, or both, should be inserted in the piping between the air receiver and the compressor.

7.10.17. Between the receiver and each consuming appliance there should be a stop valve.

7.10.18. Cylinders for compressed, dissolved or liquefied gases should be properly constructed with sound material, fitted with appropriate safety devices in accordance with national laws or regulations, inspected and tested by a competent person as prescribed and stored, transported, handled and used in conformity with the prescribed safety measures.

7.11. Conveyors

7.11.1. Conveyors should be so constructed and installed as to avoid hazardous points between moving and stationary parts or objects.

7.11.2. When conveyors that are not entirely enclosed cross over places where workers are employed or pass beneath, sheet or screen guards should be provided to catch any falling material. Adequate fencing should be provided at transfer points. Emergency stopping devices should be fitted at convenient locations easily accessible for workers.

7.11.3. Power-driven conveyors should be provided at loading and unloading stations, at drive and take-up ends, and at other convenient places, if necessary to prevent danger, with devices for stopping the conveyor machinery in an emergency.

7.11.4. Where two or more conveyors are operated together, the controlling devices should be so arranged that no conveyor can feed on to a stopped conveyor.

7.11.5. Screw conveyors should be enclosed at all times. The cover should not be removed until the conveyor is stopped.

7.11.6. When a conveyor is discharging into a bunker or hopper, the feeding conveyor should be equipped with an overload switch.

7.12. Crusher plants

7.12.1. Crusher plants should be located at a safe distance from the construction work area to avoid injury to workers and damage to the workers resulting from dust, sand, gravel, noise and vibrations.

7.12.2. Crusher plants should be provided with an overriding power isolation switch next to the crusher unit and visible from it, to prevent starting the plant inadvertently during repair or maintenance.

7.12.3. Electrical motors, switches, connections and all instrumentation should be dust and moisture proof.

7.12.4. Equipment, plant and machinery should be cleared daily of dust and sand.

7.12.5. Access roads to the crusher hopper and screens should be cleaned by water spraying or other effective means.

7.12.6. Power cables should be laid out either underground or at safe elevation and marked with bright colour indicators to avoid damage resulting from poor visibility.

7.12.7. Earth-moving equipment working at a crusher plant should be cleaned and maintained after each work shift.

7.13. Power generators

7.13.1. Power generators should meet national laws and regulations for safe and reliable operation.

7.13.2. Power generators should be rated to meet the maximum anticipated load.

7.13.3. Power generators should be located in enclosed and properly ventilated areas.

7.13.4. Power generators should be provided with an overriding power switch to avoid accidental remote starting during maintenance.

7.13.5. Power generators should be provided with adequate silencers and exhaust piping.

7.13.6. When located near workers' accommodation, power generators should be housed in a concrete room or properly insulated area in accordance with national laws and regulations to minimise noise disturbance.

8. Work at heights including roof work

8.1. General provisions

8.1.1. Where necessary to guard against danger, or where the height of a structure or its slope exceeds that prescribed by national laws or regulations, preventive measures should be taken against the fall of workers and tools or other objects or materials.

8.1.2. Elevated workplaces, including roofs more than 2 m or as prescribed, above the floor or ground should be protected on all open sides by guard-rails and toe-boards complying with the relevant national laws and regulations. Wherever guard-rails and toe-boards cannot be provided, adequate safety harnesses should be provided and used.

8.1.3. Elevated workplaces including roofs should be provided with safe means of access and egress such as stairs, ramps or ladders complying with the relevant national laws and regulations.

8.1.4. If guard-rails are not practicable, persons employed at elevated workplaces including roofs from which they are liable to fall more than 2 m or as prescribed should be protected by means of adequate safety nets or safety sheets or platforms, or be secured by safety harnesses with lifelines securely attached.

8.2. Roof work

8.2.1. All roof-work operations should be pre-planned and properly supervised.

8.2.2. Roof work should only be undertaken by workers who are physically and psychologically fit and have the necessary knowledge and experience for such work.

8.2.3. Work on roofs should not be carried on in weather conditions that threaten the safety of workers.

8.2.4. Crawling boards, walkways and roof ladders should be securely fastened to a firm structure.

8.2.5. Roofing brackets should fit the slope of the roof and be securely supported.

8.2.6. Where it is necessary for a person to kneel or crouch near the edge of the roof an intermediate rail should be provided unless other precautions, such as the use of a safety harness, are taken.

8.2.7. On a large roof where work does not have to be carried out at or near the edge, a simple barrier consisting of crossed scaffold tubes supporting a tubing guard-rail may be provided. Such barriers should be positioned at least 2 m from the edge.

8.2.8. All covers for openings in roofs should be of substantial construction and be secured in position.

8.2.9. Roofs with a pitch of more than 10 should be treated as sloping.

8.2.10. When work is being carried out on sloping roofs, sufficient and suitable crawling boards or roof ladders should be provided and firmly secured in position as soon as is practicable.

8.2.11. During extensive work on the roof, strong barriers or guard-rails and toe-boards should be provided to stop a person from falling off the roof.

8.2.12. Where workers are required to work on or near roofs or other places covered with fragile material, through which they are liable to fall, they should be provided with sufficient suitable roof ladders or crawling boards strong enough, when spanning across the supports for the roof covering, to support those workers.

8.2.13. A minimum of two boards should be provided so that it is not necessary for a person to stand on a fragile roof to move a board or a ladder, or for any other reason.

8.2.14. To prevent danger, suitable material such as steel wire mesh should be placed in position before any roof sheeting of asbestos cement or other fragile material is placed upon it.

8.2.15. Purlins or other intermediate supports for fragile roofing material should be sufficiently close together to prevent danger.

8.2.16. Where a valley or parapet gutter of a fragile roof is used for access, protection against falling through the fragile material should be provided by covering the adjacent fragile material to a minimum distance of 1 m up the roof.

8.2.17. Buildings with fragile roofs should have a warning notice prominently displayed at the approaches to the roof.

8.3. Work on tall chimneys

8.3.1. For the erection and repair of tall chimneys, appropriate scaffolding should be provided. An adequate catch net should be maintained at a suitable distance below the scaffold.

8.3.2. The scaffold floor should always be at least 65 cm below the top of the chimney.

8.3.3. Under the working floor of the scaffolding the next lower floor should be left in position as a catch platform.

8.3.4. The distance between the inside edge of the scaffold and the wall of the chimney should not exceed 20 cm at any point.

8.3.5. Catch platforms should be erected over:

(a) the entrance to the chimney;

(b) passageways and working places where workers could be endangered by falling objects.

8.3.6. For climbing tall chimneys, access should be provided by:

(a) stairs or ladders;

(b) a column of iron rungs securely embedded in the chimney wall;

(c) other appropriate means.

8.3.7. When workers use the outside rungs to climb the chimney, a securely fastened steel core rope looped at the free end and hanging down at least 3 m should be provided at the top to help the workers to climb on to the chimney.

8.3.8. While work is being done on independent chimneys the area surrounding the chimney should be enclosed by fencing at a safe distance.

8.3.9. Workers employed on the construction, alteration, maintenance or repair of tall chimneys should not:

(a) work on the outside without a safety harness attached by a lifeline to a rung, ring or other secure anchorage;

(b) put tools between the safety harness and the body or in pockets not intended for the purpose;

(c) haul heavy materials or equipment up and down by hand to or from the workplace on the chimney;

(d) fasten pulleys or scaffolding to reinforcing rings without first verifying their stability;

(e) work alone;

(f) climb a chimney that is not provided with securely anchored ladders or rungs;

(g) work on chimneys in use unless the necessary precautions to avoid danger from smoke and gases have been taken.

8.3.10. Work on independent chimneys should not be carried on in high winds, icy conditions, fog or during electrical storms.

9. Excavations, shafts, earthworks, underground works and tunnels

9.1. General provisions

9.1.1. Adequate precautions should be taken in any excavation, shaft, earthworks, underground works or tunnel:

(a) by suitable shoring or otherwise, to guard against danger to workers from a fall or dislodgement of earth, rock or other material;

(b) to guard against dangers arising from the fall of persons, materials or objects or the inrush of water into the excavation, shaft, earthworks, underground works or tunnel;

(c) to secure adequate ventilation at every workplace so as to maintain an atmosphere fit for respiration and to limit any fumes, gases, vapours, dust or other impurities to levels which are not dangerous or injurious to health and are within limits laid down by national laws or regulations;

(d) to enable the workers to reach safety in the event of fire, or an inrush of water or material;

(e) to avoid risk to workers arising from possible underground dangers such as the circulation of fluids or the presence of pockets of gas, by undertaking appropriate investigations to locate them.

9.1.2. Shoring or other support for any part of an excavation, shaft, earthworks, underground works or tunnel should not be erected, altered or dismantled except under the supervision of a competent person.

9.1.3. Every part of an excavation, shaft, earthworks, underground works and tunnel where persons are employed should be inspected by a competent person at times and in cases prescribed by national laws or regulations, and the results recorded.

9.1.4. Work should not commence therein until the inspection by the competent person as prescribed by national laws or regulations has been carried out and the part of the excavation, shaft, earthworks, underground works or tunnel has been found safe for work.

9.2. Excavations

9.2.1. Before digging begins on site:

(a) all excavation work should be planned and the method of excavation and the type of support work required decided;

(b) the stability of the ground should be verified by a competent person;

(c) a competent person should check that the excavation will not affect adjoining buildings, structures or roadways;

(d) the employer should verify the position of all the public utilities such as underground sewers, gas pipes, water pipes and electrical conductors that may cause danger during work;

(e) if necessary to prevent danger, the gas, water, electrical and other public utilities should be shut off or disconnected;

(f) if underground pipes, cable conductors, etc., cannot be removed or disconnected, they should be fenced, hung up and adequately marked or otherwise protected;

(g) the position of bridges, temporary roads and spoil heaps should be determined;

(h) if necessary to prevent danger, land should be cleared of trees, boulders and other obstructions;

(i) the employer should see that the land to be excavated is not contaminated by harmful chemicals or gases, or by any hazardous waste material such as asbestos.

9.2.2. All excavation work should be supervised by a competent person and operatives doing the work should be given clear instructions.

9.2.3. Sides of excavations should be thoroughly inspected:

(a) daily, prior to each shift and after interruption in work of more than one day;

(b) after every blasting operation;

(c) after an unexpected fall of ground;

(d) after substantial damage to supports;

(e) after a heavy rain, frost or snow;

(f) when boulder formations are encountered.

9.2.4. No load, plant or equipment should be placed or moved near the edge of any excavation where it is likely to cause its collapse and thereby endanger any person unless precautions such as the provision of shoring or piling are taken to prevent the sides from collapsing.

9.2.5. Adequately anchored stop blocks and barriers should be provided to prevent vehicles being driven into the excavation. Heavy vehicles should not be allowed near the excavation unless the support work has been specially designed to permit it.

9.2.6. If an excavation is likely to affect the security of a structure on which persons are working, precautions should be taken to protect the structure from collapse.

9.2.7. Sides of excavations where workers are exposed to danger from moving ground should be made safe by sloping, shoring, portable shields or other effective means.

9.2.8. All support work should be regularly checked to ensure that the props, wedges, etc., are tight and no undue deflection or distortion is taking place.

9.2.9. All timber subject to the varying weather conditions should be regularly checked for dryness, shrinkage and rot.

9.3. Underground construction

9.3.1. General provisions

9.3.1.1. Underground construction work should be carried on in accordance with plans approved by the competent authority when required by national laws and regulations. The plant should define excavation methods, rescue and evacuation methods in case of fire, flood and fall or dislodgement of earth or rock.

9.3.1.2. All underground construction work should be supervised by a competent person and operatives doing the work should be given clear instructions.

9.3.1.3. All occupied workplaces underground should be inspected at least once in every shift.

9.3.1.4. Places occupied by solitary workers should be inspected at least twice in every shift.

9.3.1.5. At least once in every week, thorough inspection should be made of all machinery, equipment, structures, supports, roadways, means of egress, magazines, medical facilities, sanitation and working places.

9.3.1.6. All workers should be withdrawn from underground workings if:

(a) the ventilation fails; or

(b) other imminent danger threatens.

9.3.1.7. A suitable communication system should be maintained from the vicinity of the face of underground workings to the surface with stations at intermediate workplaces.

9.3.1.8. In tunnels and other underground workings where an explosive mixture such as methane and air may form, operations should be carried on in accordance with national laws and regulations applicable to gassy mines or coal mines.

9.3.1.9. Air should be tested to ascertain if it is hazardous and no one allowed entry until it is fit for breathing.

9.3.1.10. Escape routes should be properly indicated with signs visible in dim light.

9.3.2. Shaft sinking

9.3.2.1. Every shaft not sunk through solid rock should be cased, lined or otherwise made safe.

9.3.2.2. Shuttering for masonry lining of shafts should only be removed gradually as the masonry progresses.

9.3.2.3. Workers employed on sinking shafts should be provided with staging, scaffolds or cradles from which they can work safely.

9.3.2.4. A thorough inspection of the shaft should be made:

(a) before a shift descends;

(b) after blasting.

9.3.2.5. All shafts over 30 m in depth should have an adequate head frame strong enough to withstand safely the maximum load that it will have to carry and preferably be of open steelwork construction.

9.3.2.6. If head frames are of timber, they should be treated to make them fire-resistant.

9.3.2.7. Head frames should be earthed or otherwise adequately protected against lightning.

9.3.2.8. All landings in shafts should be provided with gates that effectively close the opening to a height of at least 2 m.

9.3.2.9. Shafts should be equipped with a signalling system that warns the hoisting engineer when a conveyance passes beyond the safe limit of travel.

9.3.2.10. Before tunnelling operations are begun from a shaft, two separate signalling or communications systems of different types should be installed.

9.3.2. 11. The signal code should be posted in the hoisting machine room and at each landing.

9.3.2.12. Hoisting machines should be equipped:

(a) with an adequate brake that will automatically stop and hold the conveyance if the hoisting power fails;

(b) with a reliable depth indicator.

9.3.2.13. All hoisting machines should be inspected at least once a day by the hoisting engineer.

9.3.2.14. Shafts exceeding 30 m in depth should have an installation for conveying persons.

9.3.2.15. Cages or cars for conveying persons should be equipped with safety gear that automatically holds the cage or car when fully loaded if the suspension rope breaks or becomes slack.

9.3.2.16. There should be adequate means of blocking the cage or car at every landing.

9.3.2.17. Buckets used for conveying persons in shafts should:

(a) have no projections on the outside that could catch in an obstruction;

(b) be not less than 1 m deep;

(c) be provided with adequate means to prevent them from inadvertently tipping and spinning;

(d) not be self-opening.

9.3.2.18. Notices should be posted at conspicuous places at the hoisting installation stating:

(a) the maximum speed for transporting persons in the shaft;

(b) the maximum number of persons and the maximum weight of material that may be safely carried in each conveyance.

9.3.2.19. Hoisting operations in shafts should be governed by suitable signals.

9.3.3. Ventilation

9.3.3.1. All underground workings should be traversed by a regular air current to keep them in a fit state for working and, in particular:

(a) to avoid excessive rises in temperature;

(b) to dilute harmful dusts, gases, vapours and fumes to safe concentrations;

(c) to prevent the oxygen content of the atmosphere from falling below 17 per cent or a level prescribed in national laws and regulations.

9.3.3.2. In all underground workings it should be possible to reverse the air flow.

9.3.3.3. In tunnels where blasting is done:

(a) an adequate supply of air should be taken to the face by mechanical ventilation;

(b) after every blast the face should be cleared of harmful gases and dust as far as practicable by exhaust ventilation; where necessary, the dust should be controlled with water sprays or fog guns;

(c) if necessary to remove the fumes, auxiliary ventilation should be provided.

9.3.3.4. Where adequate ventilation is not possible, workers should be provided with suitable breathing apparatus. Only in very exceptional circumstances should people be allowed to work without adequate ventilation.

9.3.4. Fire protection

9.3.4.1. No combustible structure should be built or any flammable material stored within 30 m of a shaft, tunnel mouth, hoisting-engine house or ventilation-fan house.

9.3.4.2. As far as practicable, combustible materials and flammable liquids should not be stored underground.

9.3.4.3. Lubricating oils, grease and rope dressings underground should:

(a) be kept in closed metal containers;

(b) be stored in a safe place away from shafts, hoists, explosives and timber.

9.3.4.4. Unless there is no risk of fire or explosion, naked lights and smoking should not be allowed underground.

9.3.4.5. Petrol engines should not be used underground except under conditions approved by the competent authority.

9.3.4.6. If welding or flame cutting is done underground:

(a) timber supports and other combustible structures or materials should be protected by a fireproof screen;

(b) suitable fire extinguishers should be kept readily available;

(c) a constant watch should be kept for outbreaks of fire;

(d) welding fumes should be removed by exhaust ventilation.

9.3.5. Electricity

9.3.5.1. Electrical installations in shafts and tunnels should comply with the relevant national laws or regulations.

9.3.5.2. Main switchgear for cutting off the supply of electricity from all underground installations should:

(a) be installed on the surface;

(b) be accessible only to authorised persons;

(c) be attended by a competent person authorised to operate it.

9.3.5.3. Where necessary suitable lightning arresters should be installed on the surface to protect the installation below ground from abnormal voltage due to atmospheric electricity.

9.3.5.4. The main cables supplying current to electric motors installed in the vicinity of shafts (such as those for underground fans or drainage pumps) should be duplicated if the stopping of these motors would cause danger.

9.3.5.5. All switches should be of the enclosed safety type.

9.3.5.6. Fixed lamps underground should be provided with a strong protective cover of glass or other transparent material or with a guard.

9.3.5.7. Whenever required by local conditions, lamp fittings should be proof against dust, gases and water.

9.3.5.8. The voltage of hand lamps (portable lamps) used underground should not exceed extra-low safety voltage.

9.3.6. Underground lighting

9.3.6.1. All places where workers have to work or pass should be adequately lit.

9.3.6.2. In addition to the main lighting, there should be emergency lighting that functions long enough to enable the workers to reach the surface safely.

9.4. Drilling

9.4.1. When drilling is done in rock, loose rock should be scaled down to protect drillers against falls of ground; where this is not practicable, a protective canopy or overhead screen should be provided.

9.5. Transport, storage and handling of explosives

9.5.1. The transport, storage and handling of explosives should comply with the requirements of national laws and regulations.

9.5.2. Explosives should not be conveyed in a shaft cage or bucket together with other materials.

9.5.3. Explosives and detonators should not be conveyed together in a shaft unless they are in a suitable powder car.

9.6. Blasting

9.6.1. The modes of blasting should be in accordance with national laws or regulations.

9.6.2. No other electrical circuit should be installed on the same side of the tunnel as the blasting circuit.

9.6.3. Before any shot is fired, all electrical circuits other than the blasting circuit should be de-energised within an adequate distance from the firing point.

9.6.4. Only suitable battery lamps should be used during loading shotholes.

9.6.5. After every blast, the sides, workface and roof should be inspected and cleared of loose rock.

9.7. Haulage

9.7.1. The haulage system should comply with the national laws and regulations.

9.7.2. In tunnels where there are rail tracks, unless there is adequate clearance between the rolling stock and the sides, recesses should be provided at suitable intervals which should be large enough to accommodate two persons and should be at least 60 cm deep.

9.7.3. Mechanical haulage operations should be controlled by suitable signals.

9.7.4. Trains and single cars should have headlights and tail-lights.

9.7.5. Rerailing by hauling with a winch should only be done under the control and supervision of a competent person.

9.7.6. Workers should not be transported on locomotives or in cars other than those specially provided for that purpose.

9.8. Dust control

9.8.1. Adequate measures should be taken to prevent the formation of, or to suppress as close to the source as practicable, all dust in tunnelling operations and in particular siliceous dusts consisting of particles less than 5 microns in size.

9.8.2. If drilling in rock is done dry, the dust produced should be effectively exhausted and collected.

9.8.3. If drilling in rock is done wet, the drill should be so constructed that it cannot be operated unless the water feed is operating.

9.8.4. During blasting, before any shots are fired the floor, roof and sides in the vicinity should be thoroughly wetted, if practicable.

9.8.5. Loose rock should be adequately wetted during loading, transport and unloading underground.

9.8.6. Excavated material should not be exposed to high-velocity air currents during transport.

9.8.7. If any stone-crushing equipment is used underground, adequate measures should be taken to prevent any dust from it penetrating to areas occupied by workers.

9.9. Underground pipelines

9.9.1. Adequate ventilation should be provided for workers in pipelines.

9.9.2. When laying pipes in water-bearing ground, a flood gate should be provided at the end section.

9.9.3. When bodies of water or explosive gases may be encountered, trial boreholes should be drilled ahead of the workings.

9.9.4. Reliable means of communication between workers inside pipes and persons outside should be provided.

9.9.5. It should be possible for workers employed in piping to reach a safe place quickly in an emergency.

9.9.6. Adequate arrangements should be made to rescue workers who are in danger and cannot reach a safe place.

10. Cofferdams and caissons and work in compressed air

10.1. General provisions

10.1.1. Every cofferdam and caisson should be:

(a) of good construction and suitable and sound material and of adequate strength;

(b) provided with adequate means for workers to reach safety in the event of an inrush of water or material;

(c) provided with safe means of access to every place where workers are employed.

10.1.2. The construction, positioning, modification or dismantling of a cofferdam or caisson should take place only under the immediate supervision of a competent person.

10.1.3. Every cofferdam and caisson should be inspected by a competent person at intervals prescribed by national laws or regulations.

10.1.4. A person should only be allowed to work in a cofferdam or caisson if it has been inspected and found safe by a competent person within such preceding period as is prescribed by national laws or regulations and the results thereof recorded in a prescribed form or register.

10.1.5. Work in compressed air should be carried out only in accordance with measures prescribed by national laws or regulations.

10.1.6. Work in compressed air should be carried out only by workers who are 18 years old or more and who have been medically examined and found fit for such employment.

10.1.7. Work in compressed air should be carried out only when a competent person is present to supervise the conduct of operations.

10.1.8. National laws or regulations should lay down conditions in which the work is to be carried out and the plant and equipment are to be used and provide for health surveillance of workers and the duration of work in compressed air.

10.1.9. No person should be employed in compressed air unless he is under the constant supervision of an experienced person and properly instructed and supplied with a leaflet containing advice as to the precautions to be taken in connection with such work.

10.1.10. No person should be subjected to a pressure exceeding 2.5 bar except in emergencies.

10.1.11. For every shift a record should be kept showing the time every worker spends in the working chamber and the time taken for decompression.

10.1.12. If the air pressure exceeds 1 bar, the medical examination of the worker should have been carried out within the four weeks preceding his employment.

10.1.13. Workers who have been employed continuously in compressed air at a pressure less than 1 bar should be medically re-examined every two months; if the pressure is higher, the period between re-examinations should be shorter.

10.1.14. Workers who have been absent from work in compressed air for any period due to illness or for ten days or more for reasons other than illness should be medically re-examined. Such workers should be reintroduced into compressed-air work in a graduated manner.

10.1.15. For every project where workers are employed in compressed air, a physician or a nurse or a trained first-aid attendant familiar with compressed-air work should be available at all times.

10.1.16. When persons are employed in compressed air at a pressure exceeding 1 bar the employer should inform a neighbouring hospital of the position of the worksite and of the name and address of the physician exercising medical supervision.

10.1.17. Every person employed in compressed air at a pressure exceeding 1 bar should be provided with an identification badge to be worn on the body indicating that he has been employed in compressed air and giving the address of the medical lock at his place of employment.

10.1.18. The identification badge should state that the wearer should be taken to the medical lock and not to a hospital if he is ill.

10.1.19. Adequate and suitable facilities for remaining on the site after decompression, including shelters with seats should be provided for workers working in compressed air.

10.1.20. Any person not previously employed in compressed air should not be subject to compressed air unless accompanied in the man lock by a person competent to advise him as to the appropriate conduct of persons during compression.

10.1.21. During compression the pressure should not be raised to more than about 0.25 bar until the lock attendant has ascertained that no person is complaining of discomfort, and thereafter it should be raised at a rate not exceeding about 0.5 bar per minute.

10.1.22. If during compression any person is suffering from discomfort, compression should stop and the pressure be gradually reduced.

10.2. Work in cofferdams and caissons

10.2.1. When necessary to prevent danger, caissons and shafts should:

(a) be adequately braced;

(b) be firmly secured in position.

10.2.2. Before being taken into use, shafts should undergo an appropriate hydrostatic test.

10.2.3. Every caisson and shaft containing flammable material should be provided with a water line, sufficient hose connections and sufficient hose or appropriate extinguishers.

10.2.4. Every caisson, shaft, working chamber, medical lock and man lock should have a minimum internal height of 1.8 m.

Working chambers

10.2.5. Every working chamber should be provided with a wet-bulb thermometer.

10.2.6. Work under pressure when the wet-bulb temperature exceeds 28 C should be restricted unless it is absolutely necessary.

10.2.7. While any person is in a working chamber, the door between the chamber and a man lock leading to a lower pressure should as far as practicable be kept open if the lock is not in use.

Medical locks

10.2.8. Where the pressure in a working chamber ordinarily exceeds 1 bar, a suitable medical lock conveniently situated should be provided solely for the treatment of workers employed in compressed air.

10.2.9. The medical lock should have two compartments so that it can be entered under pressure.

10.2.10. While any person is employed in compressed air a medical lock should be in the charge of a suitably qualified person.

Man locks

10.2.11. Every man lock should be of adequate internal dimensions and equipped with:

(a) pressure gauges that indicate to the man-lock attendant the pressure in the lock and in each working chamber to which it affords direct or indirect access and indicate to the persons in the lock the pressure in it;

(b) a clock or clocks so placed that the lock attendant and the persons in the lock can readily ascertain the time;

(c) efficient means of verbal communication between the lock attendant, the lock and the working chamber or chambers;

(d) means of enabling the persons in the lock to convey visible or other non-verbal signals to the lock attendant;

(e) efficient means enabling the lock attendant, from outside the lock, to reduce or cut off the supply of compressed air to the lock.

10.2.12. Persons in the lock should not be able to reduce the air pressure except:

(a) under the control of the lock attendant;

(b) in an emergency, by special means that should normally be kept sealed or locked.

10.2.13. In every man lock there should be a suitable notice indicating the precautions to be taken by persons during compression and decompression, and after decompression.

10.2.14. Every man lock should, while any person is in it or in any working chamber to which it affords direct or indirect access, be in the charge of an attendant who should:

(a) control compression and decompression in the lock;

(b) if the pressure exceeds 1 bar, keep a register showing:
   (i) the times at which each person enters and leaves the lock;
   (ii) the pressures at the times of entering and leaving;
   (iii) the times taken to decompress each person.

Air supply

10.2.15. Compressed-air installations should be provided with air-supply plant capable of supplying any working chamber with sufficient fresh air at the pressure in the chamber, and not less than 1.0 m^3 per minute per person in the chamber.

10.2.16. Pollution of the air supplied to the caisson from a compressor or any other source should be prevented.

10.2.17. All air lines should be in duplicate and be equipped with non-return valves.

10.2.18. There should be a sufficient reserve of air in compressor installations to allow a safe margin for breakdowns or repairs.

10.2.19. There should be a stand-by or reserve compressor for emergencies.

10.2.20. Two power units supplied from independent sources should be provided for each compressor.

Signalling

10.2.21. Reliable means of communication such as bells, whistles or telephones should be maintained at all times between the working chamber and surface installations.

10.2.22. The code of signals should be conspicuously displayed in convenient positions at workplaces.

Lighting

10.2.23. All locks and working chambers should be provided with adequate electric lighting.

10.2.24. There should be two separate lighting installations supplied from independent sources of current.

10.3. Work in tunnels in compressed air

10.3.1. The bulkhead separating the working chamber from areas of lower pressure should be of sufficient strength to withstand safely the maximum pressure to which it will be subjected.

10.3.2. When necessary to prevent danger in the event of rapid flooding, the bulkhead should be sufficiently close to the face or shield to allow the workers to escape in an emergency.

10.3.3. Safety bulkheads should be provided within 60 m of the working face in all tunnels having a danger of inrush of water or material.

10.3.4. If the compressor is driven by electricity, stand-by compressor plant should be provided capable of maintaining at least 50 per cent of the air supply if the electrical power fails.

10.3.5. If the compressors are not driven by electricity, not more than half of them should be driven from the same source.

10.3.6. Each air line should be equipped with an adequate air receiver, a stop valve, a pressure-reducing valve, and a non-return valve close to the man locks.

10.3.7. The air supply should be provided by duplicate air lines between the air receiver and the working chamber.

10.3.8. An adjustable safety valve should be fitted on the outside of the bulkhead to a separate pipe leading from the working chamber through the bulkhead to the outside air.

10.3.9. Where practicable, in addition to a suitable man lock and a material lock, tunnels should have an emergency lock capable of holding an entire heading shift.

10.3.10. A suitable medical lock should be provided when work in compressed air is carried on in tunnels at pressures exceeding 1 bar.

10.3.11. In all tunnels 5 m or over in diameter or height a well-guarded overhead gangway should be provided from the working surface to the nearest airlock with an overhead clearance of at least 1.80 m.

10.3.12. Every tunnel should be provided with a water line extending into the working chamber to within 30 m of the working face, sufficient hose connections at suitable places, and sufficient hose.

10.3.13. When blasting work is being done in compressed air in tunnels:

(a) no worker other than the blaster and his assistants should be in a working chamber while boreholes are being loaded;

(b) no worker should re-enter a working chamber after a blast until the fumes have cleared.

11. Structural frames, formwork and concrete work

11.1. General provisions

11.1.1. The erection or dismantling of buildings, structures, civil engineering works, formwork, falsework and shoring should be carried out by trained workers only under the supervision of a competent person.

11.1.2. Adequate precautions should be taken to guard against danger to workers arising from any temporary state of weakness or instability of a structure.

11.1.3. Formwork, falsework and shoring should be so designed, constructed and maintained that it will safely support all loads that may be imposed on it.

11.1.4. Formwork should be so designed and erected that working platforms, means of access, bracing and means of handling and stabilising are easily fixed to the formwork structure.

11.2. Erection and dismantling of steel and prefabricated structures

11.2.1. As far as practicable the safety of workers employed on the erection and dismantling of steel and prefabricated structures should be ensured by appropriate means, such as provision and use of:

(a) ladders, gangways or fixed platforms;

(b) platforms, buckets, boatswain's chairs or other appropriate means suspended from lifting appliances;

(c) safety harnesses and lifelines, catch nets or catch platforms;

(d) power-operated mobile working platforms.

11.2.2. Steel and prefabricated structures should be so designed and made that they can be safely transported and erected, and if required by national laws and regulations each unit should be clearly marked with its own weight.

11.2.3. In addition to the need for the stability of the part when erected, when necessary to prevent danger the design should explicitly take into account:

(a) the conditions and methods of attachment in the operations of transport, storing and temporary support during erection or dismantling as applicable;

(b) methods for the provision of safeguards such as railings and working platforms, and, when necessary, for mounting them easily on the structural steel or prefabricated parts.

11.2.4. The hooks and other devices built in or provided on the structural steel or prefabricated parts that are required for lifting and transporting them should be so shaped, dimensioned and positioned as:

(a) to withstand with a sufficient margin the stresses to which they are subjected;

(b) not to set up stresses in the part that could cause failures, or stresses in the structure itself not provided for in the plans, and be designed to permit easy release from the lifting appliance. Lifting points for floor and staircase units should be located (recessed if necessary) so that they do not protrude above the surface;

(c) to avoid imbalance or distortion of the lifted load.

11.2.5. Prefabricated parts made of concrete should not be stripped or erected before the concrete has set and hardened sufficiently to the extent provided for in the plans, and before use should be examined for any sign of damage which may indicate weakness.

11.2.6. Storeplaces should be so constructed that:

(a) there is no risk of structural steel or prefabricated parts falling or overturning;

(b) storage conditions generally ensure stability and avoid damage having regard to the method of storage and atmospheric conditions;

(c) racks are set on firm ground and designed so that units cannot move accidentally.

11.2.7. While they are being stored, transported, raised or set down, structural steel or prefabricated parts should not be subjected to stresses prejudicial to their stability.

11.2.8. Every lifting appliance should:

(a) be suitable for the operations and not be capable of accidental disconnection;

(b) be approved by a competent person, or tested under a proof load 20 per cent heavier than the heaviest prefabricated part.

11.2.9. Lifting hooks should be of the self-closing type or of a safety type and should have the maximum permissible load marked on them.

11.2.10. Tongs, clamps and other appliances for lifting structural steel and prefabricated parts should:

a) be of such shape and dimensions as to ensure a secure grip without damaging the part;

b) be marked with the maximum permissible load in the most unfavourable lifting conditions.

11.2.11. Structural steel or prefabricated parts should be lifted by methods or appliances that prevent them from spinning accidentally.

11.2.12. When necessary to prevent danger, before they are raised from the ground, structural steel or prefabricated parts should be provided with safety devices such as railings and working platforms to prevent falls of persons.

11.2.13. While structural steel or prefabricated parts are being erected the workers should be provided with and use appliances for guiding them as they are being lifted and set down, so as to avoid crushing of hands and to facilitate the operations.

11.2.14. Before it is released from the lifting appliance a raised structural steel or prefabricated part should be so secured and wall units so propped that their stability cannot be imperilled, even by external agencies such as wind and passing loads, in accordance with national laws and regulations.

11.2.15. At workplaces adequate instruction should be given to the workers on the methods, arrangements and means required for the storage, transport, lifting and erection of structural steel or prefabricated parts, and before erection starts a meeting of all those responsible should be held to discuss and confirm the requirements for safe erection.

11.2.16. During transport, attachments such as slings and stirrups mounted on structural steel or prefabricated parts should be securely fastened to the parts.

11.2.17. Structural steel or prefabricated parts should be so transported that the conditions do not affect the stability of the parts or the means of transport result in jolting, vibration or stresses due to blows, or loads of material or persons.

11.2.18. When the method of erection does not permit the provision of other means of protection against falls of persons, the workplaces should be protected by guard-rails, and if appropriate by toe-boards.

11.2.19. When adverse weather conditions such as snow, ice and wind or reduced visibility entail risks of accidents the work should be carried on with particular care, or, if necessary, interrupted.

11.2.20. Structures should not be worked on during violent storms or high winds, or when they are covered with ice or snow, or are slippery from other causes.

11.2.21. If necessary to prevent danger, structural steel parts should be equipped with attachments for suspended scaffolds, lifelines or safety harnesses and other means of protection.

11.2.22. The risks of falling, to which workers moving on high or sloping girders are exposed, should be limited by all means of adequate collective protection or, where this is impossible, by the use of a safety harness that is well secured to a sufficiently strong support.

11.2.23. Structural steel parts that are to be erected at a great height should as far as practicable be assembled on the ground.

11.2.24. When structural steel or prefabricated parts are being erected, a sufficiently extended area underneath the workplace should be barricaded or guarded.

11.2.25. Steel trusses that are being erected should be adequately shored, braced or guyed until they are permanently secured in position.

11.2.26. No load-bearing structural member should be dangerously weakened by cutting, holing or other means.

11.2.27. Structural members should not be forced into place by the hoisting machine while any worker is in such a position that he could be injured by the operation.

11.2.28. Open-web steel joists that are hoisted singly should be directly placed in position and secured against dislodgement.

11.3. Cast-in-situ concrete structures

11.3.1. The construction of cast-in-situ, large span and multi-storey concrete structures should be based on plans that:

(a) include specifications of the steel, concrete and other material to be used, including technical methods for safe placing and handling;

(b) indicate clearly the position and arrangement of reinforcements in structural elements;

(c) provide, if appropriate, calculations of the load-bearing capacity of the structure.

11.3.2. During the construction of cast-in-situ, large span and multi-storey concrete structures, a daily record should be kept of the progress of the work, including indications of all data which could affect the curing of the concrete.

11.3.3. Precise procedures for all stages of erection should be prepared and a competent person appointed to co-ordinate the work and check procedures.

11.3.4. During pouring, shuttering and its supports should be continuously watched for defects.

11.3.5. Loads should not be dumped or placed on setting concrete.

11.4. Provision of temporary floors

11.4.1. All tiers of open joists and girders on which workers are employed should be securely covered with close planking or any other effective covering until the permanent floor is installed, 11.4.2. Parts of the protection should only be removed to the extent required for the continuation of the work.

11.4.3. In halls and similar buildings without intermediate walls, columns or chimneys, close planking may be replaced by working platforms with adequate safeguards.

11.4.4. In buildings or structures of skeleton steel construction, permanent floor filling should as far as practicable be installed as the erection progresses.

11.5. Formwork

11.5.1. All formwork should be properly designed.

11.5.2. Clear and concise procedures to cover all stages of work should be prepared.

11.5.3. A competent person should be appointed to coordinate the work and check that the procedures are being followed.

11.5.4. No changes should be made without consulting the co-ordinator.

11.5.5. All materials and scaffolding should be carefully examined and checked with the drawings before being taken into use.

11.5.6. The foundations should be checked to see that the excavated ground conditions are as the original soil report suggested.

11.5.7. Shuttering should be examined, erected and dismantled under the supervision of qualified and experienced persons and, as far as practicable, by workers familiar with the work.

11.5.8. The necessary information for the erection of shuttering, including particulars of the spacing of stringers and props to stringers, should be provided for the workers in the form of sketches or scale drawings.

11.5.9. Lumber and supports for shuttering (forms) should be adequate, having regard to the loads to be borne, spans, setting temperature and rate of pour. Where necessary to prevent danger, adequate shoring should be provided to support slabs and beams as a protection against superimposed loads.

11.5.10. All adjustable shoring should be locked in position when adjusted.

11.5.11. Shoring should be so arranged that when it is being removed sufficient props can be left in place to afford the support necessary to prevent danger.

11.5.12. Shoring should be adequately protected from damage from moving vehicles, swinging loads, etc.

11.5.13. Shoring should be left in place until the concrete has acquired sufficient strength to support safely not only its own weight but also any imposed loads. It should not be removed until authorisation has been given by a competent person.

11.5.14. Shoring should be adequately braced or tied together to prevent deformation or displacement.

11.5.15. To prevent danger from falling parts when shuttering is being taken down, the shuttering should as far as practicable be taken down whole, or else remaining parts should be supported.

11.5.16. Mechanical, hydraulic or pneumatic lifting appliances for handling forms should be provided with automatic holding devices to prevent danger if the power of the lifting mechanism fails.

11.5.17. Vacuum-lifting appliances should only be applied to smooth, clean surfaces.

11.5.18. Vacuum-lifting devices should be provided with an automatic cut-off to prevent loss of suction in the event of a power or equipment failure.

12. Pile-driving

12.1. General provisions

12.1.1. All pile-driving equipment should be of good design and construction taking into account as far as possible ergonomic principles, and be properly maintained.

12.1.2. Pile-driving should be carried out only under the supervision of a competent person.

12.1.3. Prior to piling, all underground services in the area should be located and rendered safe.

12.1.4. Pile-drivers should be firmly supported on heavy timber sills, concrete beds or other secure foundation.

12.1.5. If necessary to prevent danger, pile-drivers should be adequately guyed.

12.1.6. Precautions should be taken if it is necessary to erect pile-drivers in dangerous proximity to electrical conductors to ensure they are first made dead.

12.1.7. If two pile-drivers are erected at one place they should be separated by a distance at least equal to the longest leg.

12.1.8. When leads have to be inclined:

(a) they should be adequately counterbalanced;

(b) the tilting device should be secured against slipping.

12.1.9. The hoses of steam and air hammers should be securely lashed to the hammer so as to prevent them from whipping if a connection breaks.

12.1.10. Adequate precautions should be taken to prevent a pile-driver from overturning.

12.1.11. Adequate precautions should be taken, by providing stirrups or by other effective means, to prevent the rope from coming out of the top pulley or wheel.

12.1.12. Adequate precautions should be taken to prevent the hammer from missing the pile.

12.1.13. If necessary to prevent danger, long piles and heavy sheet piling should be secured against falling.

12.2. Inspection and maintenance of pile-driving equipment

12.2.1. Pile-driving equipment should not be taken into use until it has been inspected and found to be safe.

12.2.2. Pile-driving equipment in use should be inspected at suitable intervals.

12.2.3. Pile lines and pulley blocks should be inspected before the beginning of each shift.

12.3. Operation of pile-driving equipment

12.3.1. Only competent persons should operate pile-drivers.

12.3.2. Pile-driving operations should be governed by suitable signals.

12.3.3. Workers employed in the vicinity of pile-drivers should wear ear protection and safety helmets or hard hats.

12.3.4. As far as practicable, piles should be prepared at a distance at least equal to twice the length of the longest pile from the pile-driver.

12.3.5. When piles are driven at an inclination to the vertical, if necessary to prevent danger, they should rest in a guide.

12.3.6. When a pile-driver is not in use, the hammer should be blocked at the bottom of the leads.

12.4. Floating pile-drivers

12.4.1. When pile-drivers are working over water, all relevant precautions for work over water should be taken in accordance with this code and in particular a suitable boat should be kept readily available at all times.

12.4.2. All members of floating pile-driver crews should be trained to handle boats.

12.4.3. Floating pile-drivers should be provided with a whistle, siren, horn or other effective signalling equipment.

12.4.4. Floating pile-drivers should be provided with adequate fire-fighting equipment.

12.4.5. The weight of machinery on a floating pile-driver should be evenly distributed so that the deck of the installation is horizontal.

12.4.6. Steel pile-driver hulls should be divided into watertight compartments.

12.4.7. Watertight compartments should be provided with siphons for the removal of water seepage.

12.4.8. Deck hatches should have firmly fastened covers that fit flush with the deck.

12.4.9. Sufficient sheaves should be provided on deck to enable the pile-driver to be safely manoeuvred in any direction and safely secured in position.

12.4.10. Regular head counts should be taken of the pile-driving crew members.

12.5. Sheet piling

12.5.1. If necessary to prevent danger from wind or other sources, handlines should be used to control the load.

12.5.2. Where practicable, a "gate support system" made up from timber "H" frames should be considered. If the gates are over 2 m high they should not be used as a working platform unless fitted with guard-rails, toe-boards and ladder access.

12.5.3. Remote release shackles should be used where possible. The length of the operating rope should be less than the length of the pile and the rope should be secured around the pile to prevent snagging, or being caught in the wind and becoming inaccessible.

12.5.4. If piles are too heavy for a remote release shackle and work cannot be carried out safely from a ladder, a lifting cage should be provided to gain access for unscrewing the shackle.

12.5.5. Long sheet piles should be pitched with a pile spreader. When this is not possible, a pile-pitching cage should be used which should hang from the adjacent pile. The operatives should be provided with a safety harness to be attached to the adjacent pile.

12.5.6. Workers handling sheets should wear gloves.

12.5.7. While it is being weighted with stones, etc., sheet piling should be securely moored.

12.5.8. Adequate pumping facilities should be available at cofferdams to keep them clear of water.

13. Work over water

13.1. General provisions

13.1.1. Where work is done over or in close proximity to water provision should be made for:

(a) preventing workers from falling into water;

(b) the rescue of workers in danger of drowning;

(c) safe and sufficient transport.

13.1.2. National laws or regulations should lay down provisions for the safe performance of work over or in close proximity to water which should include, where appropriate, the provision and use of suitable and adequate:

(a) fencing, safety nets and safety harnesses;

(b) lifebuoys, life jackets and manned boats (motor-driven if necessary);

(c) protection against such hazards as reptiles and other animals.

13.1.3. Gangways, pontoons, bridges, footbridges and other walkways or workplaces over water should:

(a) possess adequate strength and stability;

(b) be sufficiently wide to allow safe movement of workers;

(c) have level surfaces free from protruding knots, bark, nails, bolts and other tripping hazards;

(d) if necessary to prevent danger, be boarded over;

(e) if necessary to prevent danger, be adequately lit when natural lighting is insufficient;

(f) be provided at appropriate points with sufficient lifebuoys, lifelines and other life-saving equipment;

(g) where practicable and necessary to prevent danger, be provided with toe-boards, guard-rails, hand ropes or the like;

(h) be kept clear of tackle, tools and other obstructions;

(i) be strewn with sand, ashes or the like when made slippery by oil or snow;

(j) be secured to prevent dislodgement by rising water or high winds, especially in the case of decking boards on gangways and platforms erected above tidal waters;

(k) if necessary, be equipped with ladders which should be sound, of sufficient strength and length and be securely lashed to prevent slipping. Where vertical permanent ladders are provided in plant over water they should be fitted with safety hoops;

(l) where appropriate, possess adequate buoyancy.

13.1.4. Floating structures should, if necessary to ensure protection, be provided with shelters.

13.1.5. Floating operational equipment should be provided with sufficient and suitable rescue equipment such as lifelines, gaffs and ring buoys.

13.1.6. Where used, rafts should:

(a) be strong enough to support safely the maximum loads that they will have to carry;

(b) be securely moored;

(c) have safe means of access.

13.1.7. Iron decks should be studded or have some other type of non-slip surface.

13.1.8. As far as practicable, all deck openings including those for buckets should be fenced.

13.1.9. A safe walkway should be provided on all floating pipelines.

13.1.10. No person should enter a hydraulic dredge gear room without first informing the leverman and without being accompanied by a second person.

13.1.11. Hoist lines, drag lines, buckets, cutter heads and bridles should be inspected daily.

13.1.12. Workers should be embarked and disembarked only at suitable and safe landing places.

13.1.13. Regular head counts should be taken of workers involved in such operations.

13.2. Boats

13.2.1. Boats used to transport workers by water should comply with requirements which should be laid down by the competent authority.

13.2.2. Boats used to transport workers should be manned by an adequate and experienced crew.

13.2.3. The maximum number of persons transported in a boat should not be greater than safety allows and this number should be displayed in a conspicuous place.

13.2.4. Suitable and adequate life-saving appliances should be provided on boats and be properly placed and maintained.

13.2.5. Tow-boats should have a device by which the tow-rope can be quickly released.

13.2.6. Power-driven boats should carry suitable fire extinguishers.

13.2.7. Row-boats should carry a spare set of oars.

13.2.8. Rescue boats should be properly constructed and of sufficient length and beam to afford reasonable stability. For work in tidal waters or fast flowing rivers a power-driven craft should be provided, with a fixed self-starting device on the motor. Engines on powered craft when not patrolling should be run several times a day to ensure full efficiency.

13.3. Rescue and emergency procedures

13.3.1. Persons who work over water should be provided with some form of buoyancy aid. Life-jackets should provide sufficient freedom of movement, have sufficient buoyancy to bring persons to the surface and keep them afloat face upwards, be easily secured to the body, be readily visible, not be prone to snagging under water and have, when necessary, clip-on self-igniting lights.

13.3.2. Operatives should not work alone on or above water.

13.3.3. Each worker should be trained in the procedure to be followed in the event of an emergency.

14. Demolition

14.1. General provisions

14.1.1. When the demolition of any building or structure might present danger to workers or to the public:

(a) appropriate precautions, methods and procedures should be adopted, including those for the disposal of waste or residues, in accordance with national laws or regulations;

(b) the work should be planned and undertaken only under the supervision of a competent person.

14.1.2. Before demolition operations begin:

(a) structural details and builders' drawings should be obtained wherever possible;

(b) wherever possible, details of the previous use should be obtained to identify any possible contamination and hazards from chemicals, flammables, etc.;

(c) an initial survey should be carried out to identify any structural problems and risks associated with flammable substances and substances hazardous to health. The survey should note the type of ground on which the structure is erected, the condition of the roof trusses, the type of framing used in framed structures and the load-bearing walls;

(d) premises such as hospitals, telephone exchanges and industrial premises containing equipment sensitive to vibration and dust and all premises sensitive to noise should be located;

(e) a method of demolition should be formulated after the survey and recorded in a method statement having taken all the various considerations into account and identifying the problems and their solutions;

(f) a building should be checked and it should be verified that it is vacant.

14.1.3. All electric, gas, water and steam service lines should be shut off and, as necessary, capped or otherwise controlled at or outside the construction site before work commences.

14.1.4. If it is necessary to maintain any electric power, water or other services during demolition operations, they should be adequately protected against damage.

14.1.5. As far as practicable, the danger zone round the building should be adequately fenced off and signposted. To protect the public a fence 2 m high should be erected enclosing the demolition operations and the access gates should be secured outside working hours.

14.1.6. Demolition operations should only be carried out by competent workers.

14.1.7. The fabric of buildings contaminated with substances hazardous to health should be decontaminated and where necessary appropriate protective clothing and suitable respiratory protective equipment should be provided and worn.

14.1.8. Where plant has contained flammable materials, special precautions should be taken to avoid fire and explosion.

14.1.9. The plant to be demolished should be isolated from all other plant that may contain flammable materials. Any residual flammable material in the plant should be rendered safe by, for example, cleaning, purging or the application of an inert atmosphere as appropriate.

14.1.10. Care should be taken not to demolish any parts which would destroy the stability of other parts.

14.1.11. Demolition activities should not be continued under climatic conditions such as high winds, which could cause the collapse of already weakened structures.

14.1.12. When necessary to prevent danger, parts of structures should be adequately shored, braced or otherwise supported.

14.1.13. Structures should not be left in a condition in which they could be brought down by wind pressure or vibration.

14.1.14. Where necessary to keep down dust, buildings being demolished should be sprayed with water at suitable intervals.

14.1.15. Foundation walls serving as retaining walls to support earth or adjoining structures should not be demolished until the adjoining structure has been underpinned or braced, and the earth removed or supported by sheet piling or sheathing.

14.1.16. Where a deliberate controlled collapse technique is to be used, expert engineering advice should be obtained, and:

(a) it should only be used where the whole structure is to come down because it relies on the removal of key structural members to effect a total collapse;

(b) it should only be used on sites that are fairly level and where there is enough surrounding space for all operatives and equipment to be withdrawn to a safe distance.

14.1.17. Buildings and structures which are not carrying their design loads may be pre-weakened prior to a deliberate collapse, but in such cases:

(a) the pre-weakening should be carefully planned so that, despite the removal of redundant members and the partial cutting of load-bearing members, the structure should have sufficient strength to resist wind loads or impact loads until such time as a deliberate collapse is achieved;

(b) the dead load should be reduced systematically by the removal of surplus material, machinery, cladding, walls and parts of floors before work begins on the structural frame.

14.1.18. Where explosives are used to demolish key members, the blast protection and safe distances should be agreed in advance. The work should only be undertaken by personnel experienced in the controlled application of explosives in accordance with national laws and regulations.

14.1.19. The shot-firers should establish the area at risk to enable the area to be appropriately cleared or evacuated, if necessary. Blast protection should be of a high standard but should not be considered as an alternative to defining the area likely to be affected.

14.1.20. When equipment such as power shovels and bulldozers are used for demolition, due consideration should be given to the nature of the building or structure, its dimensions, as well as to the power of the equipment being used.

14.1.21. If a swinging weight is used for demolition, a safety zone having a width of at least one-and-a-half times the height of the building or structure should be maintained around the points of impact.

14.1.22. Swinging weights should be so controlled that they cannot swing against any structure other than the one being demolished.

14.1.23. If a clamshell bucket is used for demolition, a safety zone extending 8 m from the line of travel of the bucket should be maintained.

14.1.24. Where necessary during the demolition of buildings or other structures, appropriate catch platforms capable of withstanding safely a live load of 6.0 kN/m^2 and at least 1.5 m wide should be provided along the outside of exterior walls so as to prevent danger from falling objects.

14.2. Demolition of walls

14.2.1. Walls should be demolished storey by storey beginning at the roof and working downwards.

14.2.2. Where necessary, unsupported walls should be prevented from falling by means such as shoring and ties.

14.3. Demolition of floors

14.3.1. When necessary to prevent danger, workers demolishing floors should be provided with planking or walkways on which to stand or move.

14.3.2. Openings through which material is dropped should be adequately fenced or barricaded to prevent danger.

14.3.3. All work above each tier of floor beams should be completed before the safety of the tier supports is impaired.

14.4. Demolition of structural steelwork

14.4.1. All practicable precautions should be taken to prevent danger from any sudden twist, spring or collapse of steelwork, ironwork or reinforced concrete when it is cut or released.

14.4.2. Steel construction should be demolished tier by tier.

14.4.3. Structural steel parts should be lowered and not dropped from a height.

14.5. Demolition of tall chimneys

14.5.1. Tall chimneys should not be demolished by blasting or overturning unless a protected area of adequate dimensions can be established in which the chimney can fall safely.

14.5.2. Tall chimneys should only be demolished by competent persons under constant competent supervision.

14.5.3. Workers should not stand on top of the chimney wall.

14.5.4. Material thrown down should only be removed during breaks in the work or under controlled conditions.

14.6. Use and removal of asbestos and materials and articles containing asbestos

14.6.1. Use and removal of asbestos-containing materials and articles such as asbestos cement sheets or asbestos insulation present particular health problems as they often involve dismantling or breaking large quantities of friable materials. The work should be performed in accordance with the relevant provisions of the ILO code of practice on *Safety in the use of asbestos*, in particular the provisions of Chapter 18 on construction, demolition and alteration work.

15. Electricity

15.1. General provisions

15.1.1. All electrical equipment and installations should be constructed, installed and maintained by a competent person, and so used as to guard against danger.

15.1.2. Before construction is commenced and during the progress thereof, adequate steps should be taken to ascertain the presence of and to guard against danger to workers from any live electrical cable or apparatus which is under, over or on the site.

15.1.3. The laying and maintenance of electrical cables and apparatus on construction sites should be governed by national laws and regulations.

15.1.4. All parts of electrical installations should be of adequate size and characteristics for the power requirements and work they may be called upon to do and in particular they should:

(a) be of adequate mechanical strength to withstand working conditions in construction operations;

(b) not be liable to damage by water, dust or electrical, thermal or chemical action to which they may be subjected in construction operations.

15.1.5. All parts of electrical installations should be so constructed, installed and maintained as to prevent danger of electric shock, fire and external explosion.

15.1.6. The electrical distribution at each site should be via an isolator which cuts off current from all conductors, is readily accessible and can be locked in the "off" position but not locked in the "on" position.

15.1.7. The power supply to all electrical equipment should be provided with means of cutting off current from all conductors in an emergency.

15.1.8. All electrical appliances and outlets should be clearly marked to indicate their purpose and voltage.

15.1.9. When the layout of an installation cannot be clearly recognised, the circuits and appliances should be identified by labels or other effective means.

15.1.10. Circuits and appliances carrying different voltages in the same installation should be clearly distinguished by conspicuous means such as coloured markings.

15.1.11. Adequate precautions should be taken to prevent installations from receiving current at a higher voltage from other installations.

15.1.12. Where necessary to prevent danger, installations should be protected against lightning.

15.1.13. Lines for signalling and telecommunication systems should not be laid on the same supports as medium- and high-voltage lines.

15.1.14. Only flameproof equipment and conductors should be installed in explosive atmospheres or in storeplaces for explosives or flammable liquids.

15.1.15. A notice or notices should be kept exhibited at suitable places:

(a) prohibiting unauthorised persons from entering electrical equipment rooms or from handling or interfering with electrical apparatus;

(b) containing directions as to procedures in case of fire, rescue of persons in contact with live conductors and the restoration of persons suffering from electric shock;

(c) specifying the person to be notified in case of electrical accident or dangerous occurrence, and indicating how to communicate with him.

15.1.16. Suitable warnings should be displayed at all places where contact with or proximity to electrical equipment can cause danger.

15.1.17. Persons having to operate electrical equipment should be fully instructed as to any possible dangers of the equipment concerned.

15.2. Inspection and maintenance

15.2.1. All electrical equipment should be inspected before it is taken into use to ensure that it is suitable for its proposed use.

15.2.2. At the beginning of every shift, the person using the electrical equipment should make a careful external examination of the equipment and conductors, especially the flexible cables.

15.2.3. Apart from some exceptional cases, work on or near live parts of electrical equipment should be forbidden.

15.2.4. Before any work is begun on conductors or equipment that do not have to remain live:

(a) the current should be switched off by a responsible person;

(b) adequate precautions should be taken to prevent the current from being switched on again;

(c) the conductors or the equipment should be tested to ascertain that they are dead;

(d) the conductors and equipment should be earthed and short-circuited;

(e) neighbouring live parts should be adequately protected against accidental contact.

15.2.5. After work has been done on conductors and equipment, the current should only be switched on again on the orders of a competent person after the earthing and short-circuiting have been removed and the workplace reported safe.

15.2.6. Electricians should be supplied with sufficient adequate tools, and personal protective equipment such as rubber gloves, mats and blankets.

15.2.7. All conductors and equipment should be considered to be live unless there is certain proof of the contrary.

15.2.8. When work has to be done in dangerous proximity to live parts the current should be cut off. If for operational reasons this is not possible, the live parts should be fenced off or enclosed by qualified staff from the power station concerned.

15.3. Testing

15.3.1. Electrical installations should be inspected and tested and the results recorded in accordance with national laws or regulations.

15.3.2. Periodic testing of the efficiency of the earth leakage protective devices should be carried out.

15.3.3. Particular attention should be paid to the earthing of apparatus, the continuity of protective conductors, polarity and insulation resistance, protection against mechanical damage and condition of connections at points of entry.

16. Explosives

16.1. General provisions

16.1.1. Explosives should not be stored, transported, handled or used except:

(a) under conditions prescribed by national laws or regulations;

(b) by a competent person, who should take all necessary steps to ensure that workers and other persons are not exposed to risk of injury.

16.1.2. Before explosives are used for blasting on a site, an agreed system of work should be prepared and the responsibilities of persons involved detailed in writing.

16.1.3. Blasting caps, safety fuses, wiring and other blasting equipment should conform to specifications laid down in national laws or regulations.

16.1.4. Dynamite should not be removed from its original wrapper until it is being loaded into boreholes.

16.1.5. As far as practicable, blasting should be done off shift or during breaks in the work.

16.1.6. As far as practicable, blasting above ground should be done in daylight.

16.1.7. If blasting above ground has to be done during darkness, roadways and pathways should be adequately lit.

16.1.8. If blasting can endanger workers in another enterprise:

(a) blasting times should be agreed between the two enterprises;

(b) shots should not be fired until a warning has been given to the other enterprise and acknowledged by it.

16.1.9. Loaded boreholes should not be left unattended after the end of the shift.

16.1.10. At an appropriate time before the final blasting warning, workers in the area should be removed to a designated safe place.

16.1.11. An unmistakable, audible, final warning should be sounded one minute prior to the detonation of explosives; after completion, when the person in charge has established that safe conditions prevail, an "all clear" should be sounded.

16.1.12. To prevent persons entering any danger zone during blasting operations:

(a) look-outs should be posted around the area of operations;

(b) warning flags should be flown;

(c) conspicuous notices should be posted at points around the area of operations.

16.1.13. Before a borehole is loaded all workers not employed in the blasting operation should withdraw to a safe place.

16.1.14. Smoking and open flames should not be allowed in the loading area.

16.2. Transport, storage and handling

16.2.1. All explosives supplied to and issued from a magazine should be accounted for and recorded, and unused explosives should be returned to the same magazine on the completion of the operation for which they were drawn.

16.2.2. Detonators should be stored or transported separately from the explosives.

16.2.3. Workers storing, transporting or handling explosives or travelling on vehicles carrying explosives should not smoke or carry open lights.

16.2.4. Road and rail vehicles used to transport explosives should:

(a) be in good condition and running order;

(b) have a tight wooden or non-sparking metal floor;

(c) have sides and ends high enough to prevent the explosives from falling out;

(d) in the case of road vehicles, carry at least two suitable fire extinguishers;

(e) be plainly marked by a red flag, lettering or otherwise to indicate that they are carrying explosives.

16.2.5. Explosives and detonators should be transported separately from the magazine to the workplace in their original containers or in special closed containers of non-sparking metal.

16.2.6. Different types of explosives should not be transported in the same container.

16.2.7. Containers should be marked to show the type of explosive kept in them.

16.2.8. Explosives should be permanently stored only in magazines which should:

(a) be at a safe distance from occupied buildings or areas;

(b) be substantially constructed, bulletproof and fire-resistant;

(c) be clean, dry, well-ventilated, cool, and protected against frost;

(d) be kept securely locked.

16.2.9. Only flameproof electric lighting equipment should be allowed in explosives magazines.

16.2.10. Flammable substances or sparking metal objects should not be stored or used in explosives magazines.

16.2.11. In explosives magazines or in a restricted and clearly marked zone around them:

(a) smoking, matches, open lights or open flames should not be permitted;

(b) firearms should not be discharged;

(c) combustible debris such as grass, leaves or brushwood should not be allowed to accumulate.

16.2.12. Explosives magazines should not be opened during or on the approach of an electrical storm.

16.2.13. If quantities of explosives and detonators have to be provisionally stored outside the main magazine, special accommodation should be provided, such as a special room, a portable magazine or a suitable container.

16.2.14. Overshoes should be kept at each store and worn by people who have to enter them.

16.2.15. Only persons authorised to handle explosives should have the keys of magazines, storerooms or cases for explosives.

16.2.16. Containers of explosives should not be opened with sparking tools, provided that metal slitters may be used to open cartons or similar containers.

16.2.17. Explosives should be protected from impact.

16.2.18. Explosives should not be carried in pockets or elsewhere on the person.

16.2.19. As soon as the approach of an electrical storm is detected, all workers should be removed from the area where explosives are stored or are in use.

16.2.20. No explosives should be left lying about without supervision.

16.3. Disposal of explosives

16.3.1. Explosives should not be destroyed except in conformity with the manufacturers' instructions.

16.3.2. No material used in the wrapping or packing of explosives should be burned in a stove, fireplace or other confined space.

16.3.3. No person should remain within 30 m of a fire in which wrapping or packing material is burned.

17. Health hazards, first aid and occupational health services

17.1. General requirements

17.1.1. For works which by their very nature expose workers to hazards arising from the use or presence of chemical, physical or biological agents and climatic conditions, appropriate preventive measures should be taken to avoid any danger to the safety and health of workers.

17.1.2. The preventive measures referred to in paragraph 17.1.1 should place emphasis on the need to eliminate or reduce the hazard at the source and in particular should require:

(a) the replacement of hazardous substances, equipment or processes with substances, equipment or processes less harmful or hazardous to workers' safety and health;

(b) the reduction of noise and vibration caused by equipment, machinery, installations and tools;

(c) control of the release of harmful agents or chemicals into the working environment;

(d) training in manual lifting;

(e) proper working postures when workers are required to work in fixed working positions or when they are carrying out repetitive work;

(f) appropriate protection against climatic conditions likely to jeopardise health;

(g) where the foregoing measures are inappropriate:

  i) instituting work practices which will eliminate or minimise danger to safety and health;

  ii) supplying and requiring the use of personal protective equipment and clothing.

17.1.3. The employer should make arrangements for the identification and assessment by competent persons of health hazards presented by the use of different operations, plant, machinery, equipment, substances and radiations at the construction site and take appropriate preventive or control measures against the identified health risks in conformity with the national laws and regulations.

17.2. Occupational health services

17.2.1. The employer should provide for the setting up of or access to an occupational health service consistent with the objectives and principles of the Occupational Health Services Convention, 1985 (No. 161) and Recommendation (No. 171).

17.2.2. All workers should be subject to health surveillance.

17.2.3. Monitoring and control of the working environment and planning of safety and health precautions should be performed as prescribed by national laws and regulations.

17.2.4. A multiplicity of health hazards are present in construction work and every effort should be made to promote awareness of this fact and of the need to safeguard health.

17.2.5. Whenever new products, equipment and working methods are introduced, special attention should be paid to informing and training workers with respect to the implications for safety and health.

17.3. First aid

17.3.1. The employer should be responsible for ensuring that first aid, including the provision of trained personnel, is available. Arrangements should be made for ensuring the removal for medical attention of workers who have suffered an accident or sudden illness.

17.3.2. The manner in which first-aid facilities and personnel are to be provided should be prescribed by national laws or regulations, and drawn up after consulting the competent health authority and the most representative organisations of employers and workers concerned.

17.3.3. Where the work involves risk of drowning, asphyxiation or electric shock, first-aid personnel should be proficient in the use of resuscitation and other life-saving techniques and in rescue procedures.

17.3.4. Suitable rescue and resuscitation equipment, as required, including stretchers should be kept readily available at the construction site.

17.3.5. First-aid kits or boxes, as appropriate, should be provided at the workplaces, including isolated locations such as maintenance gangs, and on motor vehicles, locomotives, boats and floating equipment, and be protected against contamination by dust, moisture, etc.

17.3.6. First-aid kits and boxes should not contain anything besides material for first aid in emergencies.

17.3.7. First-aid kits and boxes should contain simple and clear instructions to be followed, be kept under the charge of a responsible person qualified to render first aid and be regularly inspected and kept properly stocked.

17.3.8. If a minimum number of workers as prescribed is employed in any shift, at least one suitably equipped first-aid room or station under the charge of qualified first-aid personnel or a nurse should be provided at a readily accessible place for treatment of minor injuries and as a rest place for seriously sick or injured workers.

17.4. Hazardous substances

17.4.1. An information system should be set up by the competent authority, using the results of international scientific research, to provide information for clients, architects, contractors, employers' and workers' representatives on the health risks associated with the hazardous substances used in the construction industry.

17.4.2. National laws and regulations should require that the manufacturers, importers and suppliers of hazardous products used in the construction industry should provide information with the products, in the appropriate language, on associated health risks and on the precautions to be taken.

17.4.3. In the use of materials that contain hazardous substances and in the removal and disposal of waste, the health of workers and of the public and the preservation of the environment should be safeguarded as prescribed by national laws and regulations.

17.4.4. Hazardous substances should be clearly labelled giving their relevant characteristics and instructions on their use. They should be handled under conditions prescribed by national laws and regulations or by the competent authority.

17.4.5. Containers of hazardous substances should carry or be accompanied by instructions for the safe handling of the contents and procedures to be followed in case of a spillage.

17.4.6. The competent authority, in consultation with the most representative organisations of employers and workers, should determine which hazardous substances should be prohibited from use in the construction industry.

17.4.7. Preference should be given to the application of hazardous substances by means other than spraying, such as by brush or roller, when feasible.

17.4.8. Where the use of toxic solvents, certain thinners, certain paints or volatile chemical substances cannot be avoided, special precautions should be taken such as providing general and local exhaust ventilation, and, if this is not practicable or is inadequate, respiratory protective equipment should be used. Such measures should be applied more rigorously in situations when such chemicals are heated or used in confined spaces. Paints and adhesives which present health hazards should be replaced with water-dispersed products.

17.4.9. Skin contact with hazardous chemicals should be avoided, particularly when dealing with chemicals which can penetrate through intact skin (e.g. certain wood preservatives) or can cause dermatitis (e.g. wet cement). Personal hygiene and the type of clothing worn should be such as to enable the rapid removal of any chemical from skin contact. Where allergic effects caused by certain materials could be reduced by introducing other additives, necessary steps should be taken to make use of these additives preferably at the manufacturing stage (e.g. adding iron sulphate to cement and cement products containing hexavalent chromium).

17.4.10. When it is necessary to deal with proven carcinogenic substances, particularly in work involving bituminous or tar asphalt, asbestos fibres, pitch, some heavy oils, and some aromatic solvents, strict measures should be taken to avoid inhalation and skin contact. Particular care should be taken with substances where there is reliable evidence of suspected carcinogenic effects.

17.5. Dangerous atmospheres

17.5.1. Where workers are required to enter any area in which a toxic or harmful substance may be present, or in which there may be an oxygen deficiency or a flammable atmosphere, adequate measures should be taken to guard against danger.

17.5.2. The measures regarding dangerous atmospheres to be taken pursuant to paragraph 17.4.1 above should be prescribed by the competent authority and should include prior written authority or permission from a competent person, or any other system by which entry into any area in which a dangerous atmosphere may be present can be effected only after completing specified procedures.

17.5.3. No naked light or flame or hot work such as welding, cutting and soldering should be permitted inside a confined space or area unless it has been made completely free of the flammable atmosphere, tested and found safe by a competent person. Only non-sparking tools and flameproof hand lamps protected with guard and safety torches should be used inside such confined space or area for initial inspection, cleaning or other work required to be done for making the area safe.

17.5.4. No person should enter a confined space or area with a dangerous atmosphere or deficiency of oxygen unless:

(a) the atmosphere has been found to be safe after suitable testing by a competent person (which should be repeated at suitable intervals);

(b) adequate ventilation is provided.

17.5.5. If the conditions in the preceding paragraph cannot conveniently be fulfilled, persons may enter such spaces for prescribed periods using air lines or self-contained breathing apparatus and safety harnesses with lifelines.

17.5.6. While a worker is in a confined space:

(a) adequate facilities and equipment including breathing apparatus, resuscitation apparatus and oxygen should be readily available for rescue purposes;

(b) a fully trained attendant or attendants should be stationed at or near the opening;

(c) suitable means of communication should be maintained between the worker and the attendant or attendants.

17.6. Radiation hazards

Ionising radiations

17.6.1. Stringent safety regulations should be drawn up and enforced by the competent authority with respect to construction workers engaged in the construction, maintenance, renovation, demolition or dismantling of any buildings in which there is a risk of exposure to ionising radiations, in particular in the nuclear power industry, and in work using radioactive sources or inside structures containing natural radioactive materials.

17.6.2. Relevant provisions of the ILO code of practice on *Radiation protection of workers (Ionising radiations)* should be followed.

Non-ionising radiations

17.6.3. Workers performing operations where they are exposed to non-ionising radiations should be provided with adequate protection, and particularly in welding, torch cutting and soldering operations, with eye and face protection.

17.6.4. For the purpose of detecting pre-cancerous lesions of the skin, workers continually working under non-ionising radiation exposure, including exposure to the sun, should be under medical surveillance, where appropriate.

17.7. Heat stress, cold and wet conditions

17.7.1. Whenever heat stress, cold or wet conditions are such that they can lead to impairment of health or extreme discomfort, preventive measures should be taken, such as:

(a) proper design of the workload and workstation, with special regard to workers in cabins, and command or driving operations;

(b) training, to enable detection of early signs of disorders;

(c) supply of protective equipment;

(d) routine medical surveillance.

17.7.2. When working in hot conditions, preventive measures to avoid heat stress should include rest in cool areas and an adequate supply of drinking water.

17.8. Noise and vibration

17.8.1. Employers should provide protection for workers from the harmful effects of noise and vibration from machines and work processes, by measures including:

(a) replacing hazardous machines and processes by less hazardous ones;

(b) reducing the exposure of workers;

(c) providing personal hearing protection.

17.8.2. Employers should consider the following developments and improvements in machines and processes:

(a) pneumatic drills and jackhammers to be replaced by hydraulic and electro-pneumatic hammers;

(b) remote operation for vibrators, jackhammers and drills;

(c) acoustic enclosure and improved design for compressed air discharges, and the cutters, blades and exhausts of internal combustion engines as well as the engines themselves;

(d) better means of supporting or holding manually operated tools in order to reduce the effects of vibration or better vibration damping on vehicle controls and seats.

17.8.3. Employers should give priority to the reduction of the duration of workers' exposure to noise and vibration when operating:

(a) jackhammers, drills and compressors;

(b) high impact noise tools such as cartridge-operated guns;

(c) manually operated vibratory tools, especially those operated upwards or in a cold environment.

17.8.4. Employers should provide personal protective equipment where the harmful effects of noise and vibration will be experienced by workers; this should include:

(a) hearing protection in accordance with national laws and regulations, which can be worn with a safety helmet;

(b) in the case of vibration, suitable protective gloves.

17.9. Biological agents

17.9.1. In areas where biological agents pose a hazard, preventive measures should be taken which take account of the mode of transmission; in particular:

– the provision of sanitation and information for workers;
– action against vectors, such as rats and insects;
– chemical prophylaxis and immunisation;
– the availability of antidotes and suitable preventive and curative medicine, mainly in rural areas;
– the supply of protective clothing and other appropriate precautions.

17.10. Additional provisions

17.10.1. The manual lifting of weights which presents a safety and health risk to workers should be avoided by reducing the weight, by the use of mechanical devices or by other means.

17.10.2. Waste should not be destroyed or otherwise disposed of on a construction site in a manner which is liable to be injurious to health.

18. Personal protective equipment and protective clothing

18.1. General provisions

18.1.1. Where adequate protection against the risk of accident or injury to health, including exposure to adverse conditions, cannot be ensured by other means, suitable personal protective equipment and protective clothing, having regard to the type of work and risks, should be provided and maintained by the employer, without cost to the workers, as may be prescribed by national laws or regulations.

18.1.2. Personal protective equipment and protective clothing should comply with standards set by the competent authority, taking into account as far as possible ergonomic principles.

18.1.3. Employers should provide the workers with the appropriate means to enable them to use the individual protective equipment and should require and ensure its proper use.

18.1.4. A competent person having a full understanding of the nature of the hazard and the type, range and performance of the protection required should:

(a) select suitable items of personal protective equipment and protective clothing;

(b) arrange that they are properly stored, maintained, cleaned and, if necessary for health reasons, disinfected or sterilised at suitable intervals.

18.1.5. Workers should be required to make proper use of and to take good care of the personal protective equipment and protective clothing provided for their use.

18.1.6. Workers should be instructed in the use of personal protective equipment and protective clothing.

18.1.7. Workers working alone on construction sites in confined spaces, enclosed premises or in remote or inaccessible places should be provided with an appropriate alarm and the means of rapidly summoning assistance in an emergency.

18.2. Types

18.2.1. Where necessary, workers should be provided with and wear the following personal protective equipment and protective clothing:

(a) safety helmets or hard hats to protect the head from injury due to falling or flying objects, or due to striking against objects or structures;

(b) clear or coloured goggles, a screen, a face shield or other suitable device when likely to be exposed to eye or face injury from airborne dust or flying particles, dangerous substances, harmful heat, light or other radiation, and in particular

during welding, flame cutting, rock drilling, concrete mixing or other hazardous work;

(c) protective gloves or gauntlets, appropriate barrier creams and suitable protective clothing to protect hands or the whole body as required when exposed to heat radiation or while handling hot, hazardous or other substances which might cause injury to the skin;

(d) footwear of an appropriate type when employed at places where there is the likelihood of exposure to adverse conditions or of injury from falling or crushing objects, hot or hazardous substances, sharp-edged tools or nails and slippery or ice-covered surfaces;

(e) respiratory protective equipment, suitable for the particular environment, when workers cannot be protected against airborne dust, fumes, vapours or gases by ventilation or other means;

(f) a suitable air line or self-contained breathing apparatus when employed in places likely to have an oxygen deficiency;

(g) respirators, overalls, head coverings, gloves, tight-fitting boiler suits, impermeable footwear and aprons appropriate to the risks of radioactive contamination in areas where unsealed radioactive sources are prepared or used;

(h) waterproof clothing and head coverings when working in adverse weather conditions;

(i) safety harnesses with independently secured lifelines where protection against falls cannot be provided by other appropriate means;

(j) life vests and life preservers where there is a danger of falling into water;

(k) distinguishing clothing or reflective devices or otherwise conspicuously visible material when there is regular exposure to danger from moving vehicles.

19. Welfare

19.1. General provisions

19.1.1. At or within reasonable access of every construction site an adequate supply of wholesome drinking water should be provided.

19.1.2. At or within reasonable access of every construction site, the following facilities should, depending on the number of workers and the duration of the work, be provided, kept clean and maintained:

(a) sanitary and washing facilities or showers;

(b) facilities for changing and for the storage and drying of clothing;

(c) accommodation for taking meals and for taking shelter during interruption of work due to adverse weather conditions.

19.1.3. Men and women workers should be provided with separate sanitary and washing facilities.

19.2. Drinking water

19.2.1. All drinking water should be from a source approved by the competent authority.

19.2.2. Where such water is not available, the competent authority should ensure that the necessary steps are taken to make any water to be used for drinking fit for human consumption.

19.2.3. Drinking water for common use should only be stored in closed containers from which the water should be dispensed through taps or cocks.

19.2.4. If drinking water has to be transported to the worksite, the transport arrangements should be approved by the competent authority.

19.2.5. The transport tanks, storage tanks and dispensing container should be designed, used, cleaned and disinfected at suitable intervals in a manner approved by the competent authority.

19.2.6. Water that is unfit to drink should be conspicuously indicated by notices prohibiting workers from drinking it.

19.2.7. A supply of drinking water should never be connected to a supply of water that is unfit to drink.

19.3. Sanitary facilities

19.3.1. The scale of provision of toilet or sanitary facilities, and the construction and installation of water flush toilets, privies, chemical closets, plumbing or other toilet fixtures should comply with the requirements of the competent authority.

19.3.2. No toilet other than a water flush toilet should be installed in any building containing sleeping, eating or other living accommodation and should be adequately ventilated and not open directly into occupied rooms.

19.3.3. Adequate washing facilities should be provided as near as practicable to toilet facilities.

19.4. Washing facilities

19.4.1. The number and standard of construction and maintenance of washing facilities should comply with the requirements of the competent authority.

19.4.2. Washing facilities should not be used for any other purpose.

19.4.3. Where workers are exposed to skin contamination by poisonous, infectious or irritating substances, or oil, grease or dust, there should be a sufficient number of appropriate washing facilities or shower-baths supplied with hot and cold water.

19.5. Cloakrooms

19.5.1. Cloakrooms should be provided for workers at easily accessible places and not be used for any other purpose.

19.5.2. Cloakrooms should be provided with suitable facilities for drying wet clothes and for hanging clothing including, where necessary to avoid contamination, suitable lockers separating working from street clothes.

19.5.3. Suitable arrangements should be made for disinfecting cloakrooms and lockers in conformity with the requirements of the competent authority.

19.6. Facilities for food and drink

19.6.1. In appropriate cases, depending on the number of workers, the duration of the work and its location, adequate facilities for obtaining or preparing food and drink at or near a construction site should be provided, if not otherwise available.

19.7. Shelters

19.7.1. Shelters should, as far as practicable, provide facilities for washing, taking meals and for drying and storing clothing, unless such facilities are available in the vicinity.

19.8. Living accommodation

19.8.1. Suitable living accommodation should be made available for the workers at construction sites which are remote from their homes, where adequate transportation between the site and their homes or other suitable living accommodation is not available. Men and women workers should be provided with separate sanitary, washing and sleeping facilities.

20. Information and training

20.1. Workers should be adequately and suitably:

(a) informed of potential safety and health hazards to which they may be exposed at their workplace;

(b) instructed and trained in the measures available for the prevention and control, and protection against, those hazards.

20.2. No person should be employed in any work at a construction site unless that person has received the necessary information, instruction and training so as to be able to do the work competently and safely. The competent authority should, in collaboration with employers, promote training programmes to enable all the workers to read and understand the information and instructions related to safety and health matters.

20.3. The information, instruction and training should be given in a language understood by the worker and written, oral, visual and participative approaches should be used to ensure that the worker has assimilated the material.

20.4. National laws or regulations should prescribe:

(a) the nature and length of training or retraining required for various categories of workers employed in construction projects;

(b) that the employer has the duty to set up appropriate training schemes or arrange to train or retrain various categories of workers.

20.5. Every worker should receive instruction and training regarding the general safety and health measures common to the construction site, which should include:

(a) general rights and duties of workers at the construction site;

(b) means of access and egress both during normal working and in an emergency;

(c) measures for good housekeeping;

(d) location and proper use of welfare amenities and first-aid facilities provided in pursuance of the relevant provisions of this code;

(e) proper use and care of the items of personal protective equipment and protective clothing provided to the worker;

(f) general measures for personal hygiene and health protection;

(g) fire precautions to be taken;

(h) action to be taken in case of an emergency;

(i) requirements of relevant safety and health rules and regulations.

20.6. Copies of the relevant safety and health rules, regulations and procedures should be available to workers upon the commencement of and upon any change of employment.

20.7. Specialised instruction and training should be given to:

(a) drivers and operators of lifting appliances, transport vehicles, earth-moving and materials-handling equipment and plant, and machinery or equipment of a specialised or dangerous nature;

(b) workers engaged in the erection or dismantling of scaffolds;

(c) workers engaged in excavations deep enough to cause danger, or shafts, earthworks, underground works or tunnels;

(d) workers handling explosives or engaged in blasting operations;

(e) workers engaged in pile-driving;

(f) workers working in compressed air, cofferdams and caissons;

(g) workers engaged in the erection of prefabricated parts or steel structural frames and tall chimneys, and in concrete work, formwork and such other work;

(h) workers handling hazardous substances;

(i) workers working as signallers;

(j) other specialised categories of workers.

20.8. Wherever required by national laws and regulations, only drivers, operators or attendants holding a certificate of proficiency or licence should be employed to operate particular vehicles, lifting appliances, boilers or other equipment.

21. Reporting of accidents and diseases

21.1. National laws or regulations should provide for the reporting of occupational accidents and diseases to the competent authority.

21.2. All accidents to workers causing loss of life or serious injury should be reported forthwith to the competent authority and an investigation of these accidents should be made.

21.3. Other injuries causing incapacity for work for periods of time as may be specified in national laws or regulations, and prescribed occupational diseases should be reported to the competent authority within such time and in such form as may be specified.

21.4. Dangerous occurrences such as:

(a) explosions and serious fires;

(b) the collapse of cranes, derricks or other lifting appliances;

(c) the collapse of buildings, structures or scaffolds, or parts thereof,

should be reported forthwith to the competent authority in such form and manner as may be prescribed, whether any personal injury has been caused or not.

Appendix

Bibliography

I. ILO publications

Listed below are various Conventions, Recommendations, codes of practice, guides and other ILO publications, which may assist the reader seeking further information about safety and health in construction.

Although this list is current as of the date of publication of this code of practice, the ILO is constantly publishing new material; for the most up-to-date information the reader is advised to contact:

– ILO Publications, International Labour Office, CH-1211 Geneva 22, Switzerland;
– International Occupational Safety and Health Information Centre (CIS), International Labour Office, Geneva, or any available CIS National Centre;
– any available ILO local or regional office.

Conventions

No.	*Title*
81	Labour Inspection in Industry and Commerce, 1947
115	Protection of Workers against Ionising Radiations, 1960
119	Guarding of Machinery, 1963
121	Benefits in the Case of Employment Injury, 1964
127	Maximum Permissible Weight to Be Carried by One Worker, 1967
136	Protection against Hazards of Poisoning Arising from Benzene, 1971
138	Minimum Age for Admission to Employment, 1973
139	Prevention and Control of Occupational Hazards caused by Carcinogenic Substances and Agents, 1974
148	Protection of Workers against Occupational Hazards in the Working Environment Due to Air Pollution, Noise and Vibration, 1977
152	Occupational Safety and Health in Dock Work, 1979
155	Occupational Safety and Health and the Working Environment, 1981
160	Labour Statistics, 1985
161	Occupational Health Services, 1985
162	Safety in the Use of Asbestos, 1986
167	Safety and Health in Construction, 1988
170	Safety in the Use of Chemicals at Work, 1990

Recommendations

No.	*Title*
81	Labour Inspection, 1947
97	Protection of the Health of Workers in Places of Employment, 1953
114	Protection of Workers against Ionising Radiations, 1960
118	Guarding of Machinery, 1963
121	Benefits in the Case of Employment Injury, 1964
128	Maximum Permissible Weight to Be Carried by One Worker, 1967
144	Protection against Hazards of Poisoning Arising from Benzene, 1971

146 Minimum Age for Admission to Employment, 1973

147 Prevention and Control of Occupational Hazards caused by Carcinogenic Substances and Agents, 1974

156 Protection of Workers against Occupational Hazards in the Working Environment Due to Air Pollution, Noise and Vibration, 1977

160 Occupational Safety and Health in Dock Work, 1979

164 Occupational Safety and Health and the Working Environment, 1981

170 Labour Statistics, 1985

171 Occupational Health Services, 1985

172 Safety in the Use of Asbestos, 1986

175 Safety and Health in Construction, 1988

177 Safety in the Use of Chemicals at Work, 1990

Codes of practice

Safe construction and installation of electric passenger, goods and service lifts. 1972. 108 pp.

Safety and health in building and civil engineering work. 1972. 386 pp.

Safety and health in shipbuilding and ship repairing. 1974. 260 pp.

Safety and health in dock work. 1977. 221 pp.

Safe design and use of chain saws. 1978. 71 pp.

Occupational exposure to airborne substances harmful to health. 1980. 44 pp.

Safety and health in the construction of fixed offshore installations in the petroleum industry. 1981. 135 pp.

Protection of workers against noise and vibration in the working environment. 1984. 90 pp.

Safety in the use of asbestos. 1984. 116 pp.

Radiation protection of workers (Ionising radiations). 1987. 71 pp.

Safety, health and working conditions in the transfer of technology to developing countries. 1988. 81 pp.

Prevention of major industrial accidents. 1991. 108 pp.

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Working conditions and environment: A workers' education manual. 1983. 81 pp.

Accident prevention: A workers' education manual. 1986. 175 pp.

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Training manual on safety and health in construction. 1987. 347 pp.

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Training manual on safety, health and welfare on construction sites. 1990. 210 pp.

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No. 65 International data on anthropometry. 1990. 113 pp.
No. 66 International directory of occupational safety and health institutions. 1990. 272 pp.
No. 67 Occupational lung diseases: Prevention and control. 1991. 85 pp.

ILO Industrial committees and analogous meetings

The improvement of working conditions and of the working environment in the construction industry, Report II, Building, Civil Engineering and Public Works Committee, Tenth Session, Geneva, 1983.

Other ILO publications

Encyclopaedia of occupational health and safety. Third ed., 1983. 1176 pp. + 1361 pp.

Guidelines for the use of ILO international classification of radiographs of pneumoconioses. 1980. 48 pp.

Automation, work organisation and occupational stress. 1984. 188 pp.

Managing construction projects – A guide to processes and procedures. Edited by A. D. Austen and R. H. Neale. 1984. 158 pp.

Safety and health practices of multinational enterprises. 1984. 90 pp.

Introduction to working conditions and environment. Edited by J.-M. Clerc. 1985. 323 pp.

Register of lifting appliances and items of loose gear (Model form and certificates as required by ILO Convention No. 152). 1985. 16 pp.

Technology and employment in industry. Edited by A. S. Bhalla. 1985. 436 pp.

II. International Social Security Association (ISSA) publications

Various publications in different sectors of industry, including construction.

Information can be obtained from:

- ISSA Secretariat, CH-1211 Geneva 22, Switzerland;
- ISSA International Section for the Construction Industry: Secretariat, Organisme professionnel de prevention du bâtiment et des travaux publics (OPPBTP), Tour Amboise, 204, Rond-Point du Pont-de-Sévres, F-925 16 Boulogne-Bilancourt, France.

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Other ILO publications

Occupational safety and health in the iron and steel industry. An ILO code of practice

All those with responsibility for safety and health or for framing provisions on safety and health in the iron and steel industry, whether in the public or in the private sector, will find this code of practice invaluable. Detailed and practical guidance is given on the basic requirements for promoting safety and health throughout the industry. The provisions of the code are readily adaptable to local circumstances, technical level and scale of operation, and to the needs of both developing and developed countries.

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This code of practice provides guidance in setting up an administrative, legal and technical system for the control of installations producing, storing or using hazardous substances. Its recommendations cover siting, analysis of risks, prevention, safe operation, emergency planning, and the duties and responsibilities of all those involved in the control of major hazards in industry.

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Safety and health in construction

The need to develop improved safety and health practices in the construction industry is well recognised by those responsible for framing provisions in this sector. This code of practice is intended for use by competent authorities, committees, management or employers' and workers' organisations.

The present volume, an update of an earlier code of practice, takes into account the changes in working practices and conditions which have arisen over the past few decades and new areas requiring protective measures in the industry.

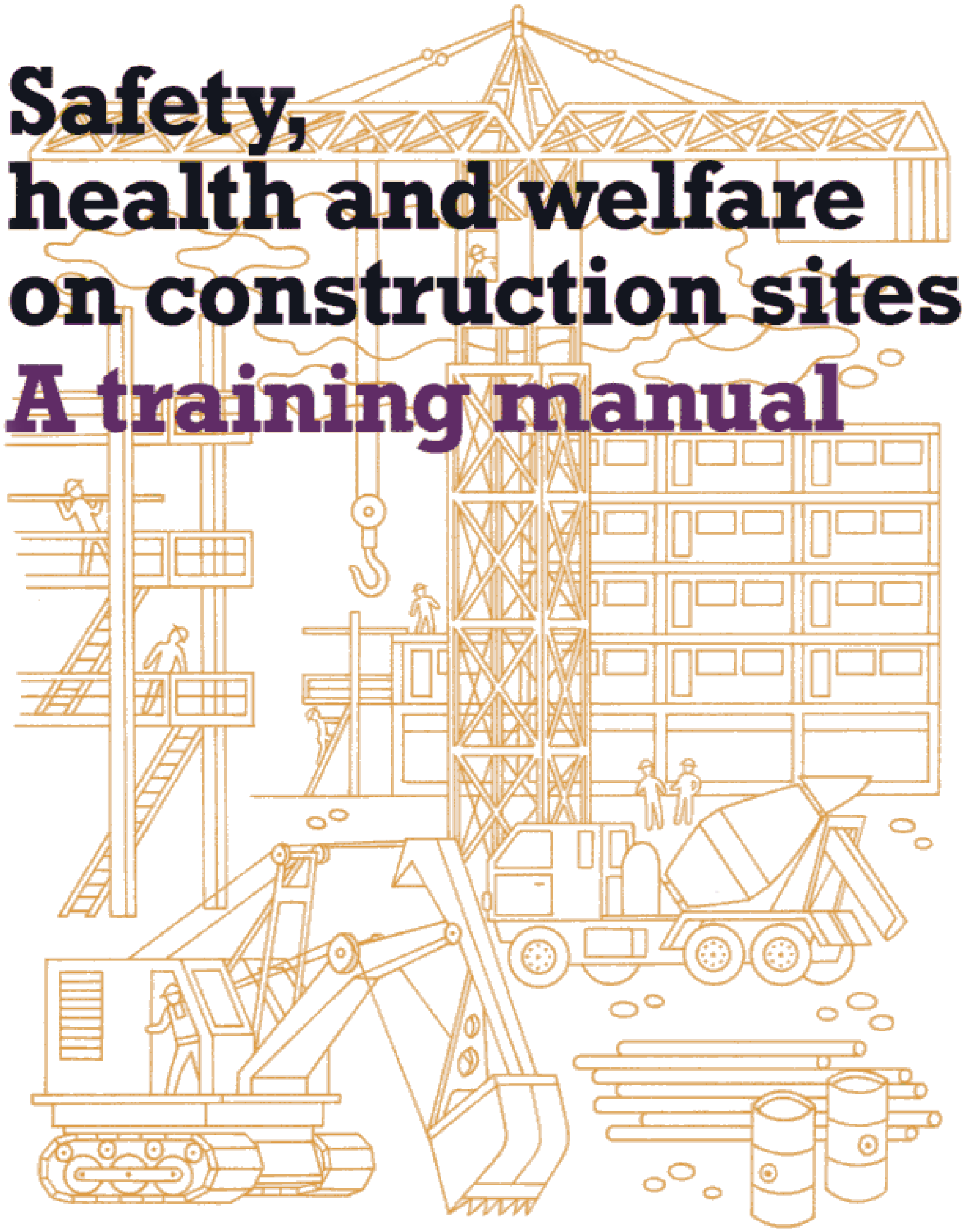
It aims to provide guidelines and practical recommendations and covers such areas as: the safety of workplaces; personal protective equipment and protective clothing; health hazards; and construction equipment and machinery.

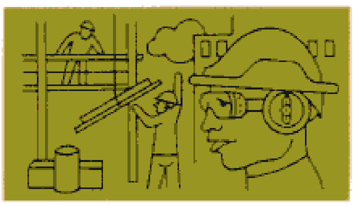
Price: 20 Swiss francs

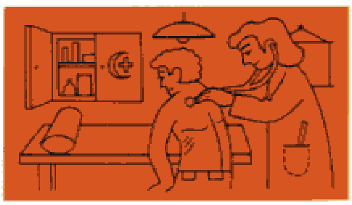
ISBN 92-2-107104-9

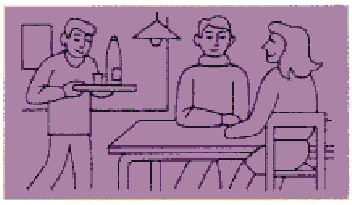
Safety, health and welfare on construction sites

A training manual









International Labour Office Geneva

Grateful thanks are due to the Joint Industrial Safety Council of Sweden for the use of figures 33, 38, 43, 44, 45, 47 and 54, which are taken from the training manual *Safety, health and working conditions* (Stockholm, 1987).

The International Programme for the Improvement of Working Conditions and Environment (PIACT) was launched by the International Labour Organization in 1976 at the request of the International Labour Conference and after extensive consultations with member States.

PIACT is designed to promote or support action by member States to set and attain definite objectives aiming at "making work more human". The Programme is thus concerned with improving the quality of working life in all its aspects: for example, the prevention of occupational accidents and diseases, a wider application of the principles of ergonomics, the arrangement of working time, the improvement of the content and organization of work and of conditions of work in general, and a greater concern for the human element in the transfer of technology. To achieve these aims, PIACT makes use of and coordinates the traditional means of ILO action, including:

– the preparation and revision of international labour standards;
– operational activities, including the dispatch of multidisciplinary teams to assist member States on request;
– tripartite meetings between representatives of governments, employers and workers, including industrial committees to study the problems facing major industries, regional meetings and meetings of experts;
– action-oriented studies and research; and
– clearing-house activities, especially through the International Occupational Safety and Health Information Centre (CIS) and the Clearing-house for the Dissemination of Information on Conditions of Work.

This publication is the outcome of a PIACT project.

Safety, health and welfare on construction sites

A training manual

Safety, health and welfare on construction sites

A training manual

International Labour Office Geneva

First published 1995
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Preface

With a view to reducing the incidence of injuries and illnesses among workers in the construction industry, the International Labour Conference adopted in 1988 the Safety and Health in Construction Convention (No. 167), and Recommendation (No. 175).

The ILO has worked diligently in numerous countries to carry out its programme of promoting the implementation of ILO standards in safety and health in the construction industry. A major contribution to this important effort was made possible by an ILO/UNDP Project on the Promotion of Safety, Health and Welfare in the Construction Industry (RAS/86/072). This project, which went into force in 1988, provided assistance to 12 participating Asian countries to improve safety, health and welfare programmes for preventing occupational accidents and diseases in the construction industry. Through this project and other programmes, the ILO encourages participating countries to strengthen national infrastructures which can help sustain their capabilities after ILO projects or programmes have terminated. These ongoing efforts are particularly important for promoting national action towards reinforcing the capacity for training in the safety and health of construction workers and management, and for improving the collection and analysis of relevant statistical data aimed at prevention.

The need for a training manual for those engaged in or concerned with the construction industry was recognized early in the implementation of the ILO/UNDP project by the policy-makers from the participating countries. This manual – a revised and expanded version of a 1990 edition – has been elaborated through the project and developed primarily for construction site workers, their representatives and the workers' immediate supervisors. It is intended to be complementary to the ILO code of practice, Safety and health in construction, published by the ILO in 1992, which contains practical recommendations for the use of all those, both in the public and private sectors, who have responsibility for safety and health in construction. The contents will, however, also be of direct concern to employers and management on whom many of the duties and responsibilities fall for creating safe and healthy working conditions. The manual is published with the expressed hope that it will be adapted to local working practices and translated into the language of the end-user.

The ILO appreciates the assistance given by Mr. Victor Jordan, formerly H.M. Deputy Chief Inspector of Factories of the Health and Safety Executive, United Kingdom, in the preparation of the text of the manual. Thanks are also due to Noha Karanuh and Igor Losavio, who drew the illustrations.

Dr. Chandra Pinnagoda,

Chief,
Occupational Safety and Health Branch
Working Conditions and Environment Department

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1. Introduction

The construction industry is one of the world's major industries. Its achievement in rebuilding areas devastated by both natural and man-made disasters, and in providing power, services and communications to meet the rising needs and expectations of people throughout the world, has conferred great benefits on the human race. Despite mechanization, construction remains a major employer of labour – it often employs between 9 and 12 per cent of a country's working population, and sometimes as much as 20 per cent.

There has, however, been a price to pay for this continuous growth and activity. Although it is difficult to obtain accurate statistics in an industry in which many accidents go undetected and unreported, in many countries known fatal accidents, and those involving loss of working time, frequently exceed those in any other manufacturing industry.

Contributing to the high rate of accidents are those characteristics of the industry which distinguish it from the rest of the manufacturing sector. These are:

- the high proportion of small firms and of self-employed workers;
- the variety and comparatively short life of construction sites;
- the high turnover of workers;
- the large numbers of seasonal and migrant workers, many of whom are unfamiliar with construction processes;
- exposure to the weather;
- the many different trades and occupations.

The purpose of the manual

All of us who have looked for and found a job in construction are concerned that our work should be safe and that conditions on the construction site should not cause damage to our life, our health and our professional skills.

Through this manual – Safety, health and welfare on construction sites – we will help you to consider safety, health and welfare conditions on construction sites in your country and to learn about possible solutions to the problems you encounter.

2. Safety organization and management

Unlike the remainder of this manual, which is intended primarily for workers and their supervisors, this chapter is intended to remind management at a more senior level of the foundations they need to lay to achieve a safe and healthy site. It will also, however, inform workers and supervisors of the essentials of a proper safety management system.

The improvement of safety, health and working conditions depends ultimately upon people working together, whether governments, employers or workers. Safety management involves the functions of planning, identifying problem areas, coordinating, controlling and directing the safety activities at the work site, all aimed at the prevention of accidents and ill health (figure 1). Accident prevention is often misunderstood, for most people believe wrongly that the word “accident” is synonymous with “injury”. This assumes that no accident is of importance unless it results in an injury. Construction managers are obviously concerned with injuries to the workers, but their prime concern should be with the dangerous conditions that produced the injury – with the “incident” rather than the “injury”. On a construction site there are many more “incidents” than injuries. A dangerous act can be performed hundreds of times before it results in an injury, and it is to eliminate these potential dangers that managers’ efforts must be directed. They cannot afford to wait for human or material damage before doing anything. So safety management means applying safety measures before accidents happen. Effective safety management has three main objectives:

– to make the environment safe;

– to make the job safe,

– to make workers safety conscious.

2.1 Safety policies

Safe and healthy working conditions do not happen by chance. Employers need to have a written safety policy for their enterprise setting out the safety and health standards which it is their objective to achieve. The policy should name the senior executive who is responsible for seeing that the standards are achieved, and who has authority to allocate responsibilities to management and supervisors at all levels and to see they are carried out.

The safety policy should deal with the following matters:

– arrangements for training at all levels. Particular attention needs to be given to key workers such as scaffolders and crane operators whose mistakes can be especially dangerous to other workers;

– safe methods or systems of work for hazardous operations: the workers carrying out these operations should be involved in their preparation;

– the duties and responsibilities of supervisors and key workers;

– arrangements by which information on safety and health is to be made known;

– arrangements for setting up safety committees;

– the selection and control of subcontractors.

2.2 Safety organization

The organization of safety on the construction site will be determined by the size of the work site, the system of employment and the way in which the project is being organized. Safety and health records should be kept which facilitate the identification and resolution of safety and health problems on the site.

Figure 1. Safety organization and management must cover all aspects of the employer's or the contractor's operations

In construction projects where subcontractors are used, the contract should set out the responsibilities, duties and safety measures that are expected of the subcontractor's workforce. These measures may include the provision and use of specific safety equipment, methods of carrying out specific tasks safely, and the inspection and appropriate use of tools. The person in charge of the site should also assure that materials, equipment and tools brought on to the site meet minimum safety standards.

Training should be conducted at all levels, including managers, supervisors and workers. Subcontractors and their workers may also need to be trained in site safety procedures, because teams of specialist workers may mutually affect each others' safety.

There should also be a system so that site management has information quickly about unsafe practices and defective equipment.

Safety and health duties should be specifically assigned to certain persons. Some examples of duties which should be listed are:

– provision, construction and maintenance of safety facilities such as access roadways, pedestrian routes, barricades and overhead protection;
– construction and installation of safety signs;
– safety provisions peculiar to each trade;
– testing of lifting machinery such as cranes and goods hoists, and lifting gear such as ropes and shackles;
– inspection and rectification of access facilities such as scaffolds and ladders;
– inspection and cleaning of welfare facilities such as toilets, clothing accommodation and canteens;
– transmission of the relevant parts of the safety plan to each work group;
– emergency and evacuation plans.

Point to remember:

- No safety policy or plan is workable without assigning a specific duty:
  – to a specific person;
  – to be completed at a specific point of time.
- The safety policy and plan must be transmitted down the line to the workers – it is their safety that the plan is intended to safeguard.

2.2.1 Safety officer/manager

Every construction company of any size should appoint a properly qualified person (or persons) whose special and main responsibility is the promotion of safety and health. Whoever is appointed should have direct access to an executive director of the company. His or her duties should include:

– the organization of information to be passed from management to workers, including those of subcontractors;
– the organization and conduct of safety training programmes, including induction training for all workers on the site;
– the investigation and review of the circumstances and causes of accidents and occupational diseases so as to advise on preventive measures;
– acting as consultant and technical adviser to the safety committee;
– participation in pre-site planning.

To carry out these functions the safety officer should have experience of the industry and should be properly trained and qualified and, where such exists, should be a member of a recognized professional safety and health body.

2.2.2 Supervisors

Good planning and organization at each work site and the assignment of clear responsibility to supervisors are fundamental to safety in construction. "Supervisor" here means the first level of supervision, which on site is variously termed as "foreman", "chargehand", "ganger", and so on.

Each supervisor requires the direct support of site management and should seek to assure within his or her field of competence that:

– working conditions and equipment are safe;
– workplace safety is regularly inspected;
– workers have been adequately trained for the job they are expected to do;
– workplace safety measures are implemented;
– the best solutions are adopted using available resources and skills;
– necessary personal protective equipment is available and used.

Making the work site safe will require regular inspection and provision of the means for taking remedial measures. The training of workers enables them to recognize the risks involved and how they can overcome them. Workers should be shown the safe way of getting a job done.

2.2.3 Workers

Every worker is under a moral, and often also a legal, duty to take the maximum care for his or her own safety and that of fellow workers. There are various ways of involving workers directly in site conditions, such as:

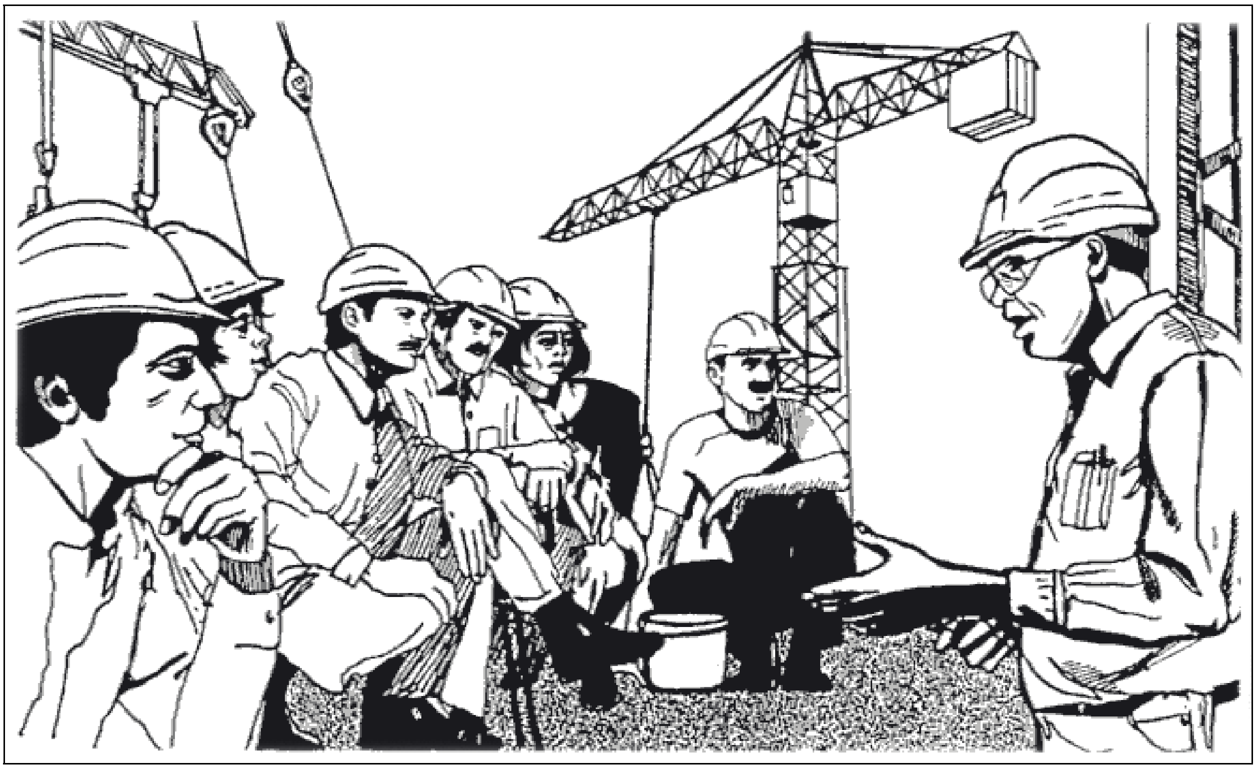
- "tool-box briefing" (figure 2), a five- to ten-minute session with the supervisor just prior to starting a task gives the workers and the supervisor a chance to talk about safety problems likely to be encountered and potential solutions to those problems. This activity is simple to implement and it may prevent a serious accident;
- "safety check"; a check by workers that the environment is safe before starting an operation may allow them to take remedial action to correct an unsafe situation that could later endanger them or another worker.

2.3 Safety committees

An active safety committee is a great spur to safety. Its primary purpose is to enable management and workers to work together to monitor the site safety plan so as to prevent accidents and improve working conditions on site. Its size and membership will depend on the size and nature of the site and upon differing legal and social conditions in the countries concerned, but it should always be an action-oriented group of people in which both management and workers are represented. The safety committee carrying out a site inspection together raises the level of safety consciousness at the site. The duties carried out by an active safety committee will include:

– regular and frequent meetings to discuss the safety and health programme on site and to make recommendations to management;
– consideration of reports of safety personnel;
– discussion of accident and illness reports in order to make recommendations for prevention;
– evaluating improvements made;
– examination of suggestions made by workers, particularly by safety representatives;
– planning and taking part in educational and training programmes, and information sessions.

Figure 2. "Tool-box briefing" should be carried out regularly



2.4 Safety representatives

These are appointed by workers, sometimes in accordance with national legislation, to represent them in dealing with safety and health matters on site. They should be experienced workers well able to recognize construction site hazards, although they are likely to require training to acquire new skills in inspection and in using information. Their functions are:

– to make representations to the management about matters of concern regarding the safety and health of workers;

– to attend meetings of the safety committee;

– to carry out regular and systematic inspections on site;

– to investigate accidents in conjunction with management to determine their causes and to propose remedies;

– to investigate complaints by workmates;

– to represent workers in discussions with government inspectors at their site visits.

Safety representatives should be given sufficient time off to be trained and to carry out their duties properly. These activities should be without loss of pay, for a safe and healthy site benefits both employers and workers.

2.5 Outside agencies

2.5.1 Government intervention

In many countries there are laws and regulations governing conditions of work in the construction industry. These are usually enforced by factory or labour inspectors who are often also able and willing to provide advice on compliance. However, even in the best-regulated countries the numbers of inspectors are too few to provide day-to-day surveillance on site, even were it their job to do so.

2.5.2 International agreements

National laws and regulations are often based upon international conventions, agreements, declarations and programmes. These have been drawn up by different United Nations organizations including the International Labour Organization (ILO) and the World Health Organization (WHO).

In 1988 the ILO adopted the Safety and Health in Construction Convention (No.167), and its accompanying Recommendation (No.175), which provide a foundation of law on which safe and healthy working conditions can be built. The texts of this essential Convention and Recommendation are reproduced in Annex 2 of this manual.

3. Site planning and layout

3.1 Site layout

A badly planned and untidy site is the underlying cause of many accidents resulting from falls of material and collisions between workers and plant or equipment (figures 3 and 4). Space constraints, particularly in urban work sites, are nearly always the biggest limiting factor and a layout which caters best for the safety and health of workers may appear to be difficult to reconcile with productivity. Proper planning by management is an essential part of preparation and budgeting for the safe and efficient running of a construction operation.

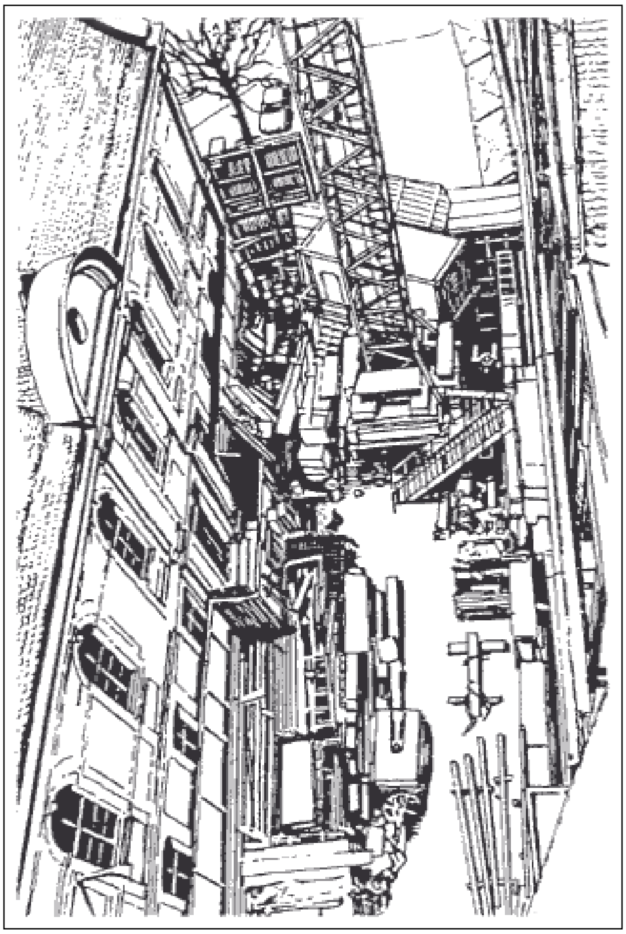
Before work even begins on site, thought needs to be given to:

– the sequence or order in which work will be done and to any especially hazardous operations or processes;

– access for workers on and around the site. Routes should be free from obstruction and from exposure to hazards such as falling materials, materials-handling equipment and vehicles. Suitable warning notices should be posted. Routes to and from welfare facilities need equal consideration. Edge protection will be required at the edge of floor openings and stairs, and wherever there is a drop of 2 m or more (figure 5);

Figures 3 and 4. Bad site layout and lack of space prevent safe movement of workers and vehicles and cause accidents

Bad layout



Good layout

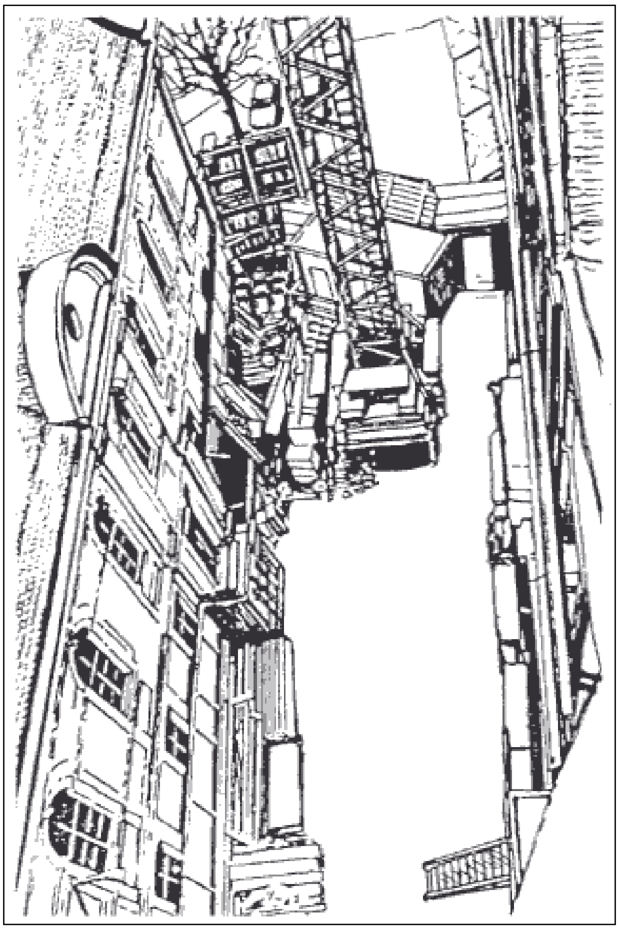
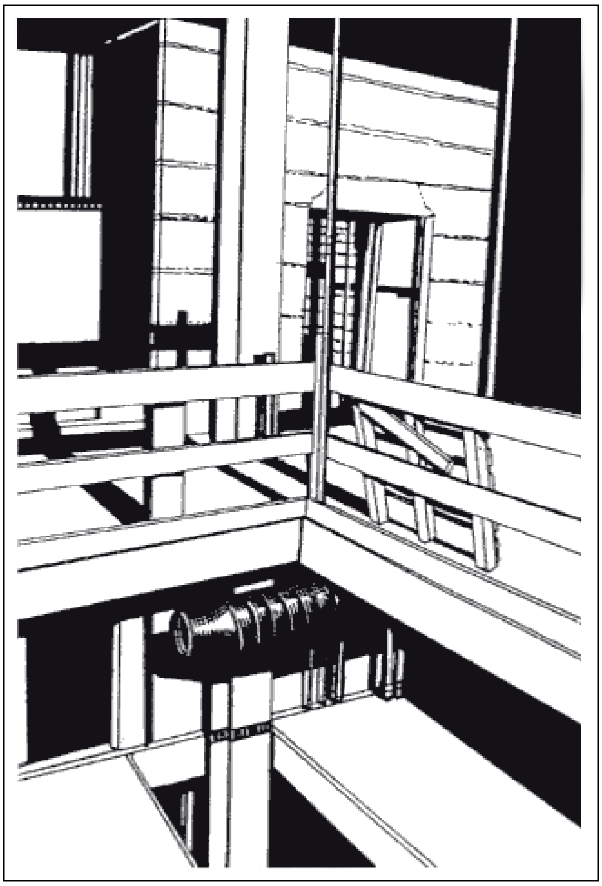


Figure 5. Edge protection: Guard-rails and toe boards at open edges of floors and working platforms to prevent workers from falling



– routes for vehicular traffic. These should be "one way" as far as practicable. Traffic congestion prejudices the safety of workers, especially when impatient drivers unload goods hurriedly;

– storage areas for materials and equipment. Materials need to be stored as close as possible to the appropriate workstation, e.g. sand and gravel close to the cement-batching plant, and timber close to the joinery shop. If this is not practicable, it is important to schedule the arrival of materials;

– the location of construction machinery. This is usually dependent on operational requirements so that tower cranes are subject to constraints such as their radius of operation, and pick-up and unloading points. The objective should be to avoid the need to slew the load over workers;

– the location of trade workshops – these are not usually moved after they are built;

– the location of medical and welfare facilities. On large sites sanitary facilities for both sexes should be provided at several locations;

– artificial lighting at places where work continues or workers pass after dark;

– site security. The site should be fenced in to keep out unauthorized persons, children in particular, and to protect the public from site hazards. The type of fencing will depend on the location of the site, but in populated areas it should be at least 2 m high and without gaps or holes. Overhead protection will be necessary if tower crane loads pass over public thoroughfares;

– arrangements to keep the site tidy and for the collection and removal of waste;

– the need for low-voltage electric power supplies for temporary lighting, portable tools and equipment;

– training needs of both workers and supervisors.

Point to remember

- The time spent on planning will make for a safer site and save money.

Discussion

- In what ways could you improve on the layout of your site?
- What are some options for sites with problems of limited space?

3.2 Site tidiness

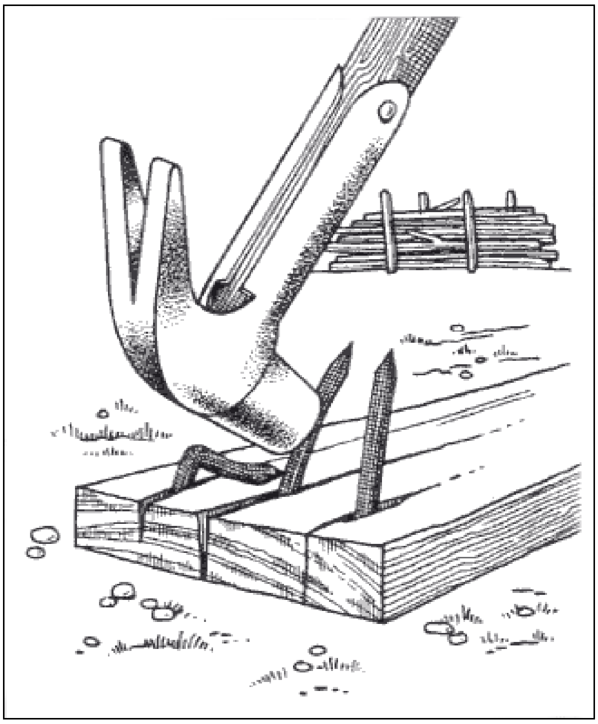
As a worker you can make a major contribution to safe working conditions on site by attention to tidiness. There are many accidents due to tripping, slipping or falling over materials and equipment which have been

left lying around, and stepping on nails which have been left projecting from timber.
Be sure you take the following steps:

- Clean up as you go – do not leave rubbish and scrap for the next person to clear.
- Keep gangways, working platforms and stairways clear of equipment and materials not in immediate use.
- Clean up spilled oil and grease (figure 6).
- Deposit waste material at a recognized disposal point.
- Remove or hammer down any nails you see projecting from timber (figure 7).

Figure 6. Clean up spilt oil or grease

Figure 7. Hammer down any nails projecting from timber



Point to remember:

- An untidy site is a dangerous site.

Discussion

- What are the best ways of disposing of site waste and scrap, and are they followed on your site?
- In what ways could you improve on the tidiness of your site?

4. Excavations

4.1 General measures

4.1.1 Hazards

Most construction work involves some form of excavation for foundations, sewers and underground services. Excavation or trenching work can be highly dangerous and even some of the most experienced workers have been caught by the sudden and unexpected collapse of the unsupported sides of a trench. Buried under a cubic metre of soil you will be unable to breathe due to pressure on the chest, and quite apart from any physical injury you will quickly suffocate and die, for even this comparatively small amount of soil weighs over 1 tonne.

Excavation work involves the removal of soil or a mixture of soil and rock. Water is nearly always present, even if only as moisture in the soil, and heavy rain is a frequent cause of soil slip. The possibility of flooding presents an additional hazard which should always be considered. Cracks are caused by pressure release as soil is removed, or from drying out in hot weather.

Soil varies in its nature (e.g. fine sand which flows easily, and stiff clay which is more cohesive). However, no soil can be relied upon to support its own weight and precautions always need to be taken to prevent the collapse of the sides of an excavation of more than 1.2 m in depth.

4.1.2 Causes of accidents

The main causes of accidents resulting from excavation work are as follows:

- workers trapped and buried in an excavation owing to the collapse of the sides;
- workers struck and injured by material falling into the excavation;
- workers falling into the excavation;
- unsafe means of access and insufficient means of escape in case of flooding;
- vehicles driven into or too close to the edge of an excavation, particularly while reversing, causing the sides to collapse;
- asphyxiation or poisoning caused by fumes heavier than air entering the excavation, e.g. exhaust fumes from diesel and petrol engines.

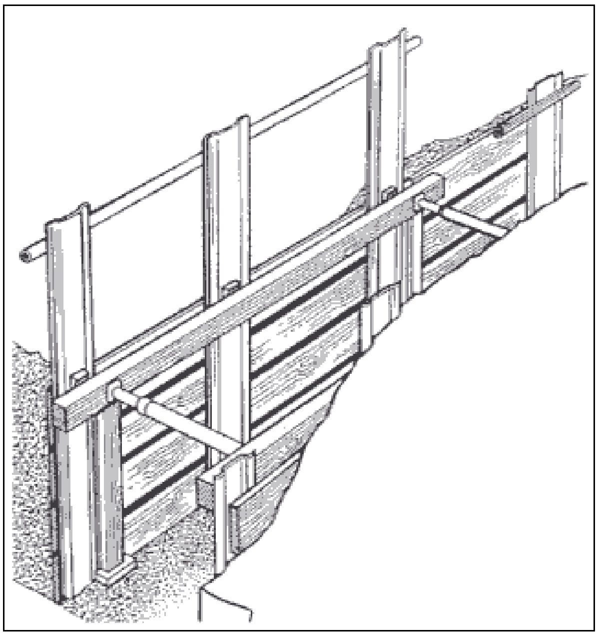
4.1.3 Safety precautions to prevent the collapse of excavations, and falls

The sides of the excavation or trench should be sloped or battered back to a safe angle of repose, usually 45°, or be supported by timbering or other suitable means to prevent a collapse. The type of support necessary will depend upon the type of excavation, the nature of the ground and the groundwater conditions.

Planning is vital. Make sure that there are enough materials to support the length of the trench to be cut, for the trench support must be installed without delay as the excavation progresses. At least random timbering or piling is required in all excavations, but excavations 1.2 m or more in depth should be provided with adequate timbering or sheeting (figure 8). Close boarding or sheeting is required if the ground is unstable or lacks cohesion. Never work ahead of the trench support.

Shoring should be erected, altered or dismantled only by a competent worker operating under supervision. Wherever practicable, it should be installed before excavating to the final depth of the trench – it is necessary to begin when the trench is less than 1.2 m deep. The excavation and installation of shoring should then proceed by stages until the full depth is reached. You should be fully aware of the procedures to follow to rescue a fellow worker trapped by a fall of earth.

Figure 8. Shoring to prevent the collapse of the sides of an excavation consisting of timber or steel frames with close boarding between frames



Workers often fall into excavations. Erect suitable barriers high enough (i.e. about 1 m) to prevent falls (figure 9). Projecting trench supports can often be used for this purpose.

4.1.4 Inspection

Excavations should be inspected by a competent person before work begins and at least once a day where work is in progress. They should be thoroughly examined by a competent person once a week and a record kept of such inspections.

4.1.5 Adjoining buildings

Wherever possible, an excavation should not be so close and deep as to undermine any adjacent building or structure. Precautions should be taken by shoring, and so on, to prevent any collapse or fall when the stability of a building or structure may be affected by excavation work in progress (figure 10).

Figure 9. Barriers along the sides of an excavation to prevent workers falling into it

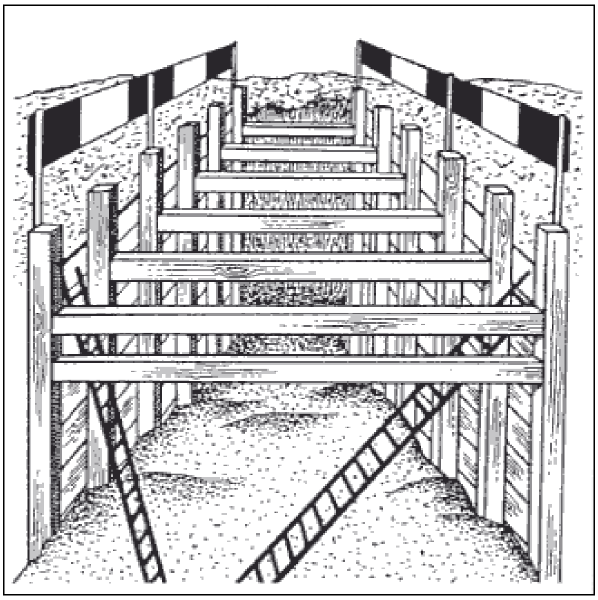
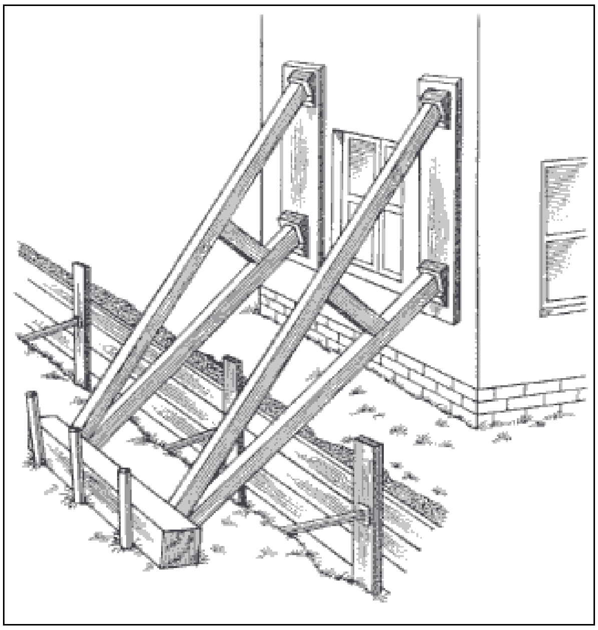


Figure 10. Excavation near a building: Shoring required to prevent collapse of the building



4.1.6 Edges

You should not store, or move, materials and equipment near the edge of an excavation. Danger may be caused either by materials falling on those working below, or by increased loading on the surrounding ground so as to cause the timbering or supports to the sides of the excavation to collapse. Spoil and waste heaps should similarly be kept well away from the edges of excavations.

4.1.7 Vehicles

Adequate and well-anchored stop blocks should be provided on the surface to prevent vehicles being driven into the excavation while tipping, a particular hazard when reversing (figure 11). The blocks should be placed at a sufficient distance away from the edge of the excavation to avoid the danger of it breaking away under the weight of the vehicles.

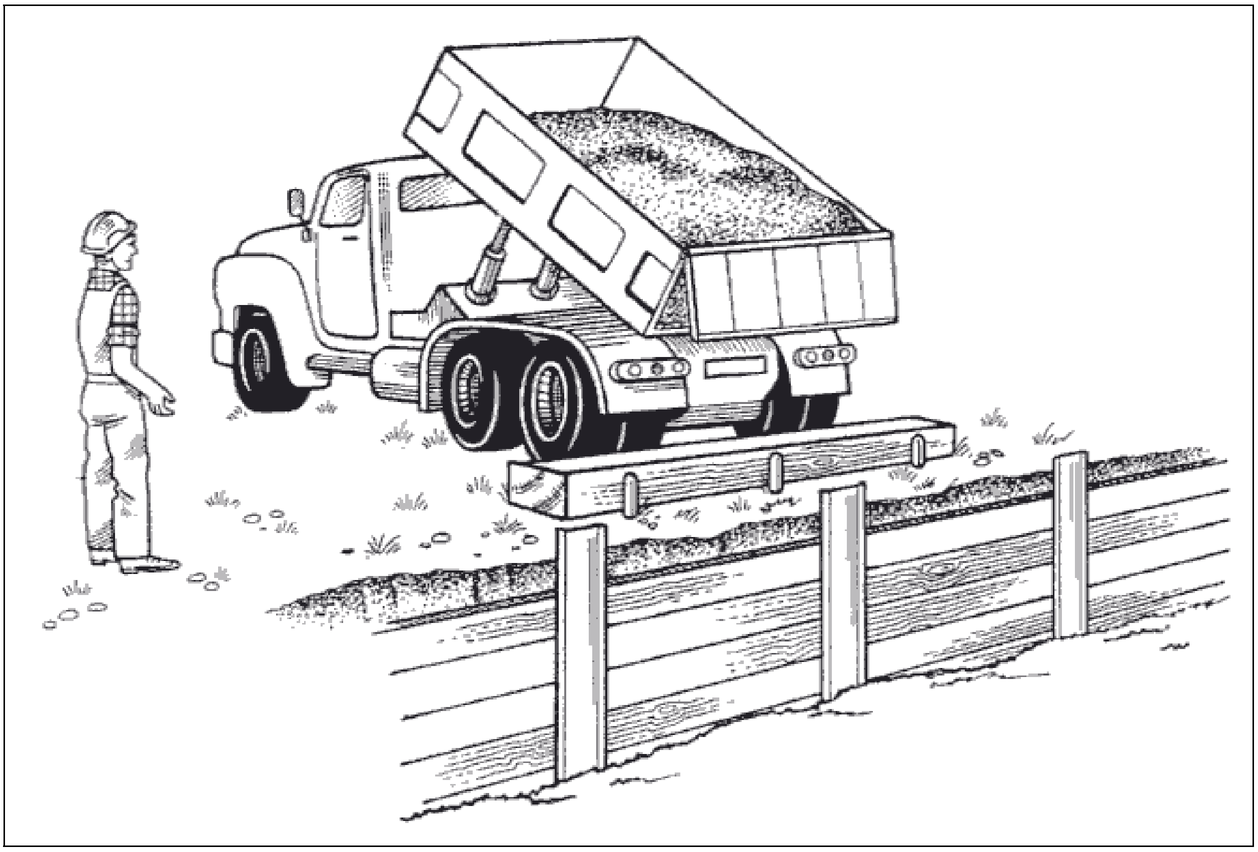
4.1.8 Access

Make sure that there are safe means of access and egress, such as a properly secured ladder, if you are working in an excavation. This is of particular importance when there is a risk of flooding and rapid escape is essential.

4.1.9 Lighting

There should be adequate lighting around the area of an excavation, particularly at access points and openings in barriers.

Figure 11. Stop block to prevent vehicles being reversed into an excavation while tipping



Points to remember:

- Never work ahead of the side supports in a trench even when you are erecting shoring.
- Appearances can be deceptive. The shallowness of an excavation or the solid appearance of the ground are not necessarily an indication of safety.
- Deep trenches look dangerous, but most fatal accidents occur in trenches less than 2.5 m deep.
- Always wear a safety helmet when you work in an excavation.

4.2 Buried or underground services

Before you do any digging, either by hand or with an excavator, remember that there may be underground services below the surface. In built-up areas, always assume that electrical cables, water services and sewers are present. In some locations there may also be gas pipes. Some of these services look alike, so when you find buried services you should always assume the worst. Striking electric cables may cause death or severe injuries by electric shock or severe burns. Broken gas pipes will leak and may cause a fire or explosion. Water and sewer pipes if broken may create sudden risks by flooding an excavation or by causing its sides to collapse.

4.2.1 Electrical cables

Every year workers digging on construction sites suffer severe burns when they accidentally hit live buried electrical cables. Always treat buried cables as live. Before you begin excavating, inquire of the electricity authority, the local authority or the site owner if they have any plans of the layout of cables in the area. Even if plans exist, remember that some cables may not be marked on the plan or may not be exactly where the plan shows, for cables rarely follow an exact straight line.

Look around for traffic signs, street lights and substations which are usually supplied by buried cables. Use a cable locator if you have one – remember that if cables are close together the locator may not be able to tell them apart. Some types of cable cannot be traced by locators. Once you have found the cable, notify your supervisor and fellow workers. The position of the cable should be marked with chalk, crayon or paint or, if the ground is too soft for this, with wooden pegs (figure 12). Never use sharp spikes. Once the approximate position of a buried cable is known, use hand tools to expose it. Use spades and shovels rather than forks or pick-axes. Keep a careful watch for evidence of cables during digging work. Power tools should not be used within half a metre of a cable.

4.2.2 Other services

As with electricity supplies, inquire of the appropriate authorities and the site owner if plans are available of the layout of gas pipes, water pipes, sewers and telephone cables, and then use similar working methods.

Do not use mechanical excavators within half a metre of a gas pipe. If you smell gas, make sure there are no sources of ignition nearby such as a lit cigarette or running vehicle engine. Keep away from the area, keep other people away and summon the gas authority. Do not use heavy plant or equipment over or near a gas pipe, as the pipe may fracture.

All exposed pipes and cables should be supported when an excavation is open. Do not use them to support equipment or as steps to get in and out of the excavation. Make sure when backfilling a trench with a gas pipe that the fill is adequately compacted beneath the pipe to prevent settlement which could lead to pipe fracture.

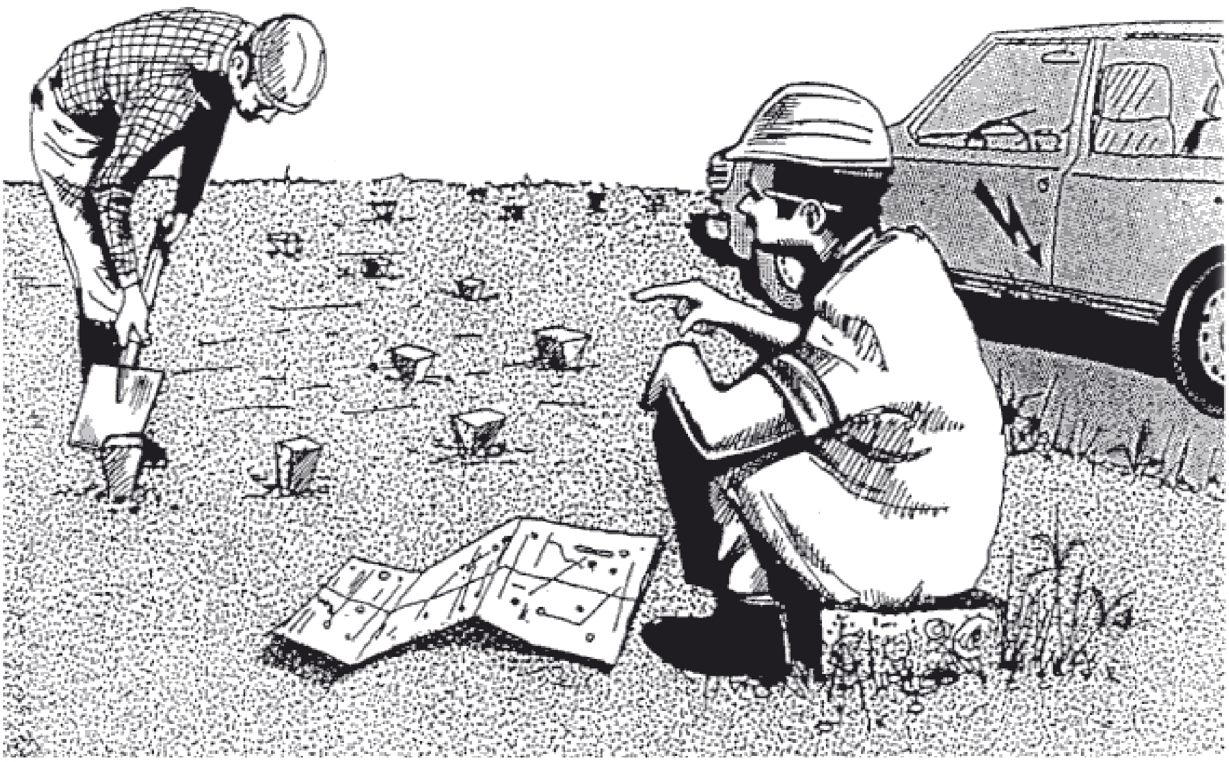
Points to remember:

- Hand dig with care, as cables may be just below the surface.
- Use a spade or shovel and not a fork or pick-axe, and do not spear the tools into the ground.
- If' you find a cable embedded in concrete, do not break it out but seek advice.
- If a cable is damaged, even slightly, keep well clear.
- Do not work bare chested. Normal work clothing can provide some protection from flash burns.

Discussion

- Outline the precautions that should be taken before anyone is allowed in a trench or excavation.
- What conditions can affect the stability of the sides of an excavation?
- Why are a considerable number of the accidents in excavation work fatal?
- Outline the potential hazards you are likely to meet in a deep excavation.
- If the sides of a trench collapse burying a fellow worker, what action would you take?
- What precautions do you need to take to avoid danger from underground services?

Figure 12. Locating buried electrical cables from a plan and marking their position



5. Scaffolding

5.1 Hazards

Falls of persons from a height, and similarly of materials and objects, represent the most serious safety risk in the construction industry. A high proportion of deaths are caused by falls. Many of the falls are from unsafe working places or from unsafe means of access to working places. This chapter of the manual, and those which follow dealing with ladders and hazardous processes, are aimed at tackling the problem.

Scaffolding can be defined as a temporary structure supporting one or more platforms and which is used either as a workplace or for the storage of materials in the course of any type of construction work, including both maintenance and demolition work. This is the sense in which it is used here.

Where work cannot safely be done from the ground or from the building or structure being worked upon, then there should always be suitable and sufficient scaffolding. This must be properly constructed of sound material which is of adequate strength to provide you with both means of safe access and a safe place of work.

Scaffolds should be erected, altered or dismantled only by competent persons under supervision, and this training manual sets out general principles for the various common types of scaffold. After erection, scaffolds should be inspected at least once a week and a written report on each inspection kept.

There are many different materials used to construct scaffolding, such as steel, aluminium, wood and bamboo. Whatever the material, the principles of safe scaffolding remain the same that it should be of adequate strength to support the weight and stress which the processes and workers will place upon it, that it is securely anchored and stable, and that it is designed to prevent the fall of workers and materials. The design and erection of tubular metal scaffolding, which is increasingly found worldwide, is taken as the example in this manual.

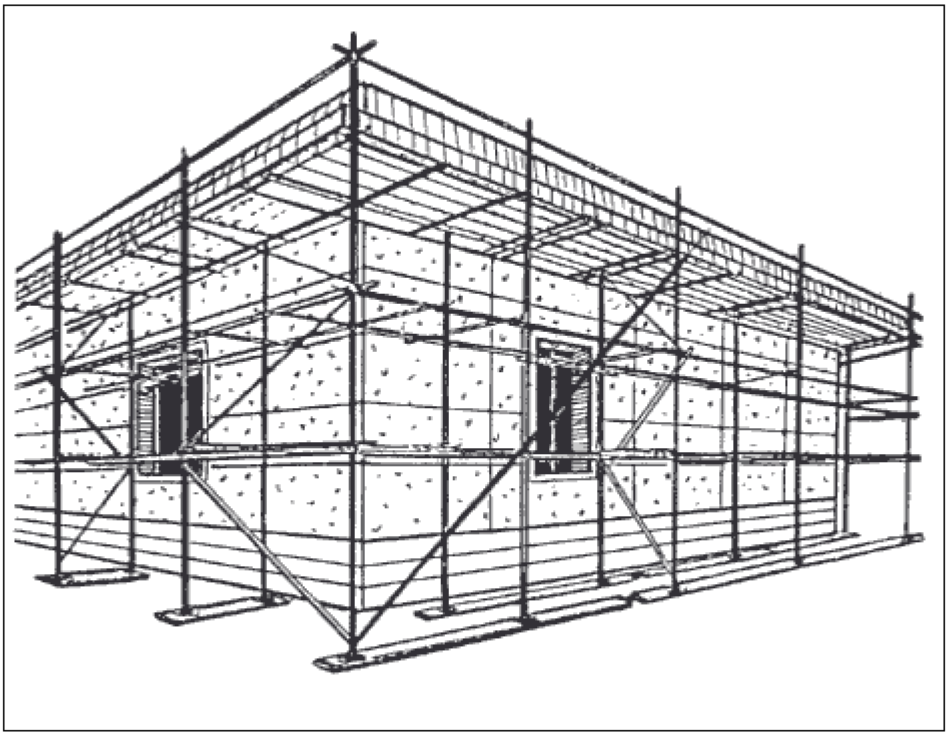
5.2 Independent tied scaffolds

An independent scaffold consists of a platform resting on horizontal tubes, usually called transoms, which are fixed at 90° to the face of the building and which are secured at both ends to a row of uprights, or standards, and to horizontal tubes, often called ledgers, running parallel to the face of the building. An independent scaffold, although it must be tied to the building or structure, does not rely on it for its strength (figure 13).

The uprights of the scaffolding should be placed on firm and level ground and the base plates at their feet should rest on timber sole boards. These help to ensure that the load carried by each upright is distributed over a fairly large area and so prevents the upright from sinking into the ground and affecting the balance of the scaffold. Never use material which can shatter or move, such as bricks and broken paving stones, as support for uprights.

Uprights should be kept equidistant and should be connected and strengthened by ledgers fixed on the inside of the uprights; for strength, joints in ledgers should be staggered. Transoms should be set on top of ledgers and at right angles to them and the building or structure. Horizontal distances between transoms at working platform level will depend on the thickness of the boards you are using, and which rest on them. For 38 mm thick boards, transoms should be spaced so that no scaffold board overlaps by more than 150 mm (6 in.) or less than 50 mm. Ledgers and transoms should not project more than is necessary beyond the general outline of the scaffold, or they become a danger to pedestrians or passing vehicles. Bracing is essential to stiffen the scaffold and prevent sideways movement, and it should run diagonally from ledger to ledger or upright to upright. Braces may run parallel to each other or rise in zig-zag fashion. If bracing has to be removed for the passage of workers and material, this should be only within one lift and it should be immediately replaced.

Figure 13. An independent tied scaffold which does not rely on the building for its strength. It has inner and outer rows of uprights or standards



5.2.1 Ties

Make sure that the scaffold is tied or anchored to the building or structure at suitable intervals so as to prevent movement. Remember that the effect of wind is greater on a sheeted scaffold, and can cause a scaffold which is not adequately tied to move away from the face of the building and collapse. Ties may need to be removed in the progress of the work (e.g. for the installation of glazing), but this should be done one at a time with the first tie replaced before the next is removed: it may then be necessary to use a different form of tie. As a rough guide, the area of scaffold per tie should not, generally, be more than 32 sq. m reduced to 25 sq. m for a sheeted scaffold.

5.2.2 Working platforms and gangways

The scaffold boards which make up a working platform should rest squarely and evenly on transoms to prevent the risk of tripping. Where the ends of boards meet, transoms must be doubled and so spaced that no board overhangs by more than four times its thickness. Too much overhang will cause the board to tip if you step on it, while too little – less than 50 mm – will mean that it is easily dislodged. Normally, each board should have three supports to prevent it bending or sagging. The space between the edge of the working platform and the face of the building should be as small as possible. The width of a working platform should be sufficient for the work which is to be carried out from it, and recommended widths are:

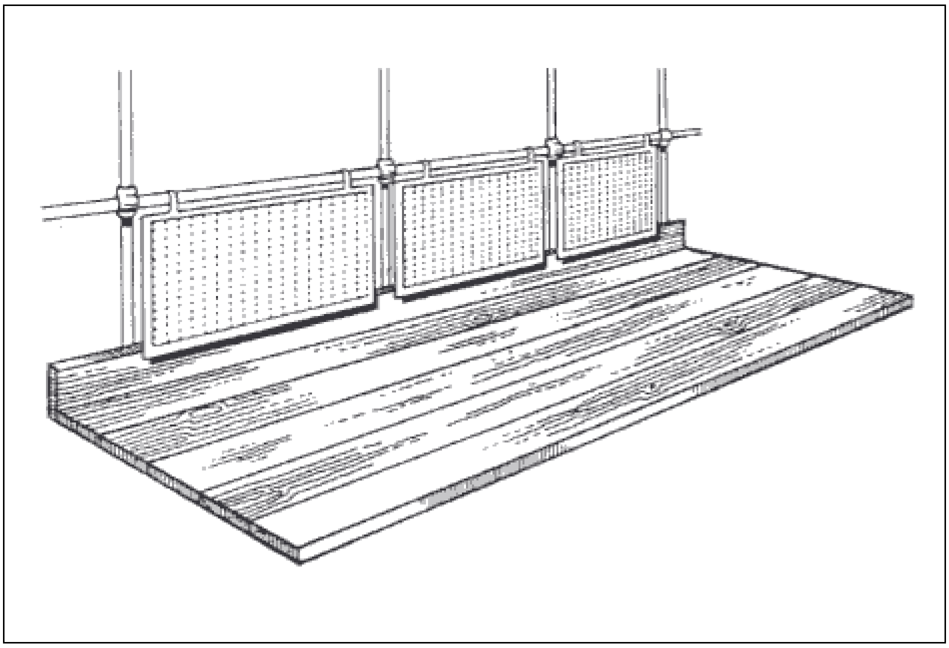
– not less than 60 cm if used as footing only;
– not less than 80 cm if used also for the stacking of material;
– not less than 1.1 m if used for the support of a trestle platform.

Gangways or runs should be of adequate width for their purpose and should preferably be horizontal. If the slope exceeds 20°, or the surface is likely to become slippery with rain, laths should be fixed at 90° across the slope, allowing a small central gap to accommodate wheelbarrow wheels. Finally, precautions must be taken to prevent boards lifting in high winds.

5.2.3 Guard-rails and toe boards

The provision of secure guard-rails and toe boards at every point at which you may fall more than 2 m is critical if falling accidents are to be prevented. Both should be fitted on the inside of the uprights. Guard-rails should be between 90 cm and 115 m above the platform to prevent you from easily falling over or under the rail. Toe boards, which are also intended to prevent material being knocked over the edge of the platform, must rise at least 15 cm above the working platform to achieve this, and if materials are stored to greater than this height then additional boards may be necessary or the space filled in with wire mesh (figure 14). If guard-rails and toe boards are removed for the passage of materials, replace them as soon as possible.

Figure 14. Working platform showing guard-rail and toe board with wire mesh filling between them and the closely boarded platform



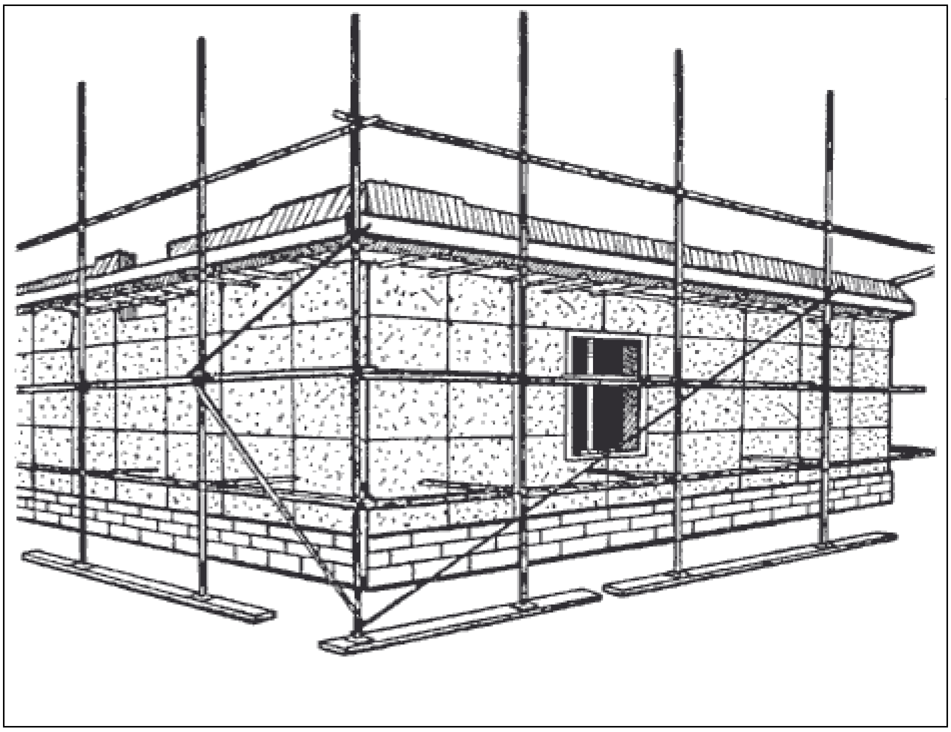
5.3 Single pole or putlog scaffolds

A common type of scaffold for smaller jobs is a single pole or putlog scaffold which consists of a platform resting on horizontal putlogs (called transoms in independent scaffolds) fixed at 90° to the face of the building (figure 15). The outer ends of the putlogs are supported on horizontal ledgers fixed parallel to the face of the building and secured to a single row of uprights or standards, also parallel to the wall. The flattened inner end of the putlogs rests flat on the wall, or in holes in the wall, rather than on ledgers. It follows that the scaffold cannot stand without the support of the structure. Putlog scaffolds are mostly used where brick structures are being built. The same principles of good construction as for independent scaffolds are generally applicable.

A good base for the single row of uprights is essential and the base plates for each upright should again rest on a timber sole board – a sole board should be long enough to support at least two uprights. The uprights should be not more than 2 m apart and set at 1.3 m from the wall to allow for a five-board platform. Ledgers should be connected on the inside of the uprights, at a vertical distance of not more than 2 m – a lesser distance may be necessary for some types of work – and left in position as the scaffold rises.

Putlogs should rest on and be secured to the ledgers at horizontal gaps depending on the thickness of the boards used – of not more than 1.5 m for boards of 38 mm – while their flattened, or spade, ends should lie on the brickwork, or enter the wall to a depth of at least 75 mm. For repointing old brickwork, the spade ends can rest vertically in joints in the brickwork. Tying into the building is of even greater importance than with independent scaffolds, as putlogs can easily work loose in brickwork. In this type of scaffold, bracing along the face and to the full height of the scaffold is required. Bracing should be at an angle of about 45° to the horizontal and at 30-metre intervals. The requirements already described for the construction of working platforms and gangways and for the erection of guard-rails and toe boards apply equally to putlog scaffolds.

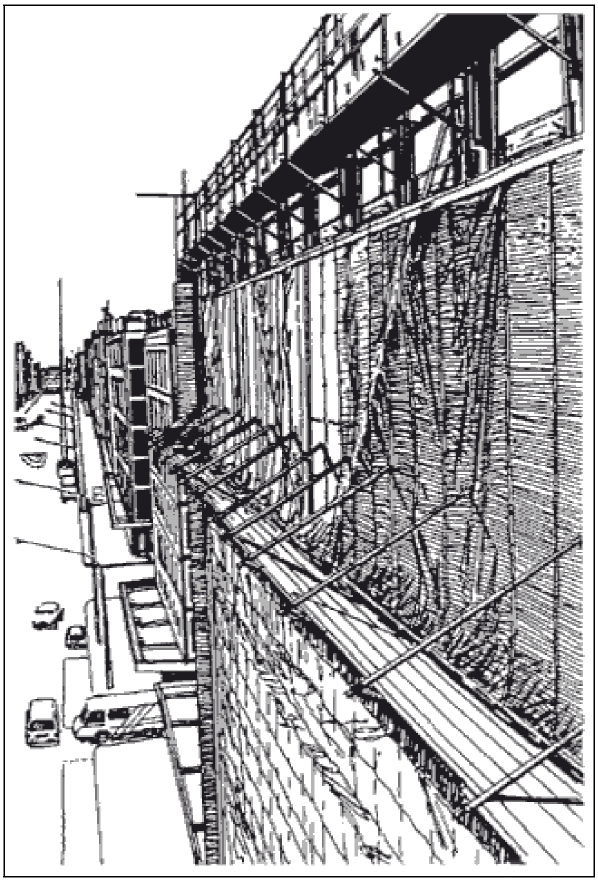
Figure 15. A single pole or putlog scaffold, with a single outer row of uprights or standards and which is partly supported by the building



A scaffold should not be left partly constructed or dismantled unless adequate notices warning against its use are displayed and all points of access are blocked off.

With both types of scaffold, there is often a need to provide sheeting, boarding, netting, fans or brickguards to prevent materials falling from the scaffold into the street or public places (figure 16). Scaffolding is often easily accessible from the street and positive steps such as the removal of access ladders should be taken to prevent children climbing a scaffold, particularly after the close of the working day.

Figure 16. Protection of scaffold from falling materials – scaffold fan and debris netting



Points to remember

- Where you cannot work safely from the ground or from part of the building, it is better to use a suitable scaffold than a ladder.
- Use a scaffold only for the purpose for which it has been provided and make sure it is securely anchored or tied to the building.
- Do not overload the scaffold. In particular, do not load it with plant and materials unless it has been erected for this purpose. Never keep materials on the scaffold unless they are needed for work within a reasonable time.
- Make sure that timber used in scaffolding is not painted or treated so that defects cannot be seen.
- Do not use bamboo that show signs of rotting or being infested by insects; also examine the ropes for early signs of decay, avoid using material about which there is doubt.

5.4 Tower scaffolds

A tower scaffold consists of a platform resting on horizontal ledgers connected to four uprights, supported on base plates if static or on castor wheels if mobile (figure 17). It is devised for painters and others who do lightweight work of limited duration mainly in one place.

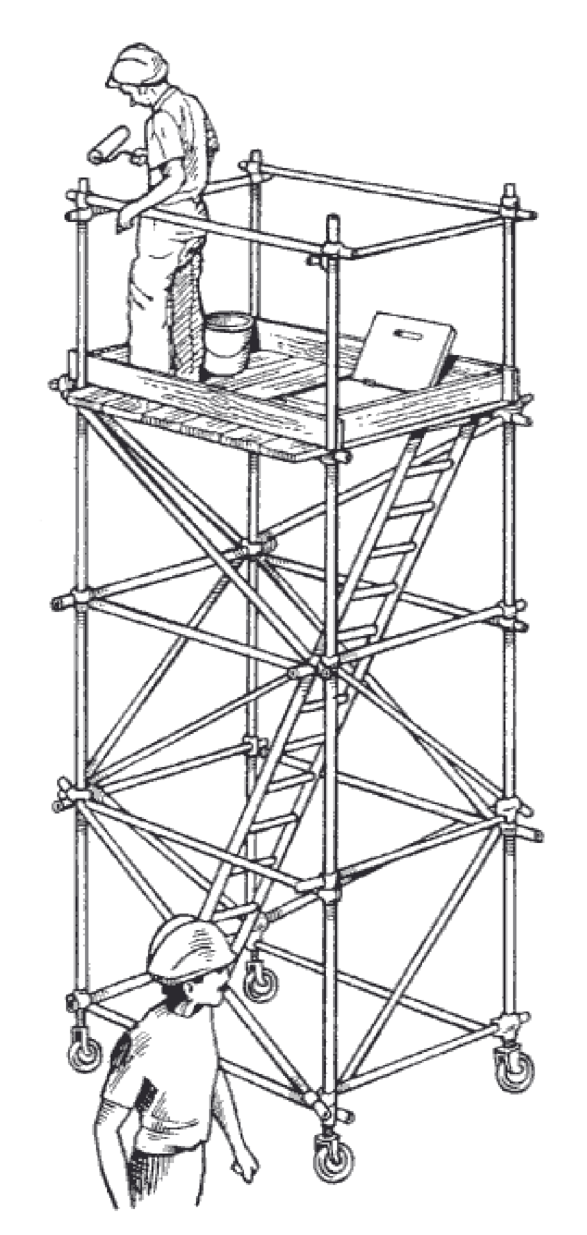
5.4.1 Causes of accidents

Accidents can happen when a tower topples over. This is likely to happen in any of the following cases:

– the ratio of the height of the tower to the width of the base is excessive;

– the top working platform is overloaded causing the tower to become unstable;

Figure 17. Mobile tower scaffold-wheels should be locked when in use; ladder access should be inside the tower



– a ladder is placed on the top platform to extend the height of the tower;

– work involving percussion tools produces an outward horizontal or lateral force at the top of the tower;

– a mobile tower is moved with persons or materials carried on the top platform;

– the tower is used on sloping or uneven ground;

– the tower is not tied to the building or structure where this is necessary;

– access to the platform is via the outside of the tower.

5.4.2 Height limitations

The first precaution with tower scaffolds is to achieve stability. For this the ratio of height to base width should not be more than 4:1 for a static tower which you are using indoors. For a static tower used outdoors the ratio is reduced to 3.5:1, while for a mobile tower used outdoors it should not be more than 3:1. Any loading on the platform will raise the centre of gravity of the tower and too great a load will endanger its stability.

Static towers should not exceed 12 m in height when free-standing, and above this height they should be tied. Mobile towers should not exceed 9.6 m in height when free-standing or 12 m when tied to a structure.

5.4.3 Structure

Towers should be vertical, have a single platform and be used only on a firm and level base, with the uprights of static towers on adequate base plates. Dimensions will vary according to need but corner standards should never be less than 1.2 m apart. The uprights of mobile towers should have castor wheels of not less than 125 mm in diameter which are locked into the base of the uprights. The castor wheels should be fitted with locks or brakes which cannot be accidentally released, and you should ensure that the brakes are applied whenever the tower is stationary.

5.4.4 The working platform

The platform should be equipped with a cover for the ladder access opening which is able to be fixed in both open and closed positions with a latch. This prevents an accidental step into the opening. The cover should be provided with a suitable handhold to provide support when you are climbing through the opening. Guard-rails and toe boards will be necessary for the sides of the working platform, erected as for independent scaffolds. The ladder provided for access to the working platform should be positioned inside the tower as a precaution against overturning (figure 17).

5.4.5 Movement

Never move a mobile tower with persons or materials on the working platform. Move the tower by pushing and pulling at the base and not by towing with a vehicle.

Points to remember:

- Tie the tower into the adjacent structure wherever possible.
- Use the locks on the wheels whenever the scaffold is in use.
- Never climb a mobile scaffold unless the wheels are locked and on level ground.
- Keep the material on the platform to a minimum.
- Keep towers away from overhead electrical supply lines and check that mobile towers are free of overhead obstructions before moving them.
- Avoid using a tower in windy or severe weather conditions.

5.5 Trestle scaffolds

Trestle scaffolds are simply working platforms supported on “A” frames or a similar type of folding support.

Remember that trestle scaffolds, whether the trestles be fixed or folding in type, should be used only for light work of comparatively short duration (figure 18). Folding trestles should be used only for scaffolds of one tier in height, and the working platform should be at least 430 mm (two scaffold boards) wide. One-third of the height of the trestles should be above the working platform. Fixed trestles should not be used for scaffolds of more than two tiers in height, and where the working platform is more than 2 m high guard-rails and toe boards should be provided. Trestle scaffolds are not suitable for work situations where a person is liable to fall a distance of more than 4.5 m from the platform.

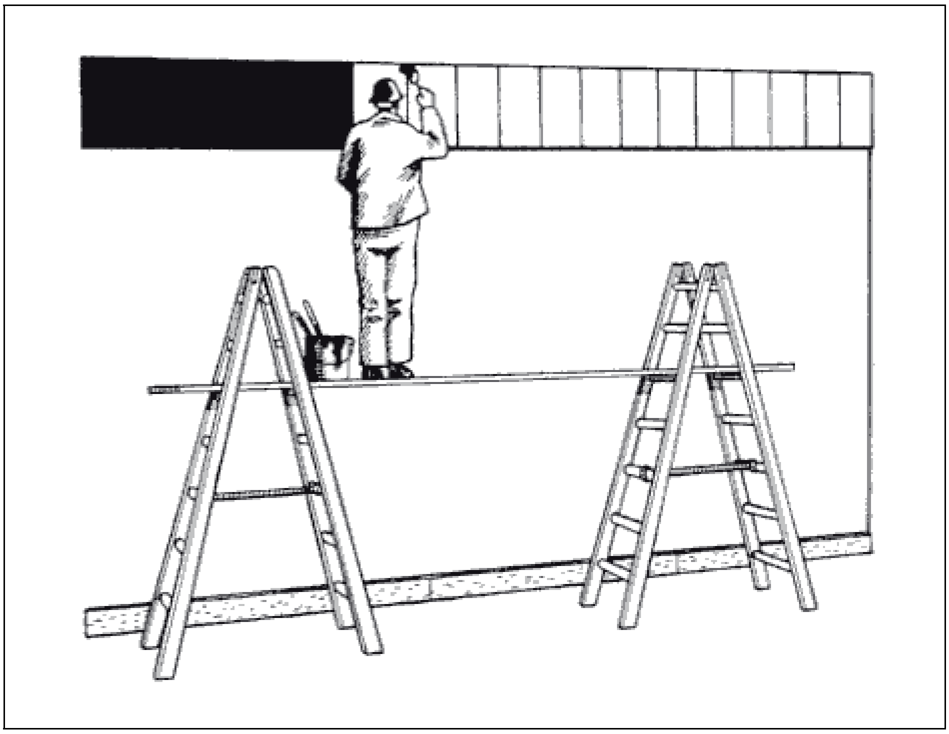
As with the other types of scaffold, trestle scaffolds should be set up on a firm and level base and firmly fixed so as to prevent displacement. Make sure the trestles are adequately braced to ensure rigidity and to resist lateral movement. Trestles should be no more than 1.35 m apart when boards 38 mm thick are used, and 2.45 m apart if 50 mm boards are used. Wider spans are possible if proprietary staging is used and such staging is generally preferable to scaffold boards.

Inspect the trestles before use and reject them if they have defective components such as loose or damaged crossbearers, broken or damaged hinges including missing screws or bolts, or damaged or split stiles.

Points to remember:

- Never use odd lengths of board to make up the working platform.
- Always sit to work if you can do so.

Figure 18. A trestle scaffold suitable only for light work such as cleaning or painting



5.6 Suspended scaffolds

Suspended scaffolds are used most frequently for work on tall buildings or structures above busy streets, or in other situations where it is not feasible or economic to build a scaffold from the ground. Suspended scaffolds are of two main types:

- suspended platforms, hinged or independent;
- cradles.

All are suspended from the building or structure by means such as outriggers, tracks and parapet hooks.

Typical accidents on all types of suspended scaffold occur because of:

- difficulty getting in and out of the suspended cradle;
- insufficient or poorly secured counterweights;
- failure of suspension ropes;
- poor maintenance.

5.6.1 Access to the scaffold

Normal access should be at either ground or roof level. If at roof level the guard-rail of the platform (or cradle) should be at roof or parapet level and only one person at a time should enter or leave the platform.

5.6.2 Suspension ropes

To safeguard against the consequences of a rope failure, a fall arrest device operating on a secondary safety rope should be used. All ropes should be thoroughly examined by a competent person at least once every six months.

5.6.3 The platform

The working platform or cradle should be inspected before each use and at least once a week. The safe working load should be clearly marked on it.

5.6.4 Erection and training

Whatever type of suspended scaffold is used, the services of a competent person able to supervise construction and subsequent use is required. Erection should be carried out only by an experienced person. The only people who should work from a suspended scaffold are those who have been trained in the use of the equipment and of its safety devices, and who are aware in practical terms of its safe working load and of emergency procedures. Remember that if you work on a suspended scaffold you should always wear an approved safety harness with a lifeline securely attached to the building.

Points to remember:

- Do not work on a suspended scaffold unless you have been trained to do so.
- Never climb up or down the suspension ropes to get into or out of the scaffold or cradle.

Discussion

- What do you understand by the term “scaffold”?
- When should a scaffold be provided instead of a ladder?
- What considerations should be given to providing safe means of access for workers and materials?
- What is the difference between a single pole (or putlog) scaffold and an independent scaffold?
- What are the main causes of accidents arising from the use of such scaffolds and what precautions can be taken?
- How do you ensure that the integrity of a scaffold is maintained throughout its use?
- What precautions are necessary to ensure the stability of tower scaffolds?
- From your own experience, what unsuitable and unsafe scaffolding have you seen being used, what were the potential dangers and what steps should have been taken to remove the hazards?

6. Ladders

Every year many workers are killed or severely injured while using ladders of all types. Because a ladder is so readily available and inexpensive, its limitations are easily overlooked. So the first question to ask is – can the job be done more safely using other equipment? For example, a proper working platform can often ensure that the job is performed more quickly and efficiently.

6.1 Limitations

If you are thinking of using a ladder, remember that if properly used it:

- enables only one person to climb or descend at any one time;
- enables only one person to work from it at any one time;
- if not lashed at the top, requires two workers for use – one on the ladder and the other at the bottom;
- leaves only one hand free; carrying tools or loads up a ladder is difficult and dangerous and the weight which can be carried is severely limited. There is also the risk of dropping items on passers-by;
- restricts movement;
- has to be safely situated and secured;
- has a limitation on heights at which it can be used.

6.2 Secure your ladder

More than half of ladder accidents are caused by the ladder slipping at the base or at the top. So make sure that you stand the foot of your ladder on a firm and level base. Never wedge one side of the ladder up if the ground is uneven. If possible, level the ground or bury the foot of the ladder. If the ground is soft, put down a board. Never support the ladder by carrying its total weight on the bottom rung – only the stiles or side members are meant for this.

The head of the ladder should rest against a solid surface able to withstand the loads imposed on it; otherwise use a ladder stay. Whenever practicable, tie or lash your ladder at the top – someone should hold the ladder at the foot while you do so (figure 19). If this is impracticable, secure the ladder at the bottom by tying it to stakes in the ground or by using sandbags (figure 20). If neither is practicable, a fellow worker should be at the foot of the ladder to prevent it slipping while you are working from it, but this precaution is only effective if the ladder is not more than 5 m in length. Your fellow worker should face the ladder with a hand on each stile and with one foot resting on the bottom rung. The use of non-slip pads on ladder feet helps to prevent ladders slipping at the base.

Point to remember:

- Make sure your ladder is lashed or footed before you climb it

Figure 19. Ladder secured at its upper end, extending above the landing place

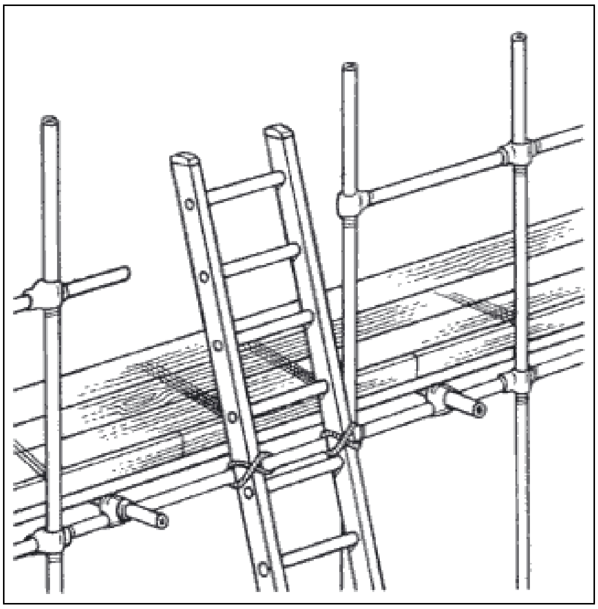
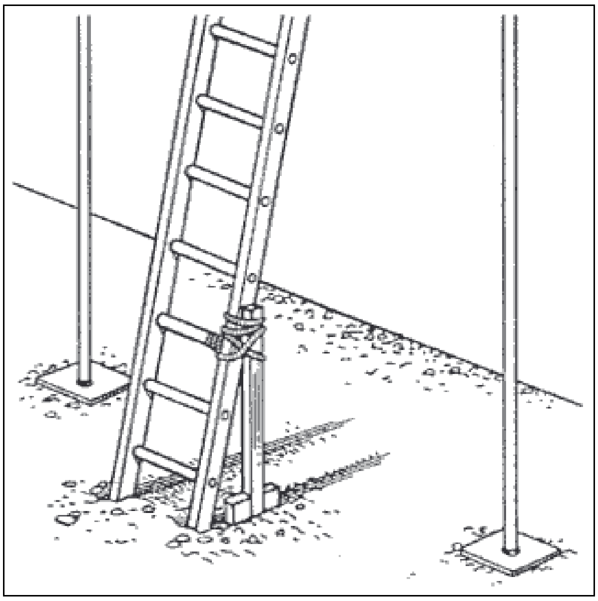


Figure 20. Ladder secured at its foot to stop movement



6.3 Safe use of ladders

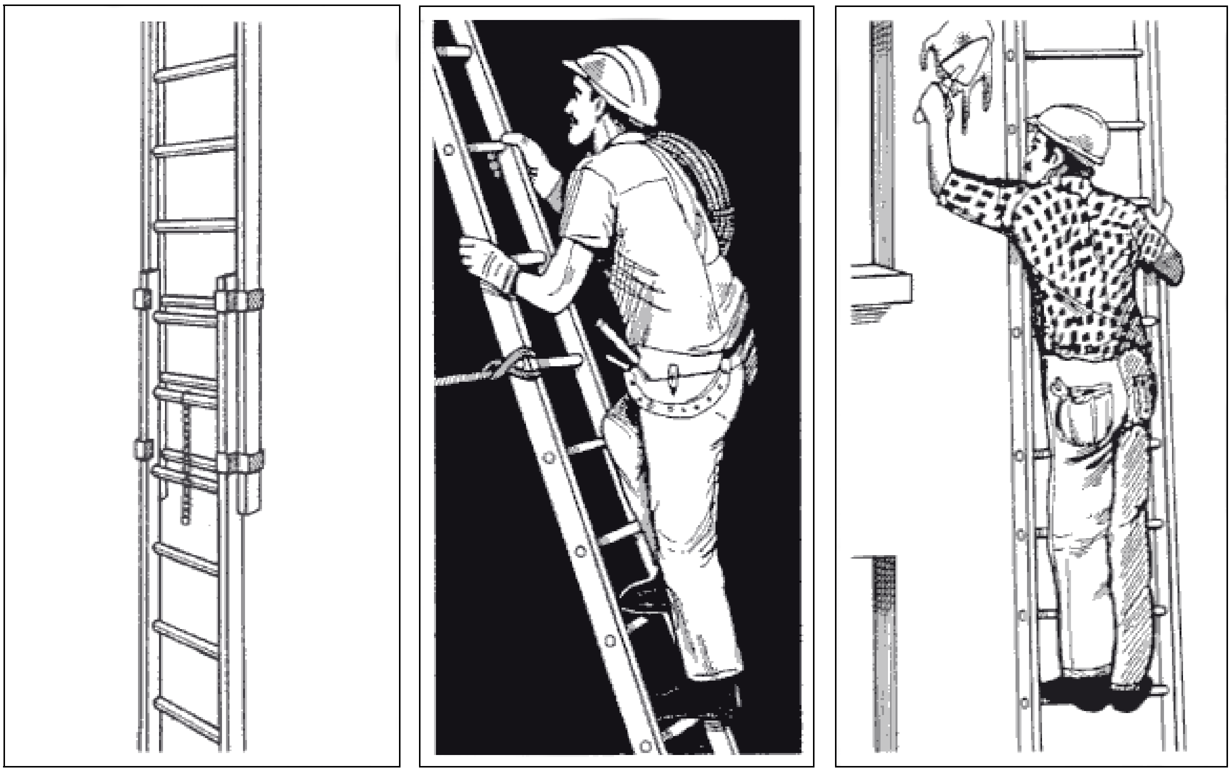
Safe use means observing the following precautions:

– make sure there are no overhead power lines with which the ladder might make contact;
– wooden ladders with wire-reinforced stiles should be used with the wired side facing away from you. Wire tie rods should be beneath and not above the rungs;
– the ladder should extend at least 1 m above the landing place, or above the highest rung on which you have to stand, unless there is a suitable handhold to provide you with equivalent support (figure 19). This is to stop the risk of over-balancing when you step off and on at the top;
– you should be able to step off the ladder at the working place without being required to climb over or under guard-rails or over toe boards. However, keep the gaps in guard-rails and toe boards as small as possible;
– never use a ladder which is too short, and never stand it on something such as a box, bricks or an oil drum to gain extra height;
– place the ladder at a safe angle of about 75° to the horizontal, that is about 1 m out at the base for every 4 m in height;
– face the ladder when climbing or descending;
– ensure that there is sufficient space behind the rungs to provide a proper footing;
– for extension ladders, make sure you leave an overlap of at least two rungs for sections up to about 5 m in length and at least three rungs for sections of more than 5 m in length (figure 21);
– always raise and lower extension ladders from the ground and make sure that hooks or locks are properly engaged before you start to climb;
– make sure that your footwear is free from mud or grease before you begin to climb a ladder;
– if possible carry your tools in your pockets or in a holster or bag when you climb ladders so as to leave both hands free to grip the stiles (figure 21);
– try not to carry materials while you are climbing ladders – use a hoist line instead;
– a common cause of accidents is overbalancing or overreaching, so do not be tempted to stretch too far (figure 21); instead move the ladder.

Points to remember:

- Make sure that your ladder is long enough for the job.
- Avoid carrying tools or materials in your hand while you are climbing ladders.
- Clean your footwear before climbing.

Figure 21. Safe use of ladders – allow sufficient overlap of extension-ladder sections; carry tools safely; don't overreach



6.4 Care of ladders

Proper care of ladders involves the following measures:

- ladders need to be inspected regularly by a competent person and damaged ladders removed from service. Timber ladders should be checked for splits or cracks, splintering or warping, metal ladders for mechanical damage. Look for missing, loose or worn rungs;
- ladders should be capable of being individually identified, e.g. by some form of marking;
- ladders not in use should not be left on the ground so that they are exposed to weather water and impact damage. They should be properly stored on racks under cover and above ground, and ladders over 6 m in length should have at least three support points to avoid sagging;
- a ladder should not be hung from its rungs or from one stile as this tends to pull out the rungs;
- timber ladders should be kept in areas with good ventilation which are free from excessive heat or dampness;
- timber ladders and equipment may be coated with transparent varnish or preservative, but should not be painted as paint conceals defects;
- aluminium ladders should be given an adequate protective coating when they are likely to be subject to acids, alkalis or other corrosive substances.

Points to remember:

- Always inspect your ladder before you use it.
- Remove damaged ladders from use and make sure that they are properly repaired. If they cannot be properly repaired, they must be destroyed.

6.5 Stepladders

Stepladders should be spread to their fullest extent and used on a level surface. They should be placed at right angles to the work whenever possible. Work should not be carried out from the top platform or tread of a stepladder unless there is an extension to provide an adequate handhold.

The strings, chains or cords used to prevent stepladders from spreading should be of sufficient and equal length and kept in good order. If you use a stepladder in a doorway, make sure the door is wedged open.

Discussion

- What are the advantages and disadvantages of using ladders?
- For what sort of work are they best suited?
- What are the most common causes of ladder accidents?
- What procedures should you follow to take care of ladders?
- What precautions should you take in using stepladders?

7. Hazardous processes

7.1 Roof work

Without proper precautions, roof work is among the most hazardous of construction operations. The most common accidents to workers are due to:

– falls from the edge of roofs;
– falls through openings in roofs;
– falls through fragile roof materials.

Although most accidents happen to specialist roofworkers, there are many workers engaged simply in maintaining and cleaning roofs. To undertake roof work safely you require knowledge and experience, and special equipment. Before the job begins, a safe system of work must be planned. Precautions must be adopted to reduce the risk of a worker falling or, if it occurs, to prevent the fall being the cause of serious injury. The precautions to be taken will depend on the type of roof and the nature of the work to be undertaken.

7.1.1 Flat roofs

Flat roofs include those with a pitch of up to 10°. All the edges and openings on a roof from or through which there is a possible fall of more than 2 m should be protected with suitable guard-rails and toe boards erected to the same standard as described in Chapter 5 for scaffolding (figures 22 and 23). In the case of openings, the alternative is to provide a substantial cover which will bear your weight, and which is not easily moved. It must be boldly and clearly marked as to its purpose. If there is an upstand at the edge of the roof of sufficient strength, conventional scaffold tubes to support guard-rails and toe boards can be attached to this. Alternatively, a system of simple precast counterweights can be used to support edge protection, or a series of triangular tubular steel frames approximately 2.4 m apart and using conventional scaffold tubes can be anchored to the roof, again by precast concrete counterweights.

Figure 22. Edge protection for flat roof – diagram of what is required

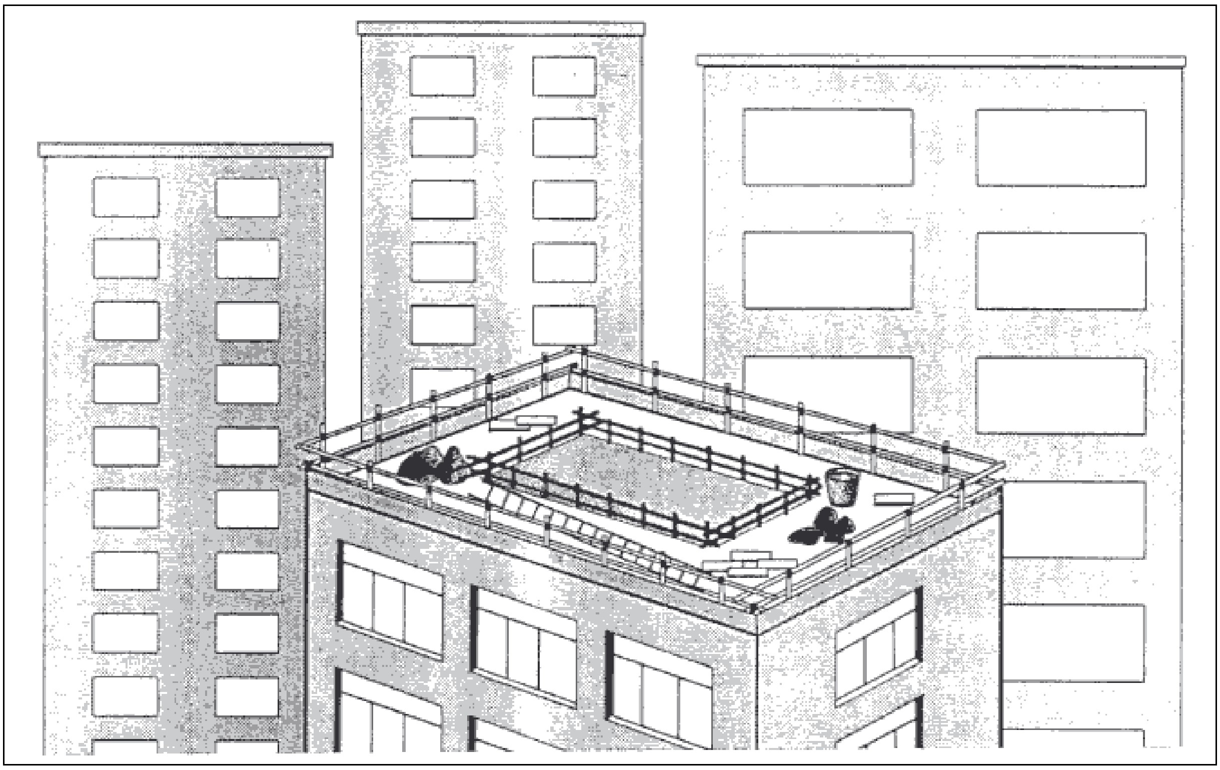
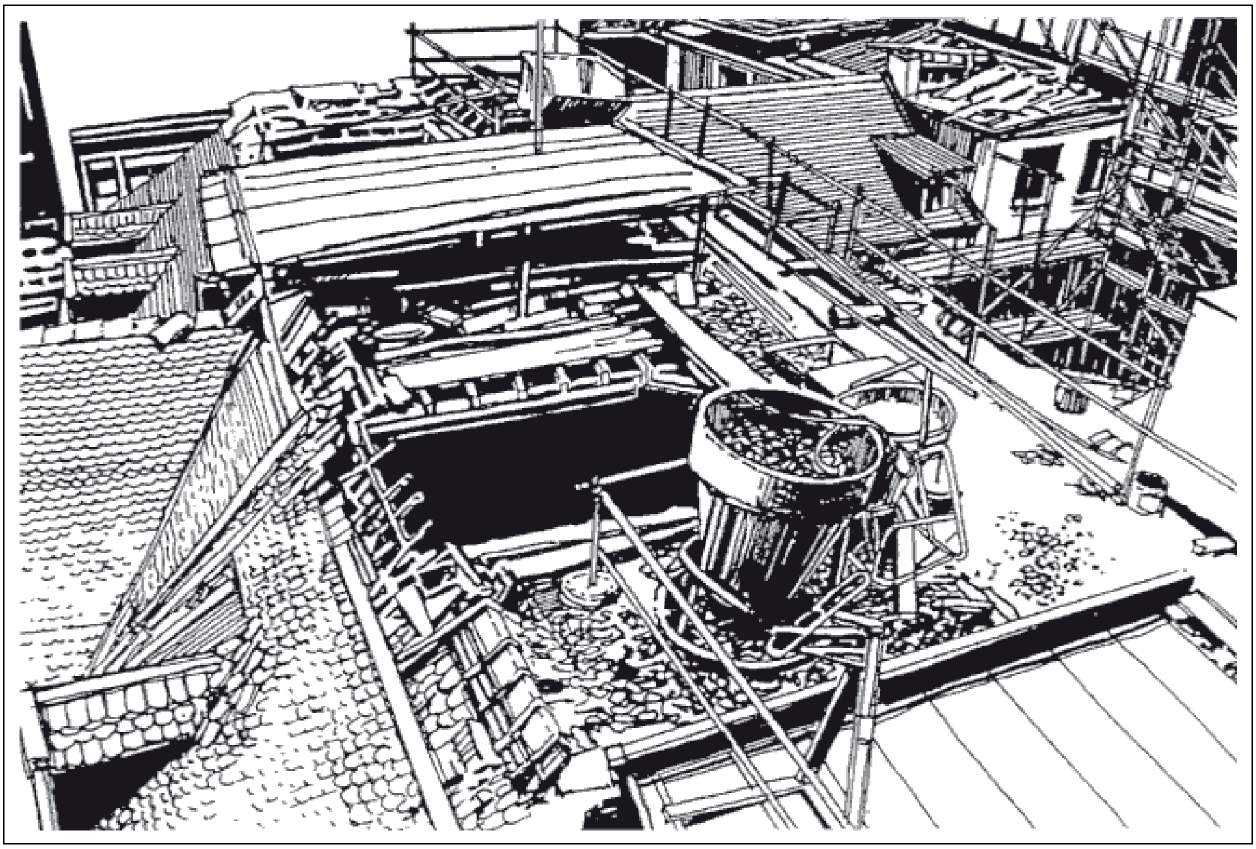


Figure 23. Edge protection for flat roof – a real-life example



7.1.2 Sloping roofs

Edge protection is necessary for all sloping roofs, that is of more than 10° pitch, or which have a slippery surface and where there is the possibility of a fall of more than 2 m from the edge of the roof. It should take the form of barriers or guard-rails high enough and strong enough to stop you if you are rolling or sliding down the roof slope (figure 24). The roof surface may be slippery because of the material from which the roof is constructed or because of the growth of moss or lichen, or it may quickly become slippery after rain or snow.

Unless tile battens on a roof are of adequate strength and themselves provide adequate handholds and footholds, you should use purpose-made crawling ladders or crawling boards (figure 25), even for inspection or work of short duration.

7.1.3 Fragile roofs

Before you use any roof as a means of access or a place of work, make sure that no part is covered with fragile material. Some roof coverings give a false sense of security and the impression of a surface which is solid enough to bear your weight, but they will not carry a concentrated load such as that applied by the heel of your foot, or if you stumble or fall. A common example is single-thickness asbestos cement sheeting which may shatter without warning. Do not make the common mistake of believing that it is safe to walk along the lines of sheeting bolts. Other examples of fragile material are wired glass, corrugated plastic sheeting for roof lights, rusted corrugated iron sheeting and unreinforced insulating slabs. Sometimes fragile materials are not easily recognizable beneath a paint or tar covering, particularly when they have been used to patch or repair a roof.

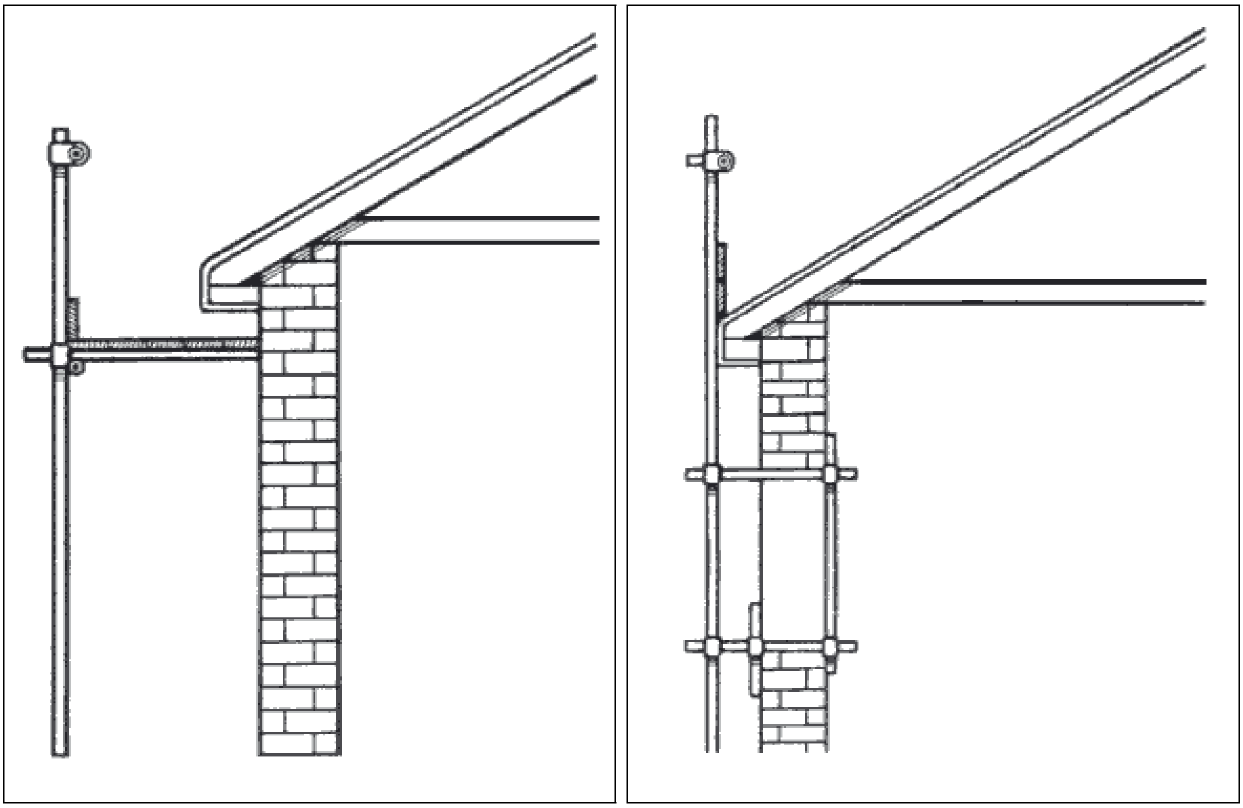
Once fragile material has been identified, or if you are in any doubt, use at least two crawling boards or roof ladders, so that one is available to stand on while you are moving the other.

Special precautions are necessary where a valley or parapet gutter is used as a means of access and the adjacent roof is covered with fragile material. Covering, or guard-rails, should be provided to prevent you from falling through if you slip or stumble. Prominent warning notices should be displayed at the approaches to fragile roofs.

Points to remember:

- Never work on a roof which is without adequate edge protection.
- Before you work on a roof make sure you know which parts are made of fragile material.
- Never step on to a fragile roof.

Figure 24. Sloping roofs: Two methods of providing edge protection



7.1.4 Crawling boards and roof ladders

Crawling boards and roof ladders (figures 25 and 26) should be properly designed and constructed, and not made up from odd timber found at the site. Boards should have cross battens at least 32 mm thick and not more than 380 mm apart, and should be secured in position.

The ridge anchorage or ridge iron at the top of the board or ladder should not rely for support on the ridge capping which is liable to break away, but should bear on the opposite slope of the roof or be secured by a rope. Eaves gutters should not be used as a footing or to support a roof ladder, as they are not strong enough.

Discussion

- What types of accident are most associated with roof work?
- What are the precautions you need to take to prevent them?
- Describe ways of providing protection against falls from the edges of roofs.
- What are the characteristics of a good crawling board or roof ladder?

Figure 25. Roof ladder for work on a sloping roof or over fragile materials

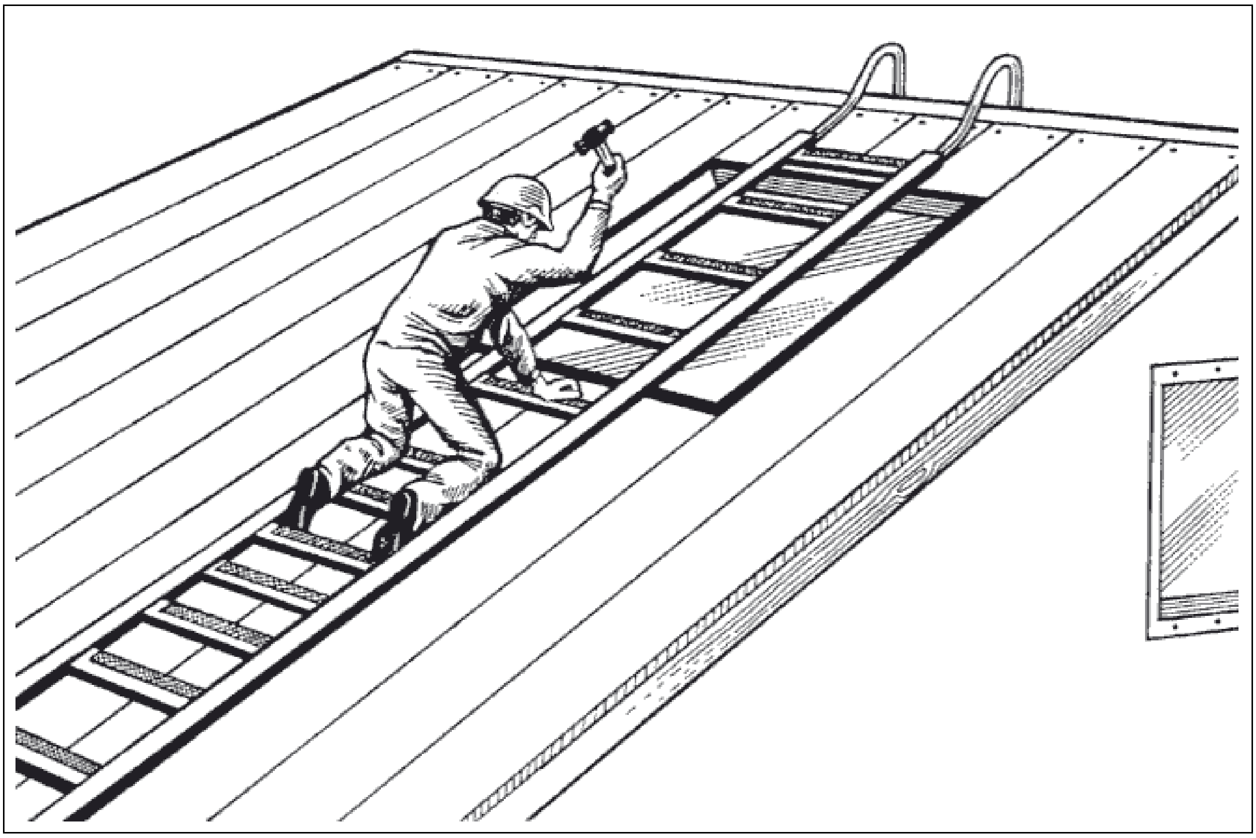
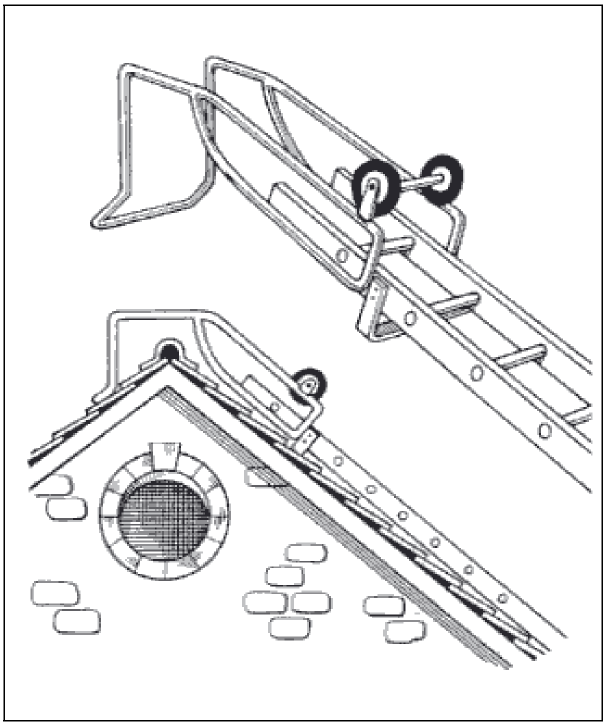


Figure 26. Roof ladder with ridge iron to place over roof ridge



7.2 Steel erection

The erection of steel structures and building frames involves work at heights and in exposed positions. The incidence rates for injury and death of steel erection workers are much greater than those for workers in the construction industry as a whole, high as these are.

Because the time spent at individual workpoints is often relatively short, access scaffolding is frequently not used and steel erectors perform many tasks in unnecessarily dangerous situations, often from a mistaken belief in their own invulnerability.

7.2.1 Design planning

If you work in steel erection you should know what safety precautions should always be taken before you begin work on site. It is essential that safety in steel erection begins at the design stage. Designers of structural steelwork should have sufficient site experience to understand fully the problems of steel erection, such as joint positions affecting erection sequences, the accessibility of connections, fixings for working platforms, and means of access and weights in relation to crane capacity. Designers should provide sufficient information so that the erection contractor is aware of the precautions which need to be taken to ensure the stability of the steelwork during erection. The contractor in turn should provide a statement of the proposed erection method and submit this to the designer for acceptance. A safe method of work includes the identification of hazards and difficulties which could lead to departures from the planned sequence of erection.

7.2.2 Supervision

Because fabricators and erectors of structural steelwork are often from different companies, there is the need for a supervisor from the main contractor to ensure that all procedures, checks and inspections are carried out, including clearance of any modifications or changes introduced.

7.2.3 Work preparation

Because erection of steelwork usually takes place during the early stages of a project before the site has been cleared and prepared, arrangements for the storage and handling of prefabricated steelwork are frequently haphazard, and there is often no proper access and freedom of movement for transport and cranes. Prior construction of ground-floor concrete slabs, access roads and hardstandings will encourage the use of cranes, tower scaffolds and mobile platforms, and provide a cleaner and safer site. The layout of the storage area for steelwork and materials needs to be arranged so that vehicles and cranes can move about without fear of collision.

To assist in safe lifting and movement of structural steelwork by crane, or by guy and pole derricks where cranes cannot be used, there should be clear indications of the weight of components and, wherever possible, markings giving suitable slinging points. Use should be made, wherever practicable, of hand lines attached to any item being moved.

The weather should be constantly monitored in relation both to wind and rain. There is danger in using cranes in high winds, and in working on steelwork in high winds and on wet surfaces.

Holding-down bolts are usually provided and fixed before the steel erectors arrive, and their importance is often underestimated. Errors in position, alignment and level can lead to improvization, and careful checking is necessary before erection begins. During the early stage of construction, excess loadings can be applied to the bolts and there is a danger of collapse unless adequate temporary bracing is provided in the form of props or guys. Many of the collapses which occur are caused either by failing to use adequate bracing, or by departing from planned arrangements to ensure stability. Erection planning should include the provision of sufficient guys, props, bracings and temporary connections.

During steel erection by crane, two hand lines should always be attached at each end of the steelwork. Workers controlling the placement of the steelwork using these hand lines should be positioned at a safe distance at least 5 m away from the point of placement.

Points to remember:

- Trying to save crane time by reducing the number of bolts used in connections is a dangerous practice.
- Do not work in high winds or on wet steelwork.

7.2.4 Means of access to working areas

Because of the mistaken belief that steel erectors are in a special class, able to rely on their skill to take care of themselves in all situations, dangerous practices such as climbing bare steel, beam walking (feet on top flange) and straddling (feet on lower flanges) are commonplace. In general, there are no technical or practical difficulties to prevent the provision and use of working platforms, stagings and working positions for the use of erectors working on the structural framework. In the majority of cases work can be planned and platforms designed to be attached at ground level, raised with the components and removed by crane after use. Often there is no reason why ladders fixed to stanchions before erection should not be used for vertical access. If they are attached to lugs fixed to the steelwork you need not be at risk when the ladders are removed, e.g. by being lifted out by crane after slings have been attached.

Project planning should always include the earliest possible provision of horizontal access between points of structural frames by means of permanent staircases and walkways complete with guard-rails. Prior to this, long-span metal or timber stagings should be used to provide temporary gangways. Where work is proceeding above 6 m, or two storeys high, then a tightly planked temporary floor should be installed. Mobile scaffold towers and mobile hydraulic extending platforms can often be used with greatly improved safety (figure 27), particularly if the site is cleared, access routes are provided and ground floor slabs and temporary floors are laid as soon as practicable.

If sufficient anchorage points are provided and used correctly, safety nets, safety belts and harnesses can save lives or prevent serious injury from falls, and their overall advantages outweigh any possible inconveniences (figure 28). A harness should be used in preference to a belt. A safety net should always be installed when the potential fall is more than two storeys (figure 29).

Steel erection involves a good deal of manual handling and lifting activities resulting in many back injuries and the trapping of hands or feet. You require proper training in safe methods of handling and lifting, and you should always wear suitable personal protective equipment.

Point to remember:

- If you climb or walk on bare steel, sooner or later you will fall.

Discussion

- Why is the incidence of accidents in steel erection so high?
- Describe what can be done to improve safety before steel erection begins.
- What are the principal ways of preventing accidents in steel erection?
- How can you overcome problems of providing safe access and safe working areas?
- What personal protective equipment should be used during steel erection?

Figure 27. Mobile hydraulic platforms provide safe means of access for steel erectors

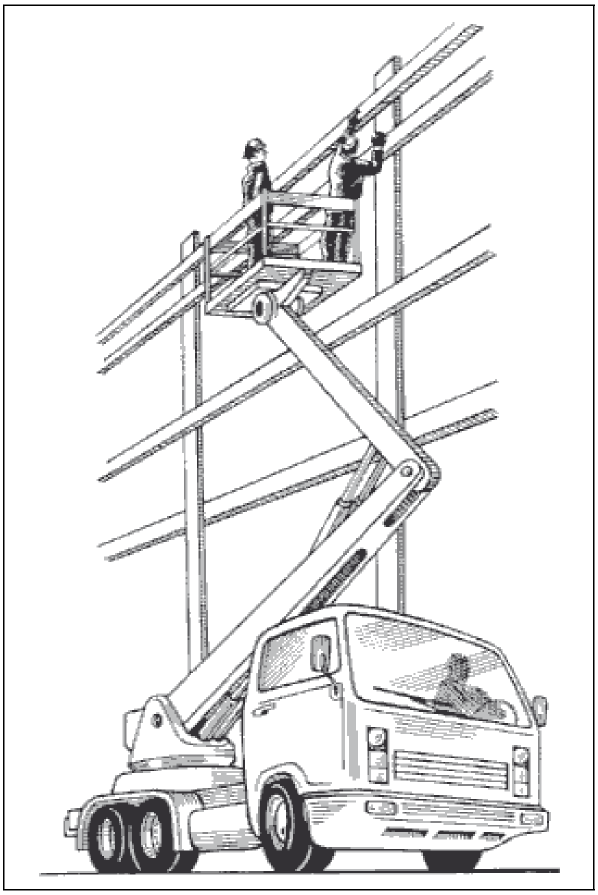
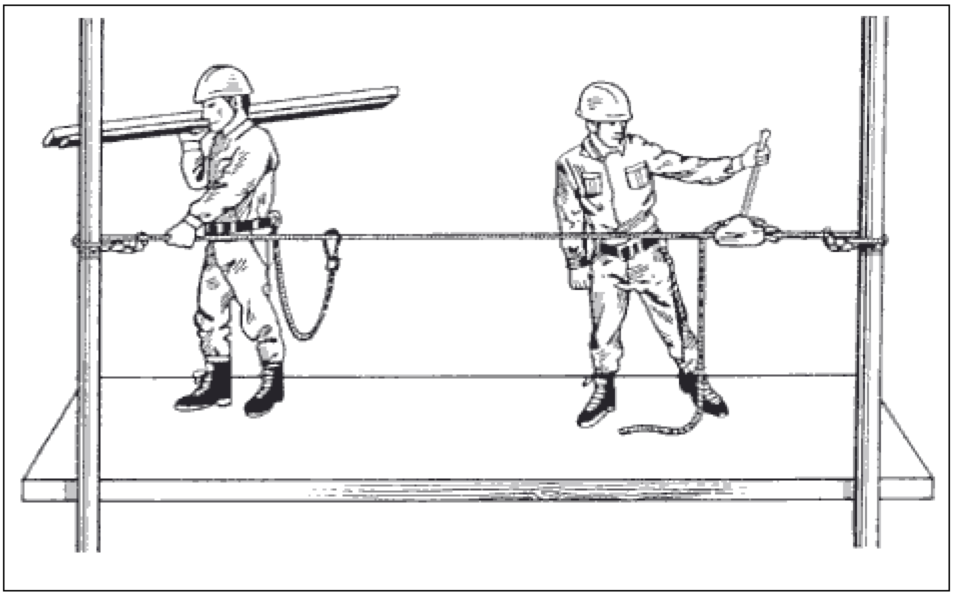
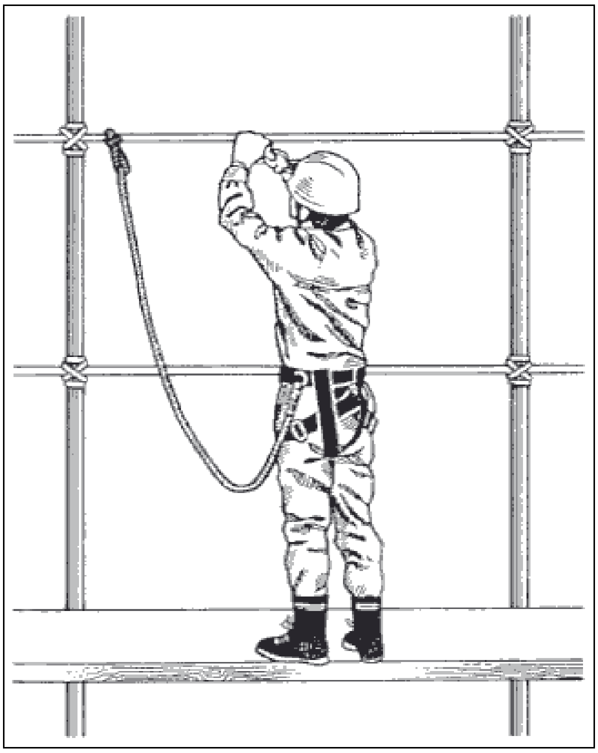


Figure 28. Use of safety belts and harnesses – different ways of providing safe anchorage points for safety lines



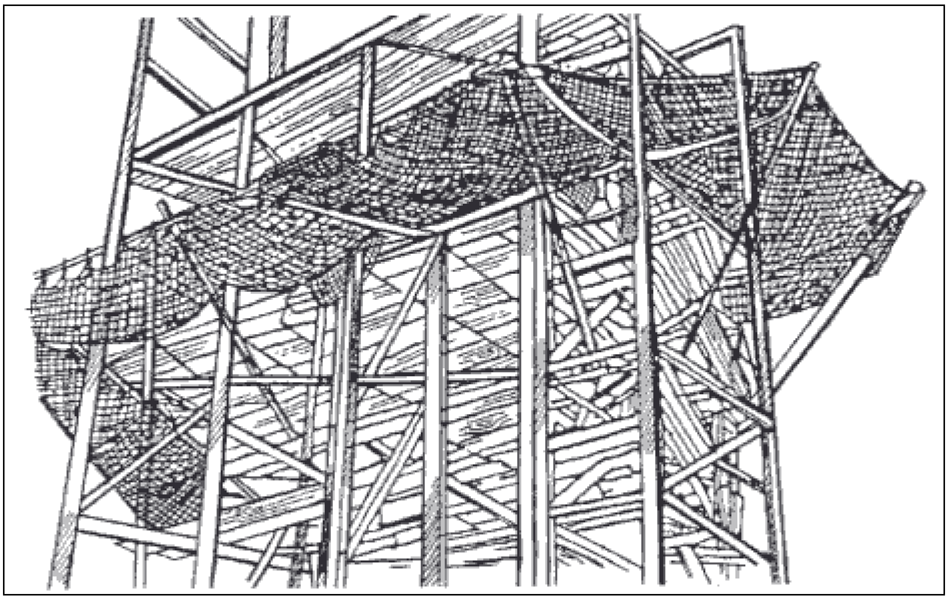


7.3 Work over water

Falling into water and being drowned or carried away by currents is an ever-present danger when working over or adjacent to water. Even though you may be a good swimmer, the following precautions should always be followed:

- Make sure that the working platform is secure and has no tripping hazards such as tools, wire, timber or bricks. Surfaces soon become slippery and should be treated immediately by cleaning, gritting or applying industrial salt or sand.
- Check that access ladders, guard-rails and toe boards are firmly fixed in position.
- Wear a safety helmet at all times – if you are struck on the head and fall into water you are at special risk.
- Wear a life-jacket, and ensure that it is properly fastened.
- Use any safety nets or safety harness provided.
- Check that lifebuoys fitted with lifelines are ready to hand for immediate use.
- Make sure that there is a safety boat and that it is manned while you are working above water – if over tidal water or a fast-flowing river, it must have a motor with a self-starting device.
- Ensure that you know the routine for raising the alarm and for rescue drill.

Figure 29. Safety nets to prevent falls of steel erectors



> **Points to remember:**
> - Do not work alone when you are working over water.
> - Check the number of work regularly to ensure that no one is missing.

Discussion

- What action would you take if a fellow worker fell into deep or swiftly running water?

7.4 Demolition

The principal causes of accidents during demolition are:

– the choice of an incorrect method of demolition;

– an unsafe place of work;

– the unintentional collapse of the building being demolished, or of an adjoining structure, because of lack of temporary support.

7.4.1 Planning and training

The safe demolition of a building depends largely on your knowledge and experience as the supervisor and on your skill as the demolition worker. However, there are vital steps which must be taken by management before you arrive on site.

Demolition must be supervised by persons with a thorough knowledge not only of demolition processes but of the principles of building construction. First, a survey of the physical characteristics and design of the building to be demolished must be carried out in order to choose a safe method of work. Contained within the structure of buildings are various forces and stresses, whether the buildings be of concrete, brick, masonry, steel or timber. When the building is complete, these forces and reactions are in balance, and equilibrium and stability is achieved. The severance or removal of a load-carrying member may unbalance the forces, upset the equilibrium and cause collapse of the whole or that part of the building. There are particular problems in some newer buildings which are post-tensioned or unbonded stressed structures, or are structures which have been progressively stressed as construction proceeds. Preliminary inquiries of the client or local authority may reveal such problems. The proposals for demolition should be contained in a written method statement which should also include drawings or sketches showing the sequence of operations, and the machinery or equipment to be used, including personal protective equipment.

Demolition is an inherently dangerous process and you and everyone on site must wear personal protective equipment (PPE) including helmet, gloves and safety footwear (see Chapter 12). The presence of debris and dust, and such jobs as the cutting of bolts or rivets, call for the provision of eye protection such as goggles or visors. The use of PPE is an essential part of your training in the basic principles and methods of safe demolition.

Before demolition begins, all services to the building or structure must be disconnected. Failure to do this adequately can result in electric shock, gasing, fire, explosions or flooding. Arrangements should be made to keep the public as far away as possible from the site, and wherever practicable a fence not less than 2 m high should be erected around it.

> **Points to remember:**
> - Plan before you demolish and demolish according to plan.
> - Have a written method statement for your demolition site.

7.4.2 The demolition process

The aim should be to adopt methods which do not expose you to falls from heights. While in general it is a sound rule gradually to reduce the height of a building and to demolish in the reverse order to construction, a deliberately engineered collapse, the licensed use of explosives, a demolition ball on a crane, or a pusher arm may sometimes be the quickest and most economical method of demolition, leaving work to be completed at ground level. It is dangerous to leave isolated wails or parts of walls standing and liable to collapse from the effect of high winds. Whatever the process adopted, debris should not be allowed to build up against walls or on floors with the consequent risk of the structure being unintentionally overloaded. Make use of debris chutes rather than throwing down material indiscriminately, even on isolated sites.

Wherever practicable, avoid working directly from parts of the building or structure you are demolishing, such as standing on the top of a brick wall. This usually means that you have both poor handholds and poor footholds.

When work cannot safely be carried out from a building, a scaffold platform, self-supporting and independent of the part of the building being demolished, should be provided (figure 30). On brick and masonry structures in particular, much of the work can be done from such scaffolding, the material being dropped to the interior of the building. Person-carrying skips or power-operated mobile work platforms can also be used to work at heights. The use of safety nets or safety harnesses may sometimes be necessary.

Figure 30. A scaffold platform from which demolition may be carried out safely

7.4.3 Tanks and vessels

The use of hot processes such as flame-cutting to demolish or dismantle plant which has contained flammable materials has caused many deaths and serious injuries. It is essential to make such tanks and vessels safe before work commences, and you should always follow a written permit-to-work system. It is usually easier to ensure that a flammable concentration of vapour is not present in a tank than it is to remove residues. Residue fires during demolition are common. In the case of small vessels up to about 50 cubic metres capacity both vapours and residues can usually be removed by steaming out, but this is often impracticable for larger vessels. The nature and distribution of residues is thus a key factor in deciding on the techniques to be used. Remember that there are other ways of cutting tanks and drums by means of cold processes and these should be considered before you adopt a hot process.

7.4.4 Health hazards

Insidious and unexpected health hazards frequently arise during demolition on account of exposure to dust and fumes. Short-term effects of poisonous fumes, or acute gasing, arise when a plant is opened up without having first been properly isolated, purged or cleaned, or when a vessel is entered without taking precautions. Another cause is the flame-cutting of plant which has been painted with zinc or cadmium paint. Long-term or systemic poisonings arise from flame-cutting lead-painted steelwork, and from the inhalation of dust or fumes from chemical deposits. The site survey should have assessed the risk, and the method of work statement should set out permit-to-work systems, the use of breathing apparatus, approved respirators, and rescue equipment.

Exposure to asbestos-bearing materials is now a particular risk in demolition. Indeed, you may be said to be more at risk from the presence of asbestos than almost any other category of worker. This applies particularly to exposure to blue asbestos, which was commonly used in sprayed insulation on columns and on the underside of ceilings and roofs for fire protection or for thermal insulation. Stringent precautions need to be taken to avoid contaminating the general atmosphere and to prevent breathing in of the dust. Material containing asbestos must be removed in isolation from other work, and you must wear positive pressure breathing apparatus and protective clothing, and be trained in their use and the techniques of asbestos removal (see Chapter 12). Where possible, wet methods of asbestos removal should be adopted rather than dry methods. Special arrangements need to be made by management for the safe disposal of asbestos-contaminated debris.

Points to remember:

- Never work on a tank or enclosed vessel without a written permit to work.
- Always check whether asbestos is present in the building to be demolished.

Discussion

- What should be done before demolition begins?
- How should demolition proceed?
- What are the common dangers to your safety and what precautions would you take?
- What are the special dangers to your health and what precautions would you take?

7.5 Confined spaces

7.5.1 Hazards

Every year there are fatal and serious accidents caused by persons entering confined spaces without the necessary tests being carried out or the correct safety and rescue equipment being provided. In many cases attempted rescue has ended in tragedy, with the death of the poorly equipped rescuer as well as the person to be rescued. While a closed tank with a restricted access opening may be the obvious example of a confined space, such spaces may also include open manholes, sewers, trenches, bored piles, pipes, ducts, enclosed basements and other places where there is inadequate ventilation.

Dangerous atmospheres can arise when there is a lack of oxygen or when toxic or flammable gases are present. These may be due to exhaust gases from plant and transport, carbon dioxide forming in chalk soil, decomposition of sludge in a sewer, leaks from gas mains, rusting of metalwork, or the presence of petrol and various kinds of waste from factories and trade premises. Work being done in a confined space can make it dangerous. Examples are some painting work, the use of adhesives to fix floor tiles, and cleaning fluids.

Many of these accidents would have been avoided if supervisors and workers had been properly trained and a permit to enter and a permit to work system had been in operation.

If you are actively engaged in work in confined spaces, you must be fit and properly trained for the job, and have the necessary personal protective equipment. You should remember that an oxygen deficiency can render you unconscious, and that toxic fumes can additionally cause dizziness and a feeling of sickness, while gases can be flammable or explosive.

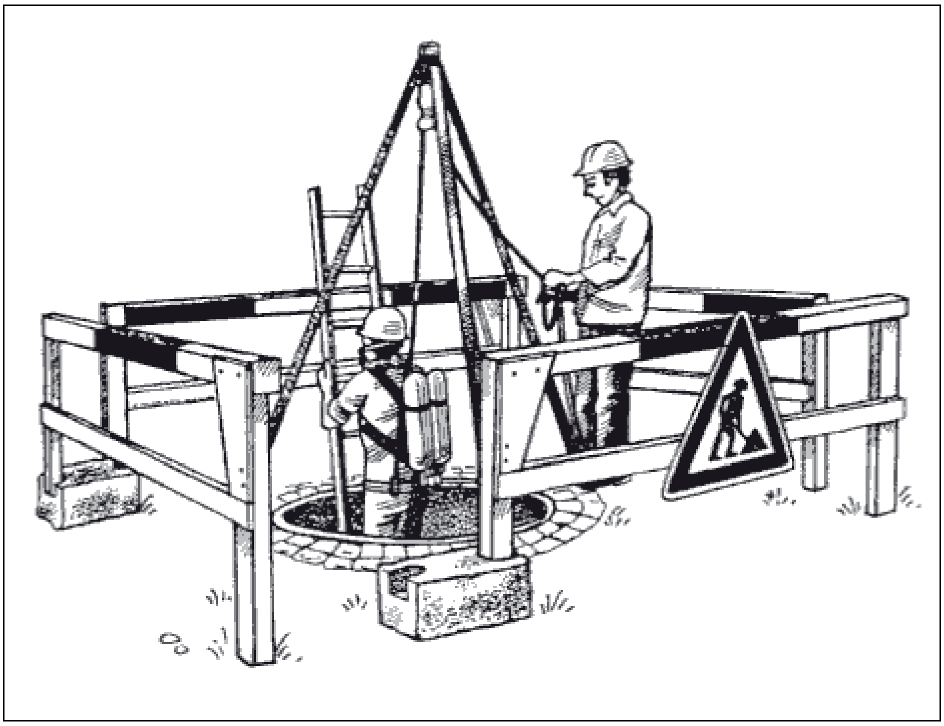
7.5.2 Safety precautions

The following precautions are essential before you enter a confined space regardless of any work you intend to carry out:

– Never enter without instructions from a supervisor and without a written permit to enter or permit to work.
– Equipment for monitoring the atmosphere at frequent intervals must be provided and must be used by a competent person. You must not enter the confined space until the competent person is satisfied that entry is safe.
– There should be forced ventilation to remove and dilute dangerous gases and provide fresh air.
– Monitoring must continue while work proceeds, and you must leave immediately if told to do so.
– You should have received proper training and instruction in the precautions to be taken, including the use of emergency breathing apparatus.
– Rescue harnesses should be worn by everyone inside the confined space, with lifelines attached to a point outside the space.
– Not less than two persons should be present when there is work in a confined space. One should be outside the confined space to keep watch and to offer rescue action or assistance. Additional emergency and accident assistance must also be readily available.
– A proper procedure for rescue in an emergency should be laid down, with specific duties allocated to specific persons. If you play a part in this procedure, make sure that you clearly understand what you have to do. Even if you think lives are at stake, you must still follow the procedure and must not take short-cuts.
– When working at a manhole in a road or public area, ensure that guard stands are provided and the appropriate traffic signs displayed.
– Make sure that you have been trained by a competent person in the use of the safety and rescue equipment.

Some of these points are illustrated in figure 31.

Figure 31. When entering a confined space, use a lifeline with a second person present and self-contained breathing apparatus



7.5.3 Safety and rescue equipment

Whenever work is to be carried out in a confined space, the following equipment should be provided:

- an atmospheric testing device (proprietary meters and lamps are available);
- two rescue harnesses with adequate lengths of rope taking into account the location of the work site;
- hand torches or lamps safe for use in a flammable atmosphere;
- at least one set of suitable breathing apparatus (cartridge, canister or filter) and an emergency breathing pack;
- first-aid equipment;
- firefighting apparatus;
- an audible alarm for summoning help;
- resuscitation equipment;
- means of communicating with surface workers.

Points to remember:

- Never work alone in a confined space.
- Never rely on your senses to tell you whether an atmosphere is hazardous.
- Never attempt to clear fumes and gases with pure oxygen because of the risk of being enveloped in fire if there is a source of ignition.
- Never rely on cartridge, canister or filter respirators in confined spaces.

Discussion

- On what sort of construction work might you find confined spaces and hazardous atmospheres?
- Have you ever worked in a confined space – What was it and were the above precautions followed?
- A worker collapses in a confined space – What would you do?

7.6 Piling

7.6.1 General precautions

There are certain hazards which are common to all types of piling, and the following precautions are necessary:

– piling machine operators should be over 18 years of age and properly trained;
– prior to piling, all underground services should be located and made safe. A check should be made to ensure there are no cellars, underground water courses or ground conditions which might cause hazards;
– there should be a firm level base for the crane, or crane mats provided;
– when working on piling operations you must wear a safety helmet, and ear and eye protection where necessary;
– all cranes, lifting appliances and lifting gear must have appropriate certificates of testing and thorough examination, and should be large enough for the job;
– particular attention should be paid to the risk of damage to lifting gear from sharp edges;
– cranes used for raising or lowering workers must be fitted with a dead man’s handle and lowering should be done under power; you must be carried in properly constructed cages which cannot spin or tip;
– piling contractors should be asked to provide a written method statement setting out the precautions relevant to the type of piling they are to employ;
– induction training and information for you as supervisor or operative should be specifically related to the method statement.

Point to remember:

- Wear your protective equipment at all times when piling.

7.6.2 Bored piles

You may need to enter a borehole for inspection or for clearing out in undercuts, and there are certain precautions which must be taken prior to your entry:

– the borehole should be at least 75 cm in diameter;
– the borehole should be treated as a confined space and the precautions which are advised elsewhere to ensure a satisfactory atmosphere must be closely followed;
– waste material from the borehole should be kept clear of the borehole;
– descent into a borehole should be in properly designed skips, chains or cages fitted with an anti-spin device. The power source of the lifting appliance should be kept running throughout the time someone is underground;
– while you are working down a borehole you must wear a safety harness;
– all workers concerned must be trained and competent in rescue from deep boreholes, and emergency rescue drills should be carried out at regular intervals;
– a banksman who can see you in the borehole should be present at all times;
– there must be adequate lighting at safe reduced voltage and a means of communication from the borehole.

Wherever possible, the need for workers to enter pile boreholes should be avoided by the use of television cameras and other techniques for remote inspection.

Discussion

- What are the dangers of piling and what should be done to overcome them?

8. Vehicles

8.1 Causes of accidents

The underlying cause of most site traffic accidents is the failure to plan a safe system of work and to train workers how to follow it. However, the common immediate causes are one or a combination of the following factors:

– bad driving techniques which include reversing blind;
– carelessness or ignorance of special hazards, e.g. work near overhead power lines or excavations;
– carrying unauthorized passengers;
– poor maintenance of vehicles;
– overloading or bad loading;
– site congestion;
– poor traffic layout;
– lack of proper roadways combined with uneven ground and debris.

8.2 Safety precautions

Transport may include trucks, tipper lorries, tractors and trailers, and small dumpers. As a driver you must be properly trained and if you take a vehicle on or across a public road you usually need to possess a national driving licence. It is good practice for all drivers to possess a driving licence in any case. Training should include instruction on negotiating steep slopes so that you know, for example, that you should drive a vehicle up and down the slope rather than across it, whenever practicable.

Routes should be levelled, marked and planned in such a way as to avoid potential hazards such as overhead power lines and steeply sloping ground. Where possible a one-way system should be used. Speed limits should be required and clearly displayed, they should be reduced for adverse site conditions and for areas near work in progress.

If routes have to approach overhead structures or overhead power lines, contact with them can be avoided by erecting warning barriers of the goalpost type (figure 32). The crossbar should be of rigid material, preferably timber, and painted in two contrasting warning colours. In the case of power lines, there should be a barrier on both sides of the line and set at least 6 m horizontal distance away. If you are operating a crane in the area of overhead power lines, make sure that arrangements have been made in advance with the power company for power to be diverted or cut off whenever the crane is in use.

Workers are frequently struck by vehicles travelling backwards when the driver's rear view is obscured. Enlist the help of another worker before you reverse and keep him or her in view at all times. If no one is available, walk round to the rear of the vehicle yourself to see that all is clear and give a sound signal before starting to reverse. Many vehicles now have an audible warning device such as a horn or warning hooter which sounds when reverse gear is engaged, but as a driver you should not rely on this alone.

An unattended vehicle should have the engine switched off, and unless the vehicle is on a marked incline the gear should be left in neutral and the handbrake on, on sloping ground the wheels should also be chocked. Tipping bodies should be lowered when the machine is unattended, but if it is occasionally necessary to leave them in the raised position they should be blocked to prevent their fall.

Foot injuries to drivers and their assistants during loading and unloading are common, and you should wear safety boots or shoes.

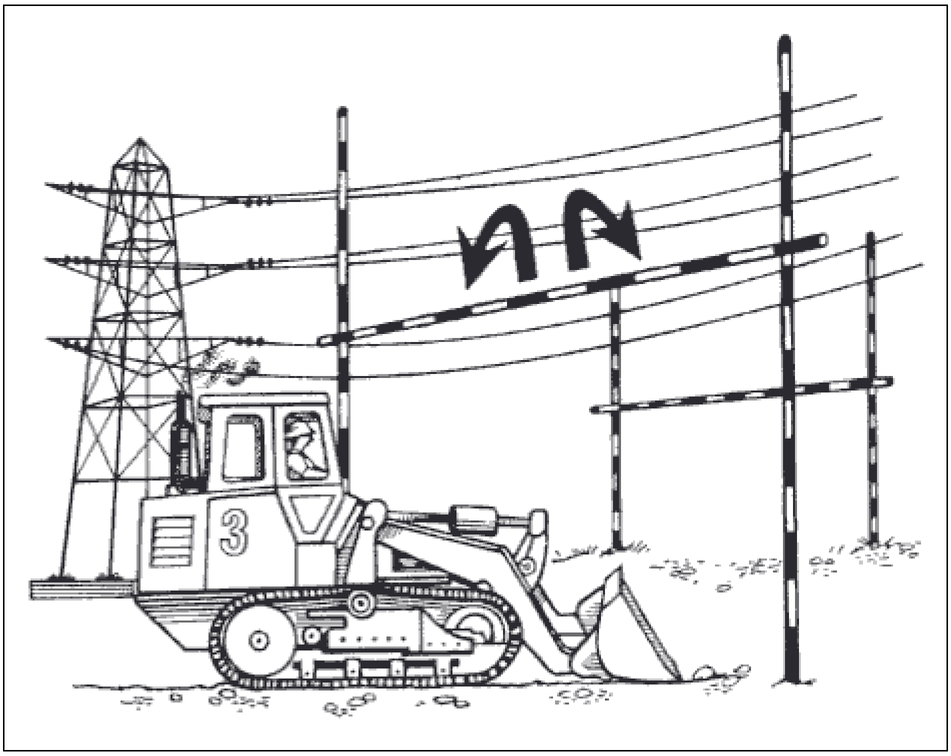
Maintenance of vehicles falls into three categories:

– a daily check by the driver of water, oil, fuel, lights, inflation of tyres and brakes – remember the acronym WOFLIB;
– a weekly check by a fitter;
– periodic servicing to the manufacturers' requirements.

A written record of maintenance and repairs should be kept on site.

Points to remember:
- Keep your vehicle tidy and the cab free from tools and material which might obstruct the controls.
- Keep to speed limits.
- Do not carry unauthorized passengers.
- Do not drive across a slope.

Figure 32. Goalposts to compel drivers to lower crane and excavator jibs, and avoid contact with overhead power lines



8.3 Overturning

Falls of vehicles into excavations or openings occur frequently when vehicles get too near the edge of an excavation and cause the side to cave in, or when in tipping materials over the edge the driver approaches too close and cannot stop in time. The precautions are barriers, banksmen and fixed stops, as discussed in Chapter 4. Construction vehicles are often basically unstable and liable to overturn, and it is therefore important not to turn at an excessive speed. Vehicles such as tractors and lift trucks should be equipped with protection to prevent the driver being hit by falling objects and from being thrown from the cab in the event of overturning.

Point to remember:
- If your vehicle begins to topple over, remain in the seat and do not try to jump clear.

8.4 Loading

Loads within the capacity of the vehicle should be evenly distributed and properly secured, and should not project beyond the plan area of the vehicle. If some degree of projection is unavoidable, it should be clearly shown by the attachment of flags. Uneven loading can cause a loss of control when cornering or braking, and insecure loads may swerve or fall off the vehicle during travel. The body of a tipper lorry should always be lowered before you drive off.

Loading and unloading should be an integral part of driver training.

Points to remember:

- Use the steps if fitted, otherwise use the wheel rims to dismount from the cab; do not jump.
- Never mount, or dismount from, a moving vehicle.

Discussion

- What are the principal reasons for site vehicle accidents?
- What further precautions to those mentioned can you take to prevent site vehicle accidents?

9. Movement of materials

9.1 Cranes

Before a crane is used on site, management should consider all the factors that could affect its safe use, such as:

– the weight, size and type of load it will have to lift;
– the maximum reach or radius required of it; restrictions on use such as overhead power lines, the state of the site and the type of ground;
– the need for trained operators and signallers.

9.1.1 Erection

Both the erection and dismantling of cranes should be done by skilled workers under the immediate direction of a competent and experienced supervisor. The manufacturers' instructions should be closely followed.

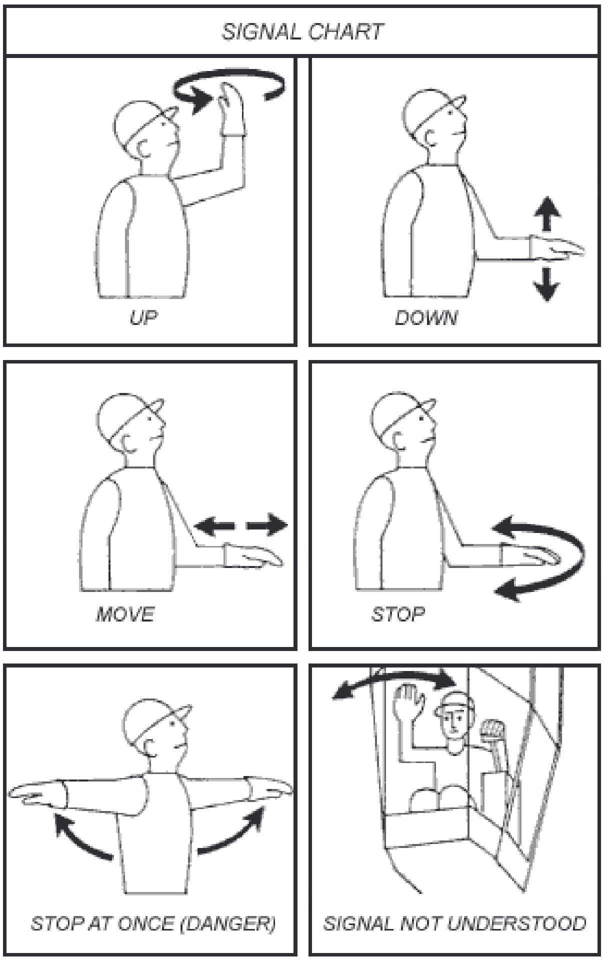
9.1.2 Signalling

Crane operators and signallers must be over the age of 18, and trained and sufficiently experienced. There should always be a signaller, or a signalling system such as a telephone, if the crane operator cannot see the load throughout the lift. Hand signals should be clear and distinct, and should follow a recognized code or system (figure 33).

9.1.3 Overloading

Overloading, causing vital parts to be stressed beyond rated capacities, can easily occur when neither the operator nor the supervisor is able to estimate the weight of material to be lifted, which is likely in the case of odd-shaped items. An operator who is not properly trained may then lower a load at too high a speed so that when the brake is abruptly applied the jib snaps. All cranes should be marked with their safe working load which must not be exceeded during the use of the crane. In the case of cranes with a derricking jib, that is with a variable operating radius, the safe working load should be shown for every radius of the jib. Winches and pulley blocks should be similarly marked.

Figure 33. Hand signals to crane drivers should be clear and distinct, and should follow a recognized code or system



9.1.4 Safe load indicators

All jib cranes should have an automatic safe load indicator which alerts the operator, usually by a light, just before the safe load is reached, and warns both the operator and others nearby, usually by a bell or hooter, if the safe load is exceeded. The safe load indicator is an aid to safe crane operation, but does not guarantee it. For example, it does not take into account the effect of wind or soft ground conditions. If you are lifting a load that you know or believe to be close to the safe working load, do not proceed immediately to a full lift. Rather raise the load a short distance and stop to check the stability of the crane before continuing with the lift. Remember that if a load is allowed to swing or is lowered rapidly, the radius of the jib may be increased unintentionally by flexing of the jib. Some indicators operate also as an overload cut-out. Never bypass the indicator in order to lift an overload.

Points to remember:

- If you cannot see the load all the time, you need a signaller.
- Beware of exceeding the safe working load when trying to free a stuck load.

9.1.5 Inspection and maintenance

Cranes are subject to wear and tear which may not be easily detected: for example, bolts and similar parts may be subject to metal fatigue. Cranes should be tested and examined by a competent person before they are used on a construction site, and subsequently inspected at regular intervals in accordance with government requirements. The manufacturer’s recommended programmes of operator checks and maintenance should be followed and any damage or defect should be reported to the supervisor. Never use a crane if you think it unsafe.

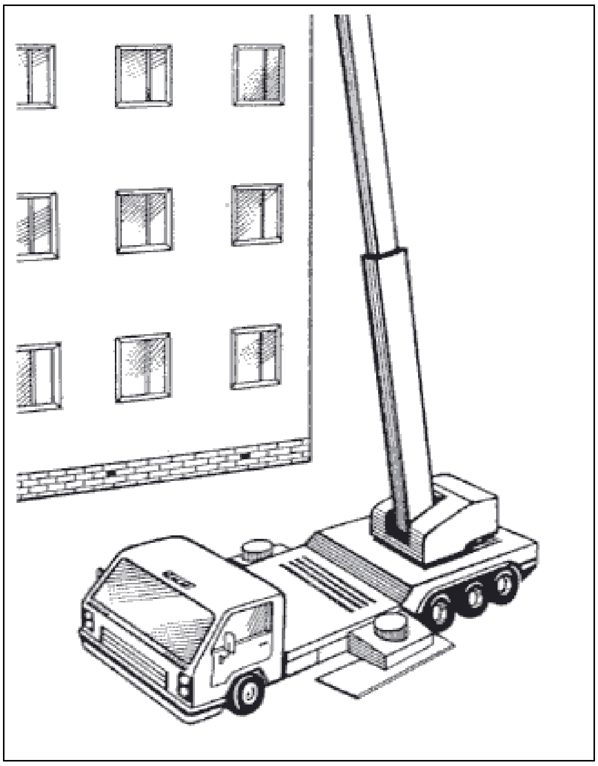
Particularly susceptible components are wire ropes, brakes and safety devices. The constant contact of wire ropes with the sheaves on the jib accelerates wear. Brakes are in constant use and need to be checked, adjusted or renewed regularly. Safe load indicators and other safety devices such as overload cut-outs and limit switches are often susceptible to breakdown under site conditions and are sometimes deliberately disconnected.

9.1.6 Mobile cranes

A mobile crane is inherently unstable and is liable to overturn if used on uncompacted ground or on a slope. Remember that rain can soften the ground and sites which are not level impose strains on the crane which may lead to unintentional overloading.

From your training as a crane operator you should understand the advantages and limitations of outrigger settings (figure 34), and be aware of the dangers of failing to use them. Lifting outdoors may be made more difficult or hazardous by the wind. Make sure that there is adequate clearance for the crane’s jib or boom and counterweight from traffic and fixed structures such as buildings, and that no part of the crane or the crane load will be closer than 4 m to live overhead power lines.

Figure 34. Mobile cranes should operate with outriggers extended to prevent overturning

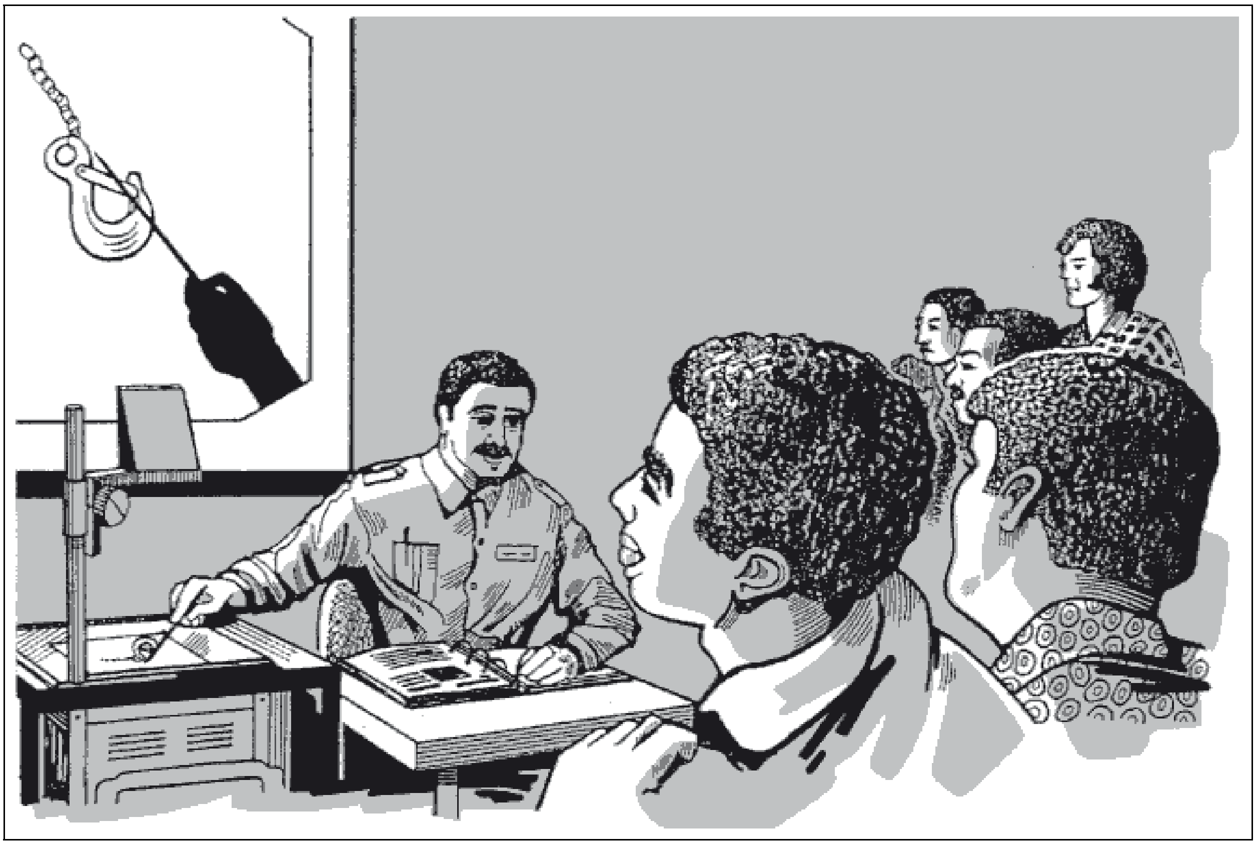


All cranes should be fitted with a safety hook designed to prevent accidental dislodgement of the load if it fouls something or meets an obstruction during the lift (figure 35).

Points to remember:

- Is there a safety hook fitted?
- Is there adequate clearance for the crane's jig or boom?
- Make sure there are no drainpipes beneath the outrigger pads.

Figure 35. Cranes: The need for a safety hook fitted with a latch to prevent displacement of loads is explained to workers



9.1.7 Tower cranes

To prevent overturning, a tower crane must either be anchored to the ground or securely counterweighted or ballasted. If the crane is rail mounted, remember that the rail tracks cannot be used as an anchor. Because ballast material may be moved, a diagram of the counterweight or ballast should be fixed to the crane, and the ballast should be checked against this whenever the crane is erected, and after bad weather.

Make sure that equipment such as slings and chains used with the crane does not clutter accessways or ladders and is well clear of any machinery in which it may become entangled.

Loads must be lifted vertically, as any out-of-vertical lifting may result in crane collapse. Never lift loads having a large surface area in windy conditions.

The crane must be positioned to ensure that the crane jib or boom is free to windvane or turn through 360° around the tower. Crane manufacturers specify the maximum wind speed at which tower cranes may be safely used.

Point to remember:

- Never climb up the tower or get onto the boom while the crane is in use.

9.1.8 Cranes used in demolition

A cast-steel ball or weight suspended from a crane jib is an extensively used method of demolition. Cranes as such are not designed for extremes of shock loading likely to arise when a demolition ball is in use and therefore should be used only to drop the ball vertically on a free fall for such operations as breaking up concrete slabs. They should not be used for swinging the ball. Excavators which are convertible to cranes are designed for drag-line operations which impose a shock load and are more suited to use with a ball. The excavator manufacturer’s recommendations as to weight and attachment of the ball should be followed. Generally the weight of the demolition ball should not be more than 33 per cent of the machine’s safe working load and not exceed 10 per cent of the hoist rope’s minimum breaking load. All parts should be inspected twice daily, and a high standard of maintenance is necessary. As an operator you need to be familiar with demolition balling and should be protected from debris by a protective structure with safety glass or metal mesh.

9.1.9 Lifting appliances used as cranes

Machines such as excavators, back-hoe diggers and front-end loaders are used as cranes when they handle loads suspended by slings.

The precautions previously advised for mobile cranes apply in general, although a safe load indicator and a radius indicator are not generally fitted if the load lifted is kept below 1 tonne. Whatever the load, you should ensure that the machine can safely lift and place it exactly where needed.

9.1.10 Slings and ropes

Only slings and ropes which have a marked safe working load should be used. Pad sharp corners of the load to prevent damage to the sling and make sure you have screwed home the shackle pins.

Point to remember:

- Make sure the load you are lifting is properly secured.

Discussion

- How would you describe a crane?
- What site conditions make it unsafe to use a crane?
- What are the safety devices used on cranes?
- What types of lifting machinery are subject to inspection and testing?
- What should inspection and testing consist of and how often should they be done?

9.2 Goods hoists

The goods, or platform, hoist used to raise materials and equipment vertically to successive levels as construction proceeds is probably the most widely used item of mechanical handling equipment. It consists of a platform which is driven either from a rope winch or by a rack and pinion with the motor and gearbox mounted on the platform. The principal dangers are of falling down the hoistway from a landing on the platform, being struck by the platform or other moving parts, and being hit by materials falling down the hoistway.

9.2.1 Erection

The erection, extension and dismantling of hoists is a specialized job and you should carry it out only under the charge of a competent supervisor. The tower or mast of the static hoist needs to be securely tied to a building or scaffold and maintained vertical, so that no undue stress is imposed on the tower, with consequent misalignment and interference with the platform. Mobile hoists should be used only to a maximum height of 18 m unless a greater height is specified by the manufacturer.

9.2.2 Enclosure

A substantial enclosure should be erected at ground level around the hoistway to a height of at least 2 m. It should have suitable gates giving access to the platform (figure 36). The remainder of the hoistway should be enclosed (e.g. with wire mesh) throughout its height sufficiently to contain falling material within the enclosure. Gates should be fitted at every landing level where access to the platform is needed, and you must keep the gates closed except when you are actually loading and unloading at that level.

9.2.3 Safety devices

An overrun device should be fitted just above the highest platform position required, or near the top of the mast. An arrestor device should be fitted to support the platform, fully loaded, in the event of failure of the hoist rope or driving gear. There should be at least three turns of rope on the winch-drum when the platform is in its lowest position.

9.2.4 Operation

To prevent the hoist operator, who should be trained and aged at least 18, from moving the platform while someone is trying to load or unload materials, the controls need to be set up so that the hoist can be operated from one position only. Make sure that from this position the operator can see all landing levels clearly. If this is not possible, a signalling system must be used during loading and unloading. There should be overhead protection for the operator if, as is usually the case, he or she is at ground level.

9.2.5 Loads

The platform should be clearly marked with its safe working load and the platform should not be overloaded. Barrows should not be overfilled, and their wheels should be chocked or secured so that they cannot move about on the hoist platform while it is moving. Loose bricks or other materials should never be carried on an open hoist platform. No one should be allowed to ride on the platform and there should be a notice on the platform forbidding riding.

9.2.6 Carriage of persons

Lifts for the carriage of persons need to be especially constructed and installed for the purpose, with such features as mechanical and electrical interlocking devices on the cage and landing gates.

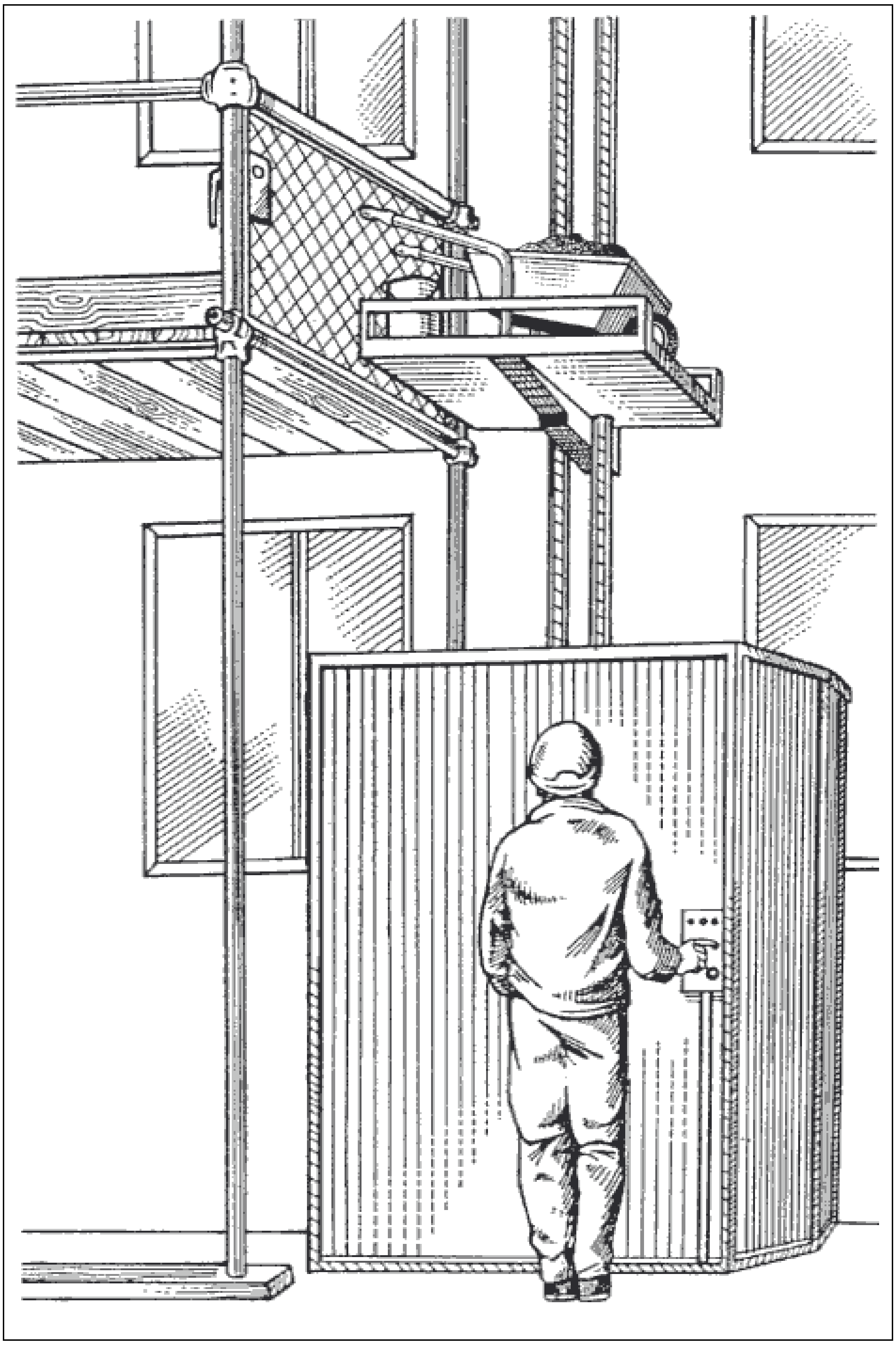
9.2.7 Testing and examination

Every hoist should be tested and examined after installation, and checks made on the arrester and overrun devices. Weekly recorded checks should then be made by a competent person.

Points to remember:

- Place barrow handles facing the direction of the offloading exit, when loading the platform on the ground.
- Never ride on the platform of` a goods hoist.
- Keep the landing gates closed whenever you are not loading or unloading.
- Make sure the platform is stopped at the landing level before you step onto it.

Figure 36. Goods hoist with enclosure and gates to prevent workers being struck by the platform



9.3 Gin or pulley wheels

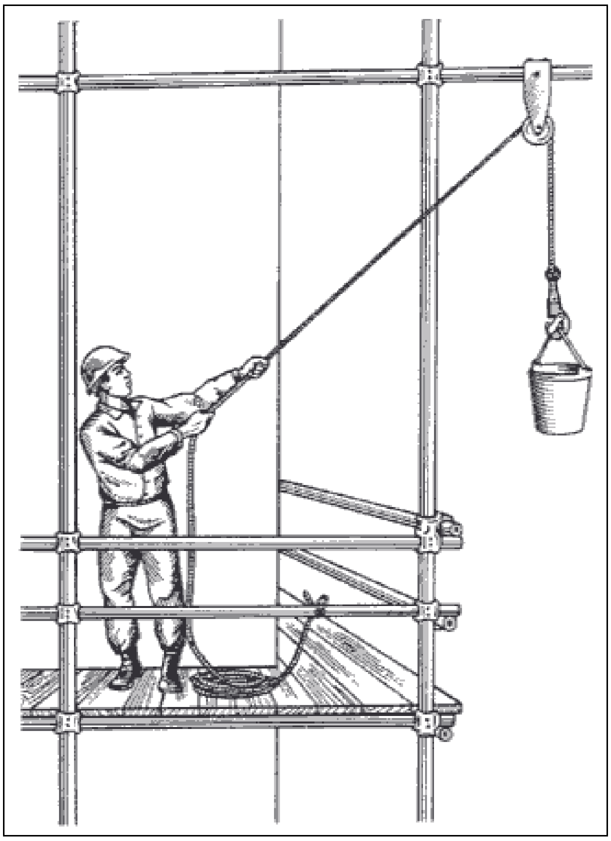
9.3.1 Causes of accidents

Gin or pulley wheels are a common and inexpensive way of lifting small loads a limited distance. The most common accidents occur when:

- the pole on which the wheel is mounted relies on a single support – two supports are always required (figure 37);

- the hoisting rope is not fitted with a properly made safety hook – hooks made of bent reinforcing rod are dangerous;
- the hoisting rope is worn, chafed and no longer serviceable;
- the bucket or load strikes the scaffold or building, tipping out its contents;
- the load is too heavy or is not secured;
- an appliance mounted on a roof does not have a secure anchorage to prevent overturning – there should be a safety factor of at least 3.

Figure 37. A gin wheel should always be secured to at least two supports



9.3.2 Safety measures

The following precautions should be taken:

- if liquid is transported in a bucket, there should always be a cover;
- when you are hoisting the bucket, always use gloves to protect your hands;
- if the height of the pulley is over 5 m, a ratchet and pawl mechanism should be considered;
- where the pulley is mounted near the edge of a roof or floor, guard-rails and toe boards are required;
- if two or more of you are lifting, one should give instructions to ensure that the team works together.

Point to remember:

- Make sure that the load you are lifting is properly secured.

9.4 Manual handling

The handling of raw materials and building components is an integral part of the construction process. Manual handling of loads and materials is still very common. Many workers carry out heavy lifting and carrying operations during much of the working day. Next to falls, manual handling is the most common cause of construction accidents.

The proper mechanical handling of materials can ensure that work flows smoothly, and helps to avoid delays and damage. In manual materials handling too, one can apply techniques and ideas which increase efficiency and are not expensive. These "low-cost" solutions most frequently arise from local needs and experience.

When approaching the problem of safe manual handling of materials there are three important questions you should ask:

- Can mechanical equipment be used in place of manual handling?
- Can the load be lightened or suitably shaped for manual handling?
- Have you been trained in proper methods of lifting and carrying?

9.4.1 Lifting and carrying

Almost one-quarter of work injuries occur during manual handling, most of which are strains to the hands, legs, feet and back. Much construction work involves heavy manual labour and workers not in good physical condition tire easily and are more susceptible to injury. You should know your physical capabilities and only tackle jobs you can reasonably handle. It is important, too, to have been trained in the right techniques of lifting and carrying. Look after your own welfare by:

– putting the load on wheels if you can instead of carrying it;
– using mechanical handling equipment if you have been trained to use it;
– wearing the right equipment for the job such as safety boots,
– checking the weight of the load before lifting;
– not lifting loads higher than is necessary;
– checking that there are no overhead power lines or obstructions when you are carrying a long load such as scaffold tubes or reinforcing rods;
– removing or securing loose objects on the load;
– getting assistance if the load is too heavy or awkward for you to handle on your own;
– making sure that there is a clear walkway to your destination and a safe stacking place.

9.4.2 Lifting technique

The size, shape and structure of the material will largely determine how easy or difficult manual handling will be. Well-designed and well-placed handles are of great help. Whenever you lift a load, follow the following procedure:

– Stand close to the load on a firm footing and with feet about 30 cm apart.
– Bend the knees and keep your back as straight as you can.
– Take a firm grip on the load.
– Breathe in and throw the shoulders backwards.
– Straighten the legs, continuing to keep the back as straight as you can.
– Make sure that your view is not obstructed by the load.
– Keep the load close to the body.
– Lift slowly and smoothly.
– When carrying a load, avoid twisting the spine to turn; move your feet instead.
– If two or more of you are lifting, one should give instructions to ensure that the team works together.

Figure 38 shows the right and wrong ways to lift a load.

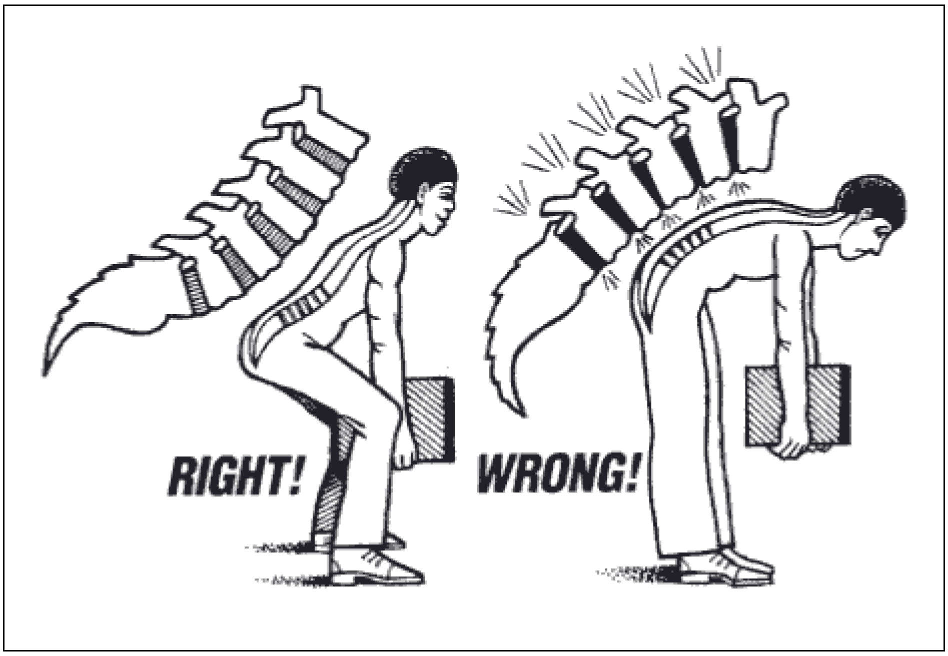
Point to remember:

- Correct lifting and carrying calls for training and practice.

Discussion

- What steps can be taken on your site to improve materials handling?
- Have you had training in the correct method of lifting and carrying?
- What handling aids do you have on your site?

Figure 38. Right and wrong ways to lift a load



10. Working positions, tools and equipment

10.1 Fitting work to people: Ergonomics

The technical development of the construction industry has led to reliance on machines and technical equipment for much heavy work previously done by hand. Although there are still many tasks on site which are carried out using manual labour, it is difficult to envisage high-rise building construction without cranes, excavators, concrete mixers or pile drivers. Mechanization has, however, brought new problems to the workplace.

Technology changes faster than people and technological change often exceeds people's ability to adapt. As a construction worker, you know the difference between a tool that is well suited for you and for the job, and one that is not. You also soon become aware of the difference between a comfortable working posture and one that is uncomfortable. Ergonomics or human engineering is a multidisciplinary way of looking at the interrelationship between the worker, the workstation and the working environment. Ergonomics plays a key role in the humanization of work, in increasing productivity, and in improving safety and health.

Even with new and modern technologies a lot of heavy work is still done by hand. Tools, machines and equipment are in many cases old-fashioned, poorly designed or badly maintained. Many operatives on construction sites are unskilled. Heavy loads frequently have to be carried up and down stairs, ladders and scaffolds, and people working on construction sites often suffer from low back pain or injury to muscles and joints.

The construction industry has a wide range of jobs and processes. These change according to the stage of the project. They involve consideration of:

– working positions, both standing and sitting;
– work which is especially strenuous;
– the use of hand tools and equipment.

Discussion

- How have various machines changed work methods in the construction industry in the past few years?
- What are the positive and negative effects of tower cranes and excavators on your work?

10.1.1 Strenuous and heavy physical work

Continuous heavy manual work increases the rate of breathing and the heart. If you are not in good physical shape, you will tire easily. There are risks involved in working at maximum physical capacity. The use of mechanical power to replace heavy work helps reduce these risks. Mechanical power also helps increase the work opportunities for people with less muscle power. On the other hand, jobs that require no physical effort are often mentally tiring and boring. It is important that the workload is not too heavy and changes during the day. Effective rest periods should always be included in the day's work.

Discussion

- Is work affected by differences in workers' heights and weights?
- Are there any jobs on your site that workers try to avoid?
- Name some jobs which are strenuous. Are there any alternative methods to carry out the task with less strain?

10.1.2 Static loads

The most natural way to work is rhythmically. When sawing with a handsaw, the hand holding the saw is doing dynamic work and the other hand static work. This “dynamic” load enables the muscles to alternate between contraction and relaxation. If an object is lifted up and held in this position, this puts the muscles under a uniform “static” load. Muscles under static load become tired because they are continually contracted, and after a short time the muscles feel painful. A static load on the muscles over a long period will also increase pressure on the heart. The pulse increases because the blood remains in the muscles.

On building sites there are many jobs where the worker is exposed to heavy static loading. Finishing work on walls and ceilings, painting and electrical wiring work frequently require you to work with arms above your shoulder line, and frequent changes of posture are desirable.

10.1.3 Working postures

On construction sites people work in a variety of different positions. Some workers are climbing up scaffolds, others are using hammers while on their knees, while others are working on surfaces above their heads. Until recently, little attention has been paid to good working positions. It is frequently argued that construction work unavoidably requires many different and changing postures, but it is clear that the principles developed for good working positions in industry apply also to construction.

Difficult working positions lead to spending longer over tasks and lead to fatigue. For example, working with one’s arms raised rapidly tires the shoulder muscles and work requiring bending or twisting can easily cause back strain (figure 39). A poor working posture translates into a gradual increase in operation time and an increased possibility of injury or damage to material or equipment.

Figure 39. Where possible, workers should not work on surfaces above their heads, as this increases the strain on arms, back and neck

10.1.4 Sitting and standing positions

Posture is defined by the working method applied and by the tool in use. When considering posture, you have to take into account the reach and muscular power of the worker involved. Where possible, work should be done in a sitting position. However, a standing position is often unavoidable in construction work where high muscular power, greater reach or considerable movement is involved.

A well-designed workstation provides possibilities for the worker to carry out the operation in many positions and postures, both sitting and standing. It also allows the worker to walk a little during the working day.

Although there are very few fixed sites in the construction industry, there are many operations where difficult postures can be improved by simple, low-cost measures. For example, welders often have awkward working postures and a simple, light three-legged stool or chair is useful.

Points to remember:

- Arrange to sit whenever possible.
- Keep materials, tools and controls within easy reach.
- Make sure you got close enough to the task.

Discussion

- Describe several different working postures you have seen on your site and how they could be improved.
- Hold your hands out straight for a while. How do you feel?
- Bend your body forwards and hold that position. How do you feel?

10.1.5 Work in cabins

Machines with cabins for the operator are frequently used on construction sites. Examples include excavators, tower cranes, bulldozers and trucks. In recent years manufacturers of these machines have paid a great deal of attention to the working conditions of the operator. Regular checking and maintenance are needed if these conditions are to remain intact over the working life of the machine. Here are some key points to check:

– Is there easy access to the cabin?
– Are controls in good working order and within easy reach?
– Is the construction of the cabin solid, are windows and noise insulation in place, and are lights working?
– Is the operator’s seat in good condition, adjustable and securely anchored?
– Is the instrumentation functioning?
– Is the engine exhaust pipe placed away from the cabin and in good condition?
– Are the engine covers and enclosures in place?

10.2 Hand tools

There are many different types of hand tool for different kinds of work, such as shovels, axes, crowbars, chisels, screwdrivers, hammers and wrenches. In many instances these tools are bought from an outside vendor without paying any attention to their design or quality.

A good-quality hand tool should be designed to fit the hand and the task. It will earn money and reduce the possibility of accidents. With the proper design of hand tools, work posture can be improved and stress can be reduced, resulting in an improved quality of work.

Accidents with hand tools nearly always arise from some human failing – carelessness, not knowing the right tool for the job, ignorance of safety precautions, or failure to maintain tools and to keep them properly. You need to be correctly instructed in how to use tools and how to look after them.

10.2.1 Selection, use and maintenance

There are basic considerations in selecting, using and maintaining hand tools:

- avoid static load at the shoulder or arm due to the continuous holding of a tool at a raised position or the gripping of a heavy tool;
- avoid awkward wrist angles while using tools such as snips and pliers;
- reduce uncomfortable pressure on the palm or joints of the hand, e.g. from pliers that are too small;
- select the correct weight, size and tool for the job;
- use only tools of good-quality steel – tools made of inferior steel chip and may even shatter when struck, tool heads mushroom, tool jaws open out and cutting tools lose their edge;
- handles should have a smooth finish, should be easy to grasp and should have no sharp edges or corners;
- tools should be firmly fixed and should be regularly checked for splits and cracks; wedges should be checked for tightness of fit;
- tools should be kept free of grease and dirt, and moving and adjustable parts should be well oiled;
- cutting edges should be kept sharp for accurate working and to avoid the need for unnecessary pressure;
- for work on or near electrical apparatus only properly insulated tools should be used;
- tools should be properly stored in boxes, racks, holders or pocket belts and should not be left so that they can fall, roll or be tripped over; cutting edges should be sheathed;
- damaged tools should be immediately repaired or replaced.

Figure 40 illustrates some worn hand tools and those in good condition.

Points to remember:

- Use the right tool for the job.
- Carry tools in tool holders and not in the pockets of your clothing.
- Replace tools, before they wear out.

Discussion

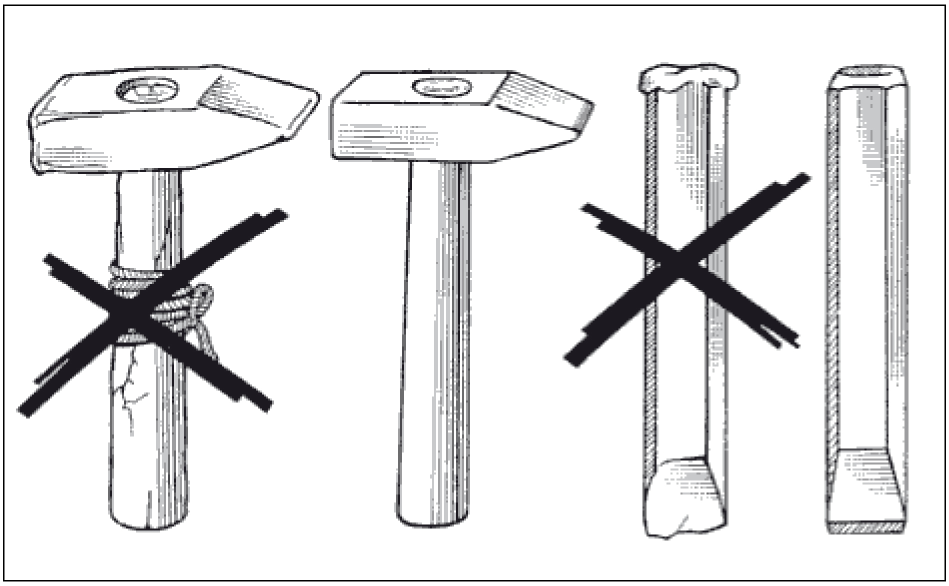
- Think of the hand tools commonly used in construction – how would you classify the risks of each and minimize them?

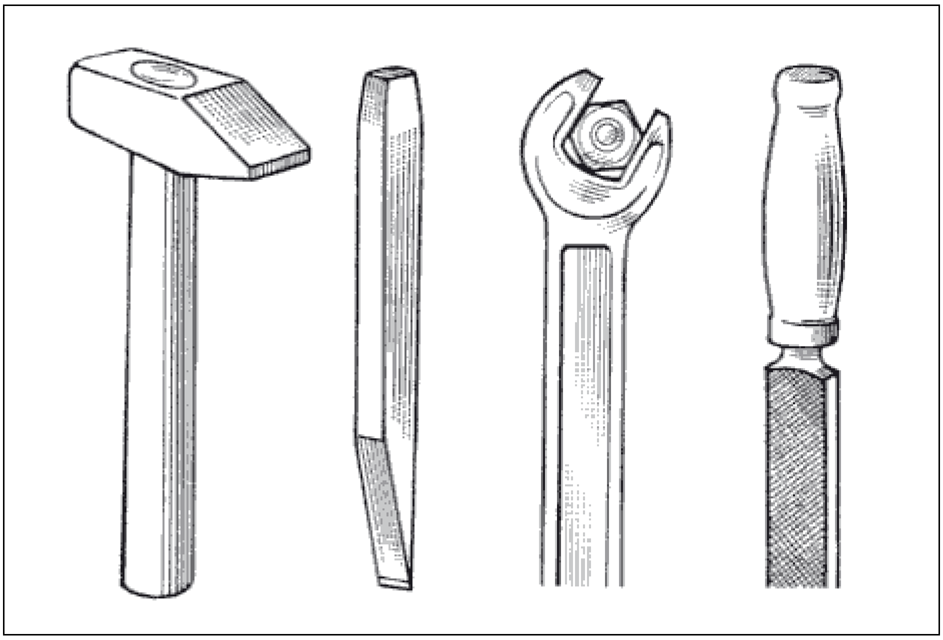
10.3 Power-driven machinery

10.3.1 Hazards

The use of power-driven machinery on construction sites involves many hazards. Common to many construction machines are in-running nip points where one part rotates against or close to another. Common examples are cog-wheels, chain and sprockets, belts and cylinder drums, and ratchet drives. All nip points should be assumed to be dangerous and should be guarded to prevent approach unless they are enclosed within the machine. Equally dangerous are rotating shafts of whatever diameter and of whatever speed. A common cause of accident is clothing becoming caught and wrapped around the shaft. If the shaft is not inaccessible within the machine frame, then it must be enclosed – a loose tube covering and resting on the shaft is a cheap, convenient and effective method.

Figure 40. Reject worn hand tools – use only those in good condition





10.3.2 Safety precautions

When you use power-driven construction tools and machinery, make it your regular practice to check whether:

– all protective devices and safety measures supplied with the machine are in position, adjusted and working;

– the machine appears to be safe to use even for an inattentive worker;

– safety devices are strong enough to withstand wear from ordinary use; and

– safety devices do not prevent efficient use of the machine.

If you are not satisfied on any of these points, discuss them with your supervisor.

Point to remember:

- A dangerous part of machinery requires a guard – a warning notice is not a substitute.

10.3.3 Circular saws

Among the most dangerous power-driven machines found on a construction site is the circular saw, mounted in a bench and used for ripping, deep-cutting or cross-cutting. The main causes of accidents are:

– hands coming into contact with the saw blade either above or below the bench;
– timber being thrown back by the revolving blade;
– the blade fracturing or disintegrating.

The top of the blade should be covered by a form of hood which is designed to prevent your hands touching the part of the blade above the wood being cut. It should be adjusted at the front or leading edge of the saw so that it almost touches the surface of the material being cut, leaving no space for a hand to pass through. Behind the blade, and set not more than 12 mm from it at bench level, should be fitted the device called the riving knife. This prevents the cut closing on the back of the blade causing the material to be thrown back at the operator. These features are shown in figure 41.

Parallel to the blade is the fence which acts as a support and guide for the wood being sawn and allows a true cut to be made. It should be locked securely in position before the cut is made.

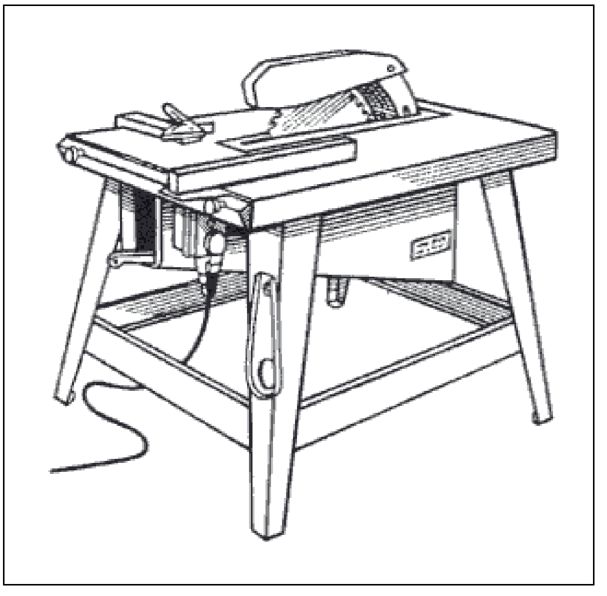
When hand-feeding material to the saw blade, use a push-stick to keep your hands away from the blade. Use the push-stick also to remove the cut pieces from between the blade and the fence and to remove offcuts from the bench. When you are ripping long lengths of material, they should be supported as they come off the table.

Always keep the saw teeth sharp and properly set. A dull blade is much more likely to break than a sharp one. Never use a blade which is defective in any way.

Points to remember:

- Never leave the saw running after you have used it.
- Always keep the push-stick at the table.
- Never start cleaning above or under the table until the blade has stopped.

Figure 41. Circular saw showing top guard and riving knife behind the saw blade. The top guard is adjusted low over the blade



10.3.4 Compressed air tools

If air under compression is allowed to penetrate the skin through a scratch, it can cause painful swelling and may result in serious damage if directed at the eyes, nose or ears. The most common cause of accidents with compressed air is its use to dust off clothing at the end of a working shift. There are also serious injuries caused by workers directing compressed air at a colleague in horseplay.

10.3.5 Cartridge-operated tools

Cartridge-operated tools, which are used for direct fixing to concrete, brick and steel, should be fitted with a guard which does not allow the tool to be fired until the guard is accurately positioned against the work.

Head and eye, and hearing protection should always be worn (figure 42). The area around the fixing should be cleared of workers in case the material splinters or there is a rejection or a ricochet of the fixing. Firing against too soft or thin material may allow the fixing to penetrate it and injure someone on the opposite side.

The recoil from firing the tool may cause the operator to lose balance – it should never be used from a ladder.

Discussion

- What are the risks associated with power-driven machinery? What would you do to minimize these risks?
- What safety devices would you expect to find on a circular saw, and what is their purpose?

Figure 42. Use of hearing and eye protection by the operator of a cartridge gun, who is also wearing a helmet

10.4 Electrical equipment

Electrical hazards are different from other types of hazard found in construction work because the human senses provide no advance warning, whereas an approaching vehicle may be heard, the prospect of a fall may be seen, or escaping gas may often be smelt.

About one in every 30 electrical accidents is fatal. The great majority of electrical accidents result in electric shock and burns. Fire and explosion from sparks in flammable atmospheres and radiation from electric arc welding or microwave heating are also possible causes of injury.

10.4.1 Electric shock

The danger from electric shock is directly related to the amount of current that passes through the body and to the time that it takes to pass. At lower levels, the effect may be no more than an unpleasant tingle, though perhaps sufficient to throw a worker off balance and cause a fall from a scaffold or ladder. Medium amounts cause increasing muscular tension, so that anything in the grasp can scarcely be released – a condition which can quickly become dangerous. Higher amounts can cause fibrillation of the heart (irregular contractions of the muscles), which is almost invariably lethal.

The passage of current can also cause burning of the skin at the points of contact. Severe burns can occur, too, from exposure to an electric shock without actual bodily contact. Damp and wet conditions greatly increase the danger of electric shock.

It is the voltage that determines the current through the body. Since reduced voltage reduces the severity of electric shock, it is common sense to use reduced voltage of 110 V wherever possible.

The main causes of electric shock are as follows:

– the earth or ground wire becomes disconnected from its plug terminal and touches a live terminal so that the metal case becomes live;
– wrong connections are made to terminals on the plug or the equipment;
– damaged or missing covers on fuse and terminal boxes, or on socket outlets, expose bare live conductors;
– flexible cables are damaged when they are dragged over sharp surfaces or run over;
– makeshift repairs are made to flexible cables with insulating tape alone.

10.4.2 Treatment for electric shock

Switch off the current, but if this is not possible free the victim by using something that is non-conductive, long, clean and dry such as a piece of wood or rubber, or a piece of cloth such as a jacket. Stand on non-conductive material such as a dry piece of wood when carrying out this effort. Do not touch the victim before the current is turned off.

If the victim is not breathing, start artificial respiration, send for help and call a doctor. Continue artificial respiration until the doctor or ambulance arrives (figure 43).

10.4.3 Existing supplies

On any site, power supplies may exist below ground or overhead. As discussed in section 4.2, contact should be made with the appropriate local or electricity authority at the planning stage of the job to determine the route and depth of any underground cables and the safety clearances advised, or if the finished job necessitates their rerouting, for this to be carried out before work commences. Methods of tracing and marking buried electric cables are described in section 4.2.1.

Figure 43. Artificial respiration: Continue mouth-to-mouth resuscitation until medical help arrives

10.4.4 Electrical installations

Electrical installations should be dealt with and serviced only by competent electricians. All forms of electrically operated equipment should be regularly checked and maintained in accordance with the manufacturers' printed instructions. If equipment appears faulty, do not tamper with the electrical part but send for an electrician. Wires and cables to fixed machines should be attached to walls or ceilings, and should not trail over the ground where they are particularly susceptible to damage and to moisture. Do not tie power cables in knots which can cause short circuits and shocks; loop the cable instead. If you are operating a fixed machine, an emergency stop device should be located within your reach.

Before using electrical equipment:

– inspect it for any defects;
– check that the correct plug and fuse have been fitted – never use makeshift connections to equipment, or to plugs, by sticking bare wires into sockets or contacts;
– check that the insulation covering wires and cables is not worn or broken;

– check that there is a good electrical connection at each joint of the earthing system.

Points to remember:

- If an accident is caused by contact with electricity, switch off the current immediately.
- Never work on live wires or cables.

10.4.5 Portable electrical tools and equipment

Double-insulated and all insulated tools are safer than ordinary tools because they incorporate layers of protective insulation to prevent external metal parts from becoming live.

If you use portable power-driven tools, you need to be properly trained in their maintenance and use.

Before operating a portable tool, check it to ensure that:

– there is no damage to the portable leads and plugs – they are subject to heavy wear on construction sites (figure 44);

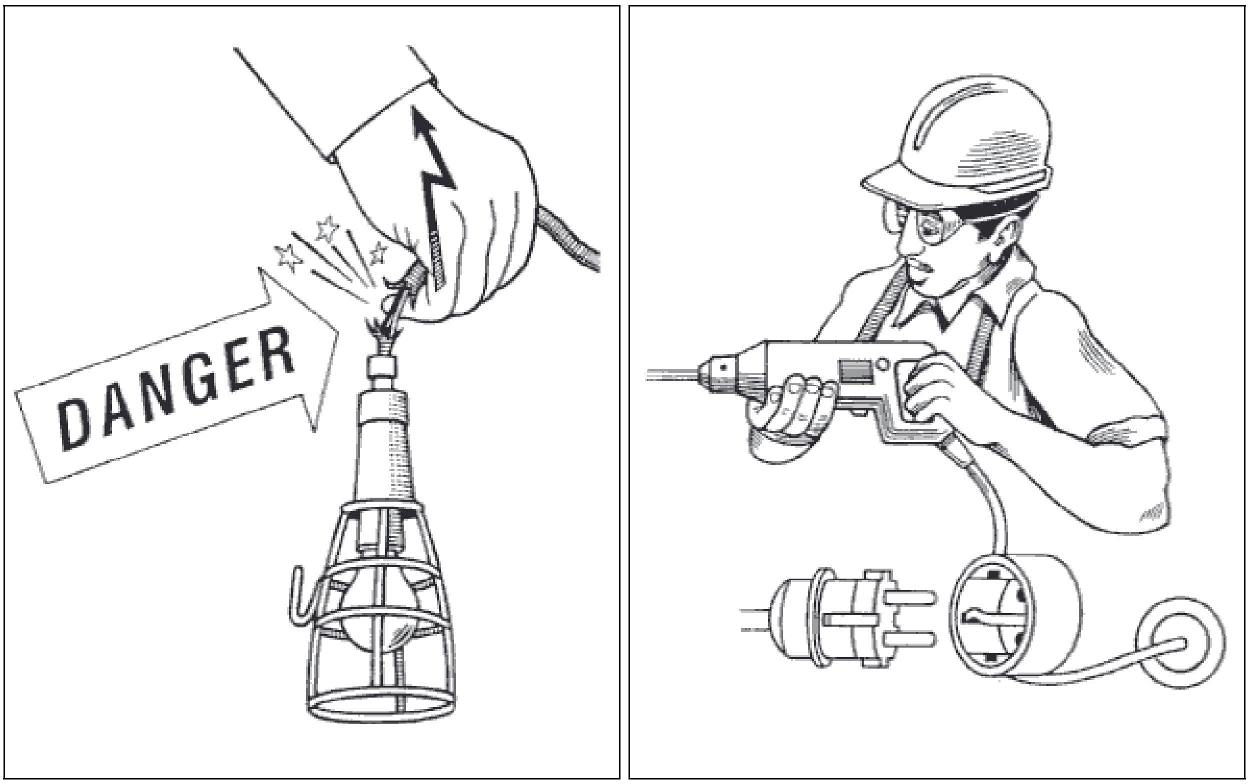
– there is a correct fuse;

– the tool is set at the right speed for the job;

– leads and cables are kept out of the way of other workers and are not in contact with water.

When you finish using the tool, make sure that the moving part is fully stopped before you put it down.

Figure 44. Electrical installations – pay special attention to the condition of temporary or portable electrical equipment and its cables



Point to remember:

- Never carry a portable tool by its cable.

Discussion

- Why is electricity particularly dangerous on construction sites?
- What is the first precaution you should consider on a construction site, and why?
- Before you begin to use a portable electric tool, what should you check?
- What are the proper actions to take when a worker has received an electric shock?

10.5 Welding and cutting

The welding and cutting of metal, using both the electric arc and oxyacetylene methods, is a process widely used in construction.

10.5.1 Electric arc welding

Danger from welding is not only to the welder doing the job but also to those working nearby. The risks include eye damage, skin injuries, burns and the inhalation of toxic gases.

The following precautions are necessary:

– The welder and anyone assisting should wear suitable protective goggles or use a face mask or shield to protect the eyes and face from invisible ultraviolet and infrared rays given off by the welding arc.

– Goggles must also be worn when carrying out weld chipping to protect the eyes from flying pieces of slag.

– The welder should wear protective gloves long enough to protect wrists and forearms against heat, sparks, molten metal and radiation. Leather is a good insulator.

– The welder should wear high-top boots to prevent sparks from entering footwear.

– The work area should be screened off with sturdy opaque or translucent materials so that other workers cannot see the arc.

– The workpiece should be well earthed, and all equipment should be earthed and insulated.

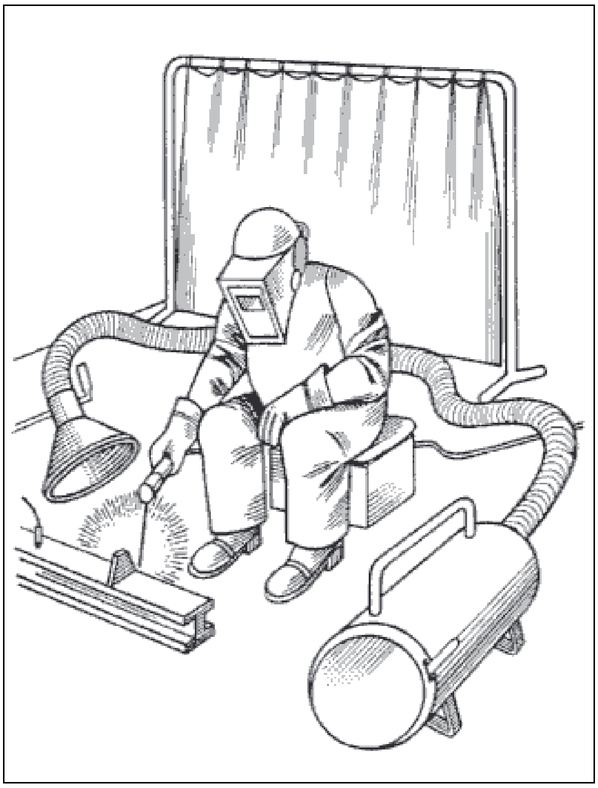
– Precautions should be taken against starting fires from sparks from the work area: burning particles are capable of starting a fire 20 m away.

Good practice in electric arc welding is shown in figure 45.

Points to remember:

- It is not enough to protect the welder – think of others working nearby who can see the arc.
- Always switch off the current to the electrode holder when you put it down.
- Remove matches and lighters from your pockets.

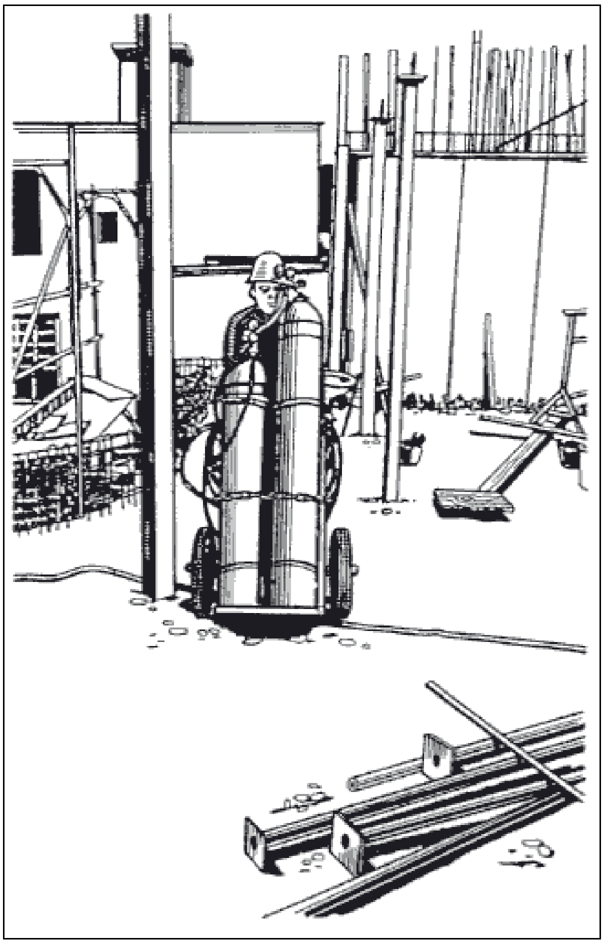
Figure 45. Arc welding – workplace earthed, welder wearing personal protective equipment, workplace screened



10.5.2 Gas welding

Acetylene and oxygen are normally used in gas welding. The cylinders should be stored separately since any mixture from gas leakages could be highly explosive. They should be kept away from any source of heat and shielded from direct sunlight. If not stored outdoors, the store must be well ventilated. The cylinders in use should be retained upright in a rack or trolley and not left free-standing (figure 46). Flashback arresters should be fitted to the cylinder regulators and non-return valves fitted in the hose connectors at the torch end.

Figure 46. Gas cylinders moved around the site in a trolley in which they are secured upright



The gas hoses should be in good condition and easily distinguished. They should be protected against heat, sharp objects and dirt, especially oil and grease. These substances can, even in small amounts, cause an explosive ignition in the event of a leak in the oxygen hose. All joints, especially on the cylinders, should be kept tight. If an acetylene cylinder becomes accidentally heated, shut off the valves, raise the alarm, clear the area of personnel, apply water (if possible, totally immerse) and send for the fire brigade.

Points to remember:

- Turn off all valves on completion of work.
- Never use oxygen to blow dust from clothing.

10.5.3 Fumes

Welding in a confined space, the use of some types of welding rod, or welding on certain painted metals may cause an accumulation of toxic gases and fumes. If local ventilation cannot be arranged, the welder should be provided with respiratory protection and a supply of fresh air. Welding carried out on metals covered with alloys of lead, cadmium, mercury or zinc may lead to a build-up of dangerous fumes requiring exhaust ventilation. Fumes may also be produced from paint and plastic on the surface being welded, and they should first be cleaned off.

Discussion

- What sort of welding do you carry out on site?
- What safety measures are taken and why?

10.6 Liquefied petroleum gases

Liquefied petroleum gases (LPG) are commonly butane or propane, or a mixture of both. LPG, usually sold under trade names, is widely used on construction sites and is a frequent cause of accidents. A leakage of liquid from a cylinder immediately vaporizes and, because it is heavier than air, flows along the ground and collects in drains, excavations and other low-lying places. As it takes only 2 per cent of the vapour in air to form a flammable mixture, if leakage occurs in a confined space there is a high risk of explosion. Whenever LPG is used indoors, there must be good ventilation.

10.6.1 Storage

LPG stores should conform to the following standards:

– Where LPG cylinders are stored on site, it should be in an open-air compound at ground level surrounded by a fence at least 2 m high; there should be sufficient shelter to prevent cylinders being exposed to extremes of temperature.
– There should be no excavations, drains or basements nearby.
– The compound floor should be paved or compacted level, and kept clear of flammable material, weeds or rubbish.
– Cylinders should be kept at least 1.5 m from the compound fence and 3 m from the site boundary.
– Cylinders should never be stored below ground level or closer than 3 m to cylinders containing oxygen or materials which are toxic or corrosive, e.g. ammonia or chlorine.
– There should be notices stating “LPG – Highly flammable” and prohibiting smoking and naked lights.
– Cylinders, full or empty, should be stored upright with the valve uppermost.
– The valves of empty cylinders should be kept closed, for if they are left open, air will diffuse into the cylinder and may form an explosive mixture.
– There should be a dry powder fire extinguisher at the store.

Point to remember:

- A fire close to a cylinder may cause the LPG to boil and the cylinder to explode, with disastrous consequences.

10.6.2 Handling

When handling LPG cylinders, you should take account of the following points:

– A damaged or leaking valve can have serious consequences.
– When cylinders are not in use, valves and regulators should be protected by appropriate caps.
– When moving cylinders use trolleys, skids or mats and never lift by the valve assemblies.
– Before using a cylinder, ensure that all joints are gas tight by using soapy water and a brush.
– If a leak is detected, move the cylinder as soon as possible to an open space and inform your supervisor at once.
– Cylinders used for heating huts should be kept outside the building.
– If, when lighting a burner, the match or taper goes out before the burner ignites, turn off the burner valve before lighting another match or taper.

Point to remember:

- Whenever you are not using the cylinder, turn off the valve.

11. The working environment

11.1 Chemical substances

A great many chemical substances are used in construction – there is hardly a site without them. They are found in adhesives, cleaning agents for brickwork and stonework, decorative/protective treatments for timber and metals, floor treatments, fungicides, cements and grouts, insulants, sealants, paints, solvents and much else. Of particular importance are solvents, which are liquids commonly used in paint strippers, lacquers, varnishes, surface coatings, thinners and similar cleaning materials.

11.1.1 Chemicals and their risks

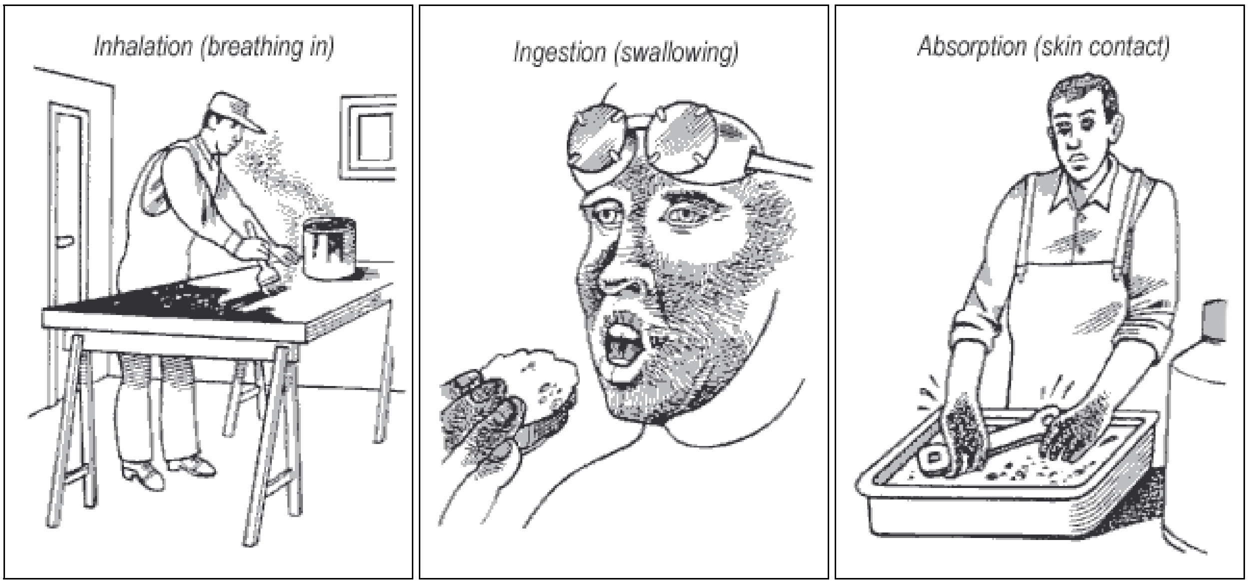
Many chemicals are hazardous, with a potential for fire and explosion, or toxic, with an inherent potential to cause poisoning. Toxic substances cause both acute effects, such as dizziness, vomiting and headaches, produced in a short time by exposure to solvents, and chronic effects resulting from exposure over a long period as in lung diseases such as asbestosis and silicosis. Contact dermatitis may result from the contact between the skin and some chemicals. Acids and alkalis are corrosive and can damage both skin and eyes.

11.1.2 Entry into the body

A chemical can cause injury in various ways depending upon whether it is solid or liquid, or in the form of airborne dust, vapour, fumes or gas. The routes into your body (figure 47) are by:

– inhalation or breathing in. This is the most important route of entry. Some toxic gases and vapours cause irritation in the nose and throat and so give warning of their presence; others do not, and penetrate to the lungs or blood stream. It is the smallest dust particles, those not visible to the naked eye, which reach furthest into the lungs. Inhaled dust accumulates in the lungs, producing changes and causing an incurable disease called "pneumoconiosis". Breathlessness and inability to work are the eventual consequence. Some dusts such as quartz and asbestos destroy the lung tissue and may lead to the development of tuberculosis or cancer;

Figure 47. Chemicals enter the body by inhalation, ingestion and absorption



– ingestion or swallowing. This is possible when you handle chemicals such as lead-based paints and then eat or smoke without first washing your hands, when toxic vapours contaminate cups, plates or eating utensils, or when you eat meals at the work site;
– absorption through the skin. Some solvents can be absorbed through the skin into the blood stream and may travel to internal organs such as the brain and liver.

Contact dermatitis or eczema frequently results from the contact between the skin and some chemicals. Acids and alkalis are corrosive and can damage the skin and the eyes on contact. Unless large amounts of water are used at once to rinse the substance off, serious burns will be caused.

Point to remember:

- Some chemical hazards are easy to see or smell. However, there are also chemicals that you cannot see or smell, and which therefore present an extreme danger.

Discussion

- What construction processes cause the most dust?
- What precautions are taken?
- In what construction processes are fumes and vapours most likely to be encountered?
- What precautions have been taken on the site against the risk of inhalation of fumes and vapours?

11.1.3 Preventive measures

Accidents and ill health from the use of chemicals can be prevented if you know what chemicals you are using and the risks they pose, and follow the established safe practice in handling them. Generally, there is an order of priority in the measures for dealing with hazardous chemical substances:

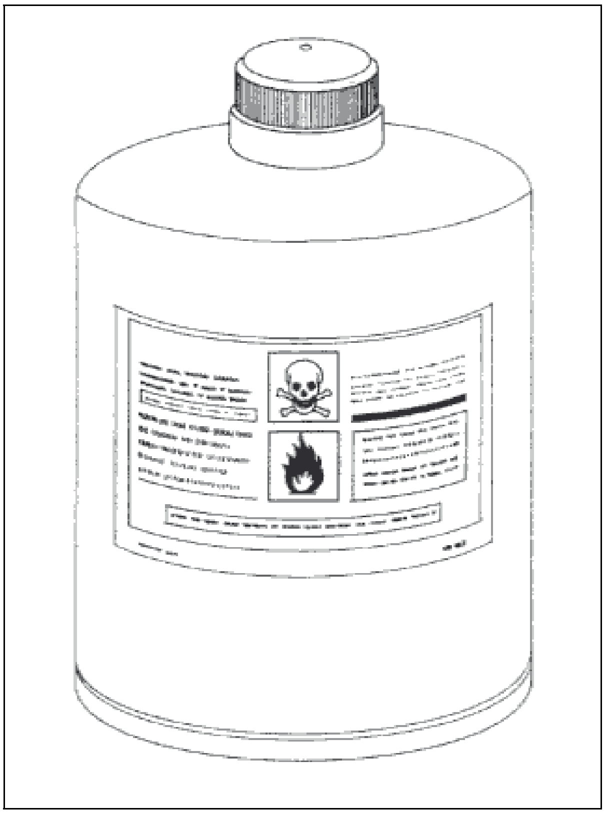
- Substitute the chemical with a harmless or less hazardous one.
- Enclose the process using the chemical, or provide other engineering controls such as exhaust ventilation; this is often difficult in construction processes.
- Use personal protective equipment (PPE).

If the use of hazardous chemicals cannot be avoided, here are some basic safety measures you can adopt to protect yourself from danger:

– Keep containers of chemicals in a separate and secure store.
– Because two containers look the same, do not assume that they contain the same material.
– Make sure there is a label on the container (figure 48) – if there is no label, then do not use the contents.
– Read the label and make sure you understand what it says, then follow the instructions.
– If the information is not sufficient to tell you how to handle the chemical safely, ask your supervisor for the chemical safety data sheet (figure 49) and do not use the chemical until you have seen it; if you do not understand it, ask questions until you do.
– Check that you are wearing the correct PPE before you handle chemicals (the chemical safety data sheet should say whether you need gloves, eye protection, protective clothing, rubber boots or respirators) and that the equipment is in good order.
– When opening containers, hold a rag over the cap or lid as some volatile liquids tend to spurt up when this is released; transfer the contents of containers in the open air.
– Avoid breathing in any fumes from chemicals. Provide good ventilation, or work in the open air. Leave the work area immediately if you feel dizzy or unwell.

– If you are using large quantities of solvents, wear impermeable clothing. Remove any clothing wetted by solvents and leave it to dry in a well-ventilated place.
– Use the smallest quantity of chemicals that is necessary for the particular job.
– Eye protection should be worn when chemicals are being moved or transferred on site.
– When mixing or pouring chemicals using temporary containers, make sure they are suitable and correctly labelled. Never use food or drink containers.
– Wash before you eat and do not eat or smoke at your workstation.
– If the skin is splashed with a chemical, it should be rinsed immediately with plenty of clean running water. Eyes should be flushed out thoroughly with water and should receive immediate medical attention.
– If you are burned by a chemical, or feel unwell after using a chemical, seek medical attention without delay.
– If there is a spillage of chemicals on the ground or floor, report the matter at once so that the right action can be taken, such as soaking it up with dry sand (figure 50).

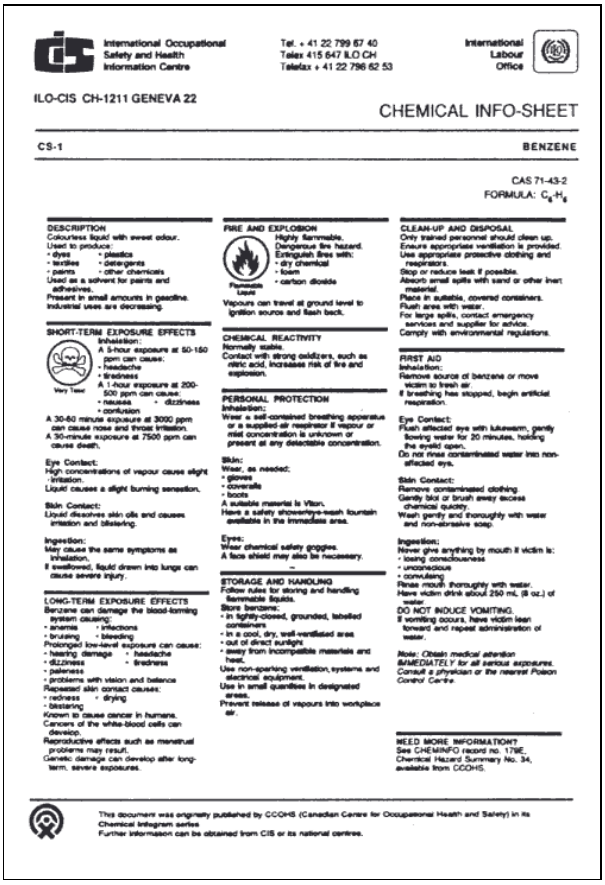
Figure 48. Every chemical used on site should have a label and sufficient information to ensure its safe use



Point to remember:

- Never use solvents to remove paint or grease from your skin.

Figure 49. An example of a chemical safety data sheet, providing essential safety and health information



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International Labour Office

ILO-CIS CH-1211 GENEVA 22

CHEMICAL INFO-SHEET

CS-1 BENZENE

CAS 71-43-2
FORMULA: C_6-H_6

DESCRIPTION
Colourless liquid with sweet odour.
Used to produce:
- dyes - plastics
- textiles - detergents
- paints - other chemicals
Used as a solvent for paints and adhesives.
Present in small amounts in gasoline.
Industrial uses are decreasing.

SHORT-TERM EXPOSURE EFFECTS
Very Toxic
Inhalation:
A 5-hour exposure at 50-150 ppm can cause:
- headache
- tiredness
A 1-hour exposure at 200-500 ppm can cause:
- nausea - dizziness
- confusion
A 30-60 minute exposure at 3000 ppm can cause nose and throat irritation.
A 30-minute exposure at 7500 ppm can cause death.

Eye Contact:
High concentrations of vapour cause slight irritation.
Liquid causes a slight burning sensation.

Skin Contact:
Liquid dissolves skin oils and causes irritation and blistering.

Ingestion:
May cause the same symptoms as inhalation.
If swallowed, liquid drawn into lungs can cause severe injury.

LONG-TERM EXPOSURE EFFECTS
Benzene can damage the blood-forming system causing:
- anemia - infections
- bruising - bleeding
Prolonged low-level exposure can cause:
- hearing damage - headache
- dizziness - tiredness
- paleness
- problems with vision and balance
Repeated skin contact causes:
- redness - drying
- blistering
Known to cause cancer in humans.
Cancers of the white-blood cells can develop.
Reproductive effects such as menstrual problems may result.
Genetic damage can develop after long-term, severe exposures.

FIRE AND EXPLOSION
Flammable Liquid
Highly flammable.
Dangerous fire hazard.
Extinguish fires with:
- dry chemical
- foam
- carbon dioxide
Vapours can travel at ground level to ignition source and flash back.

CHEMICAL REACTIVITY
Normally stable.
Contact with strong oxidizers, such as nitric acid, increases risk of fire and explosion.

PERSONAL PROTECTION
Inhalation:
Wear a self-contained breathing apparatus or a supplied-air respirator if vapour or mist concentration is unknown or present at any detectable concentration.

Skin:
Wear, as needed:
- gloves
- coveralls
- boots
A suitable material is Viton.
Have a safety shower/eye-wash fountain available in the immediate area.

Eyes:
Wear chemical safety goggles.
A face shield may also be necessary.

STORAGE AND HANDLING
Follow rules for storing and handling flammable liquids.
Store benzene:
- in tightly-closed, grounded, labelled containers
- in a cool, dry, well-ventilated area
- out of direct sunlight
- away from incompatible materials and heat.
Use non-sparking ventilation, systems and electrical equipment.
Use in small quantities in designated areas.
Prevent release of vapours into workplace air.

CLEAN-UP AND DISPOSAL
Only trained personnel should clean up.
Ensure appropriate ventilation is provided.
Use appropriate protective clothing and respirators.
Stop or reduce leak if possible.
Absorb small spills with sand or other inert material.
Place in suitable, covered containers.
Flush area with water.
For large spills, contact emergency services and supplier for advice.
Comply with environmental regulations.

FIRST AID
Inhalation:
Remove source of benzene or move victim to fresh air.
If breathing has stopped, begin artificial respiration.

Eye Contact:
Flush affected eye with lukewarm, gently flowing water for 20 minutes, holding the eyelid open.
Do not rinse contaminated water into non-affected eye.

Skin Contact:
Remove contaminated clothing.
Gently blot or brush away excess chemical quickly.
Wash gently and thoroughly with water and non-abrasive soap.

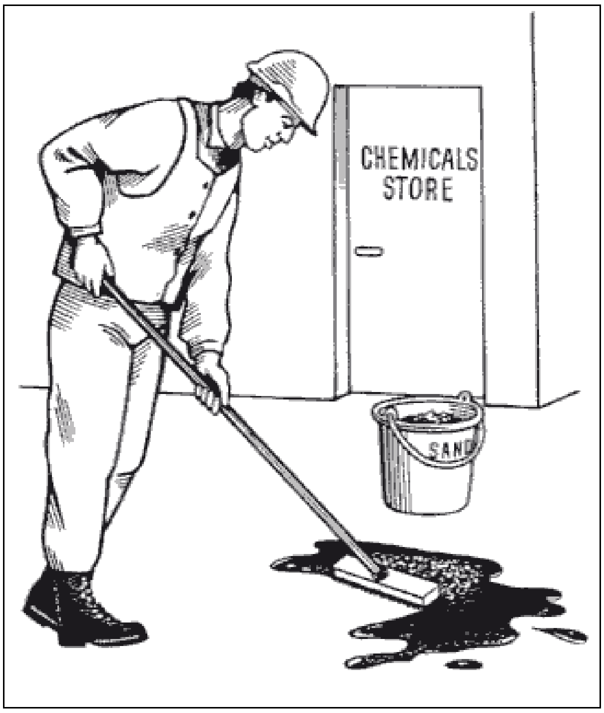
Ingestion:
Never give anything by mouth if victim is:
- losing consciousness
- unconscious
- convulsing
Rinse mouth thoroughly with water.
Have victim drink about 250 mL (8 oz.) of water.
DO NOT INDUCE VOMITING.
If vomiting occurs, have victim lean forward and repeat administration of water.

Note: Obtain medical attention IMMEDIATELY for all serious exposures. Consult a physician or the nearest Poison Control Centre.

NEED MORE INFORMATION?
See CHEMINFO record no. 179E, Chemical Hazard Summary No. 34, available from CCOHS.

This document was originally published by CCOHS (Canadian Centre for Occupational Health and Safety) in its Chemical Infogram series.
Further information can be obtained from CIS or its national centres.

Figure 50. Chemical spillage soaked up with dry sand



11.1.4 Highly flammable chemicals

Many chemical substances used in construction are highly flammable as well as toxic. The following precautions should be followed when handling or using them:

– Study the label and the instructions on the chemical safety data sheet about safe handling and first-aid measures.
– Remember that all flammable liquids give off vapours which travel unseen into the air and are easily ignited. Never smoke if there are flammable chemicals in the area. Find out what action to take in the case of fire.
– Keep containers in the store until required for use, and return them there when you have finished with them. Store drums upright.
– Treat empty drums with as much care as full ones – they will still contain flammable vapour.
– Always transfer the contents of large containers to small containers in the open air.
– Use funnels and spouts to prevent spillage. Soak up any spillage with dry sand and remove the contaminated sand to a safe place in the open air.
– If you cannot avoid using highly flammable liquids in an enclosed area, make sure there is an adequate supply of fresh air. This can usually be achieved by opening windows and doors to the full. If it is necessary to use a fan, check that the fan is electrically safe to use in a flammable atmosphere.

Discussion

- How would you recognize whether toxic or dangerous chemicals are being used on your construction site?
- Have you or anyone you know shown symptoms or suffered from using chemicals? If so, what were they?
- What steps do you think could have been taken, and were not taken, to prevent these ill-effects?
- What flammable chemicals have you used on construction sites?

11.2 Hazardous substances

11.2.1 Cement

Cement mixes are a well-known cause of skin disease. Both irritant and allergic contact dermatitis can result from proximity to wet cement. Prolonged exposure to wet cement (for example, if you kneel or stand in it) may cause cement burns or ulceration of the skin. The following precautions should be taken:

– Avoid breathing in cement dust, as well dust created by the surface treatment of hardened concrete which may contain a high silica content, by wearing suitable respiratory protective equipment.
– Protect the skin from contact by wearing long-sleeved clothing and full-length

trousers, with rubber boots and gloves when required.

- Protect the eyes; if any cement gets into the eyes, rinse them immediately with plenty of warm water.
- Immediately wash off any dust or freshly mixed cement that gets on to the skin.
- Clean off your clothing and boots after work.

11.2.2 Asbestos

Breathing in asbestos dust can kill by causing irreversible lung damage and cancer. There is no known cure for asbestos-related diseases. The more asbestos dust breathed in, the greater the risk to health. There are control limits for the various types of asbestos. You are likely to find asbestos in the following situations:

(a) as asbestos insulation or coating used for:
   - (i) thermal insulation of boilers;
   - (ii) fire protection of structural steelwork;
   - (iii) thermal and acoustic insulation of buildings;

(b) as asbestos insulating board used in a wide variety of places such as:
   - (i) fire protection on doors, protected exits, structural steelwork, etc.;
   - (ii) cladding on walls, ceilings, etc.;
   - (iii) internal walls and partitions;
   - (iv) ceiling tiles in a suspended ceiling;

(c) as asbestos cement, which is found as:
   - (i) corrugated sheets (roofing and cladding of buildings);
   - (ii) flat sheeting for partitioning, cladding and door facings;
   - (iii) gutters and downpipes.

Before starting work

If it is not clear whether insulating material, boarding, and so on contain asbestos, bulk sampling and laboratory analysis are necessary. This must be done by someone with suitable training and experience. Alternatively, you may assume that the material contains crocidolite (blue), amosite (brown) or chrysotile (white) asbestos and take appropriate precautions.

Before starting any work with asbestos, an adequate assessment must be made to work out the precautions needed to control the exposure to the substance. Work with asbestos may range from cleaning brake drums of construction plant and vehicles to full-scale asbestos removal.

Carrying out work with asbestos

In many countries those who work with asbestos to any extent, and in particular in removing and disposing of asbestos, require to be licensed or to hold a permit. In working with asbestos insulation board, workers will probably need to wear suitable protective clothing. Only working methods that keep asbestos dust levels as low as possible should be used (e.g. use hand tools and avoid breaking boards).

Asbestos cement is less likely to generate dust than many other asbestos products, but the risk of asbestos dust release is still present.

When cutting asbestos cement, use hand tools (or power tools fitted with exhaust ventilation equipment). Where it is not possible to keep asbestos dust levels under control limits, respirators should be worn. Protective clothing will probably be required for any significant work with asbestos cement. If you have to clean asbestos cement sheeting encrusted with lichens or mosses, a system of wet scraping/brushing is preferred.

Methods of limiting exposure to asbestos dust include:

- removing asbestos materials before starting major demolition work. This prevents accidental exposure to asbestos;
- wet methods of removal (to suppress dust);

– prompt removal and bagging of waste asbestos, and disposal at an approved waste disposal site;
– separating asbestos work areas from other general work areas.

Point to remember:

- The dust you cannot see is more dangerous than the dust you can see.

11.2.3 Lead

Inorganic lead is found in many construction products, e.g. electricity cables, pipes, gutters and old lead sheet roofs. Organic lead is added to motor fuels, and storage tanks will be heavily contaminated.

There is a risk to health from inhaling dust or fumes created by burning or cutting materials containing lead, including painted surfaces, by welding, by grinding or cutting, and by spray painting of leaded paints. Lead can be absorbed when swallowed, usually when food is contaminated, and adequate washing facilities should be provided. Organic lead compounds are readily absorbed through the skin.

Excessive lead absorption causes constipation, abdominal pain, anaemia, weak muscles and kidney damage. It can also affect the brain, causing impaired intellect, strange behaviour, fits and coma. If you work with lead in any form, you should take the following precautions:

– Wash your hands regularly, and always before eating; you are at higher risk if you smoke with lead on your hands.
– Use the protective clothing and respiratory protective equipment which should be provided whenever lead levels exceed national control limits.
– Wear work clothing on the job and store your “street” clothing where it cannot be contaminated by your work clothing.

Point to remember:

- Wash thoroughly and if possible change out of work clothing before you leave the site, otherwise you may be taking dangerous dust and dirt into your home.

Discussion

- What precautions have been taken at the site to prevent exposure to hazardous substances?
- Where asbestos is known or suspected to be present at the site, are adequate steps taken to prevent workers from being exposed to the dust?
- Have you noticed or heard any of your co-workers complain of symptoms which you think might be related to or caused by exposure to hazardous substances?
- Can you think of any other hazardous substances used on construction sites?

11.3 AIDS

AIDS (Acquired Immune Deficiency Syndrome) is a disease caused by a virus that attacks the body’s natural defence system, allowing the development of illnesses and infections which would not otherwise have occurred. The virus is transmitted by sexual intercourse with an infected person or by injection or contamination with infected blood.

It is not transmitted by normal social contacts such as touching an infected person, sharing toilet and washroom facilities, crockery or cutlery.

11.3.1 Precautions

A danger of AIDS exists for workers who may be cut or wounded by infected needles or razor blades found during construction work, e.g. in disused buildings in high drug abuse areas.

If you think you might cut yourself on sharp items which may be infected, take care by wearing heavy-duty gloves and overalls. Remove old syringes, needles and razor blades with disposable tongs, put them in puncture-proof bins and seal them. Your supervisor should make local arrangements to have the bins incinerated.

Clear up blood or other spillages with a solution of strong disinfectant. If splashing from infected fluids is likely (e.g. during sewer repair), protective clothing, including goggles, should be worn.

11.3.2 First aid

Your employer should provide sufficient training and information about first-aid treatment.

Cuts or abrasions should be covered with waterproof dressings. In the case of injury, thoroughly irrigate the wound and wash it with soap and water before dressing it. Always wash your hands after treating a wound. In more serious situations involving open-wound injury, prompt attention is important, and sensible first-aid procedures should be applied before sending the person for more expert treatment.

The AIDS virus has been shown to be present in saliva and this has caused anxiety among first-aiders. No cases of AIDS have been reported anywhere by transmission of the infection from saliva. Nevertheless, a portable mouth-to-mouth resuscitation device incorporating a one-way valve can be used.

AIDS generates fear because it is a new disease and many questions about it cannot yet be fully answered. It is not highly infective when compared with other diseases such as hepatitis B, which may be contracted in a similar fashion. The modes of transmission are known and infection has not been associated with any particular occupation, including the construction industry.

11.4 Noise and vibration

Construction sites are noisy places. Excessive exposure to loud noise can cause permanent damage to your hearing. Noise at work can cause stress, making it difficult to sleep. Very high levels of noise caused, for example, by using cartridge tools can cause instantaneous hearing damage.

The levels of noise produced in operations such as piling, tunnelling and cleaning operations may be such that unprotected persons will exceed their maximum recommended daily dose in a matter of seconds. Even a few minutes' exposure every day to very noisy machines can be enough to start permanent hearing damage. Loud noise can cause a temporary partial loss of hearing, with recovery time varying from 15 minutes to several days depending on the noise level. There may also be a "ringing" in the ears which should be regarded as a warning – temporary loss may become permanent with repeated exposure. Deafness develops very gradually but cannot be cured once the damage has been done.

Noise also makes it difficult to hear sounds that you need to hear such as work signals and warning shouts.

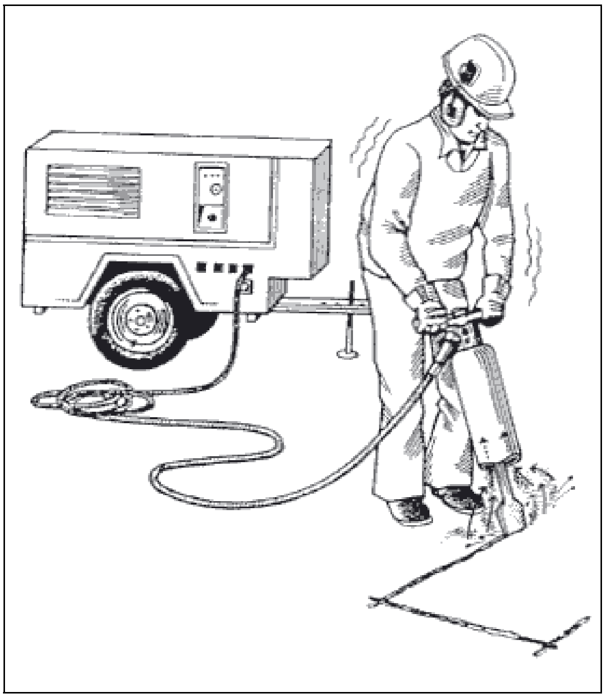
11.4.1 Noise control

There are several steps that can be taken on site to reduce noise:

- Check that exhaust outlets are fitted with silencers or mufflers, and do not keep machinery running unnecessarily.
- Keep compressor motor covers closed when they are running (figure 51).
- Check that concrete breaker mufflers and similar devices are securely fitted (figure 51).
- Check that machinery panels are secured and do not rattle.

- Ensure that sound-insulating screens are provided to reduce noise from stationary plant, and that where practicable noisy machinery is sited behind earth mounds or brick stacks to isolate or screen it as far as possible.

Figure 51. Compressor noise control – keep covers closed, use muffler on pneumatic hammer and wear hearing protectors



11.4.2 Hearing protection

If you are working at or near a noisy machine:

- ask if noise levels have been measured, and what those measurements are;
- remember that noise which is continuous at a level of 85-90 decibels (dB(A)) or more is injurious to hearing;
- ask for appropriate earmuffs or ear plugs if you work with or near a noisy machine and make sure they fit properly and are comfortable (figure 51);
- wear them all the time you are in a noisy part of the site;
- keep your hearing protection clean and in a safe place when you are not using it;
- insert ear plugs with clean hands;
- look out for damage: if the earmuffs no longer fit properly or the seals have become hard or damaged, ask for a replacement.

It is not true that ear protectors make it more difficult to understand speech or hear warning signals, as they reduce both unwanted noise and alarm signals equally; the signal can actually be heard more easily.

Point to remember:

- If you have to shout to make yourself heard by someone about 1 m away, there is a noise problem requiring action.

Discussion

- List the sources of noise on site which affect you.
- Could noisy machines be separated from other work?
- What steps could be taken to reduce noise from noisy machines that you use?
- What problems can deafness cause?

11.4.3 Vibration

Many noisy machines or hand-operated tools also transmit vibrations to the body – pneumatic rock drills or concrete breakers are common examples. In this way they can injure muscles and joints, and affect blood circulation causing what is known as ‘‘white finger disease”. When using these tools you should wear gloves, which help to cushion the vibrations.

11.5 Lighting

All parts of the site need to be properly lit by natural or artificial means whenever work is going on. Site lighting is always necessary in those areas short of natural light such as shafts and enclosed stairways. Artificial lighting should be placed to avoid deep shadows – these may conceal hazards which would be obvious in good light. Mounting of lights should be as high as practicable to avoid glare, and lights should be placed so that workers do not have to work in their own shadow.

Only robustly installed fittings which are well out of reach, such as floodlighting, should be at full mains voltage. Temporary electric lighting should be installed by trained electricians using low-voltage equipment. You can assist in its safe use in the following ways:

– Do not interfere with the installation.
– Report any damaged insulation, on broken bulbs, lampholders or fittings.
– Make sure that cables are fastened well off the ground and do not let cables or connections trail in wet conditions.
– Do not change bulbs yourself.

Point to remember:

- When moving from a very bright area to shaded area, give your eyes time to adjust.

11.6 Exposure to heat and cold

11.6.1 Hot weather

Workers on construction sites are often exposed to all weathers. In tropical countries radiation from the sun, with high air temperatures and humidity, increases fatigue from heavy work and causes heat stress which may lead to heat exhaustion and heatstroke, the latter a medical emergency, and to ill health. The effects of heat combined with physical workload tend to accumulate.

Good welfare facilities are essential to health in hot climates, and the suitable arrangement of working time is important. There should be:

– sufficient work breaks: for moderately heavy or heavy work 50 per cent or more rest time is essential;
– rest areas away from workstations to cool off;
– an adequate supply of clean, cool drinking-water: drink often and in small quantities;
– washing facilities provided to keep work clothes clean.

11.6.2 How to keep cool

It is helpful to learn how to keep the body cool:

– Keep out of direct sunlight as much as possible.
– Avoid unnecessary quick movements.
– Ensure that there is air circulation in operators’ cabins.
– Avoid wearing tight clothes or those which prevent evaporation of perspiration such as some plastic materials.
– Wear head protection.
– Take cool drinks regularly to replace moisture lost through perspiration.
– Add salt to food or eat food that contains natural salt.
– Find a shady place for rest pauses.

Point to remember

- If the urine you pass is less than usual and strong and dark in colour, you are not drinking enough water to replace loss through perspiration.

11.6.3 Cold weather

Cold is not just uncomfortable – it may affect health and judgement. Although not a serious problem in tropical climates, it may nevertheless be experienced at high altitudes and in the early morning at sites which are well inland.

Some of the hazards of cold weather are as follows:

– There are more likely to be accidents if the temperature of the hands falls below 15° Celsius: there is loss of concentration and coordination.
– Workers repeatedly using vibratory tools such as rock drills may suffer “white finger” syndrome involving sensory loss as a consequence of cold.
– Prolonged exposure to temperatures around freezing may cause frostbite or hypothermia.
– Wind can affect temperature. When the air temperature is 10° Celsius and the wind speed is 32 km per hour, the temperature, so far as the body is concerned, falls to freezing. This is called the chill factor.
– Even where the temperature is above freezing point, a condition called “immersion foot” can occur in wet conditions if the feet are not kept dry.

11.6.4 How to keep warm

The following points should be considered when working in cold conditions:

– Choose clothing which allows moisture to escape but does not allow wind and rain to penetrate: waterproof clothing tends to prevent evaporation of moisture.
– Avoid bulky clothes, as they hamper movement – a number of layers of clothing are preferred.
– Hands and feet are particularly susceptible to cold.
– Use facilities for preparing hot meals and drinks, and for storing and drying clothing.

Point to remember:

- If someone appears to be suffering from immersion foot or hypothermia, move him or her into a warm place and allow slow recovery. Sudden warming may increase the injury.

12. Personal protective equipment (PPE)

12.1 Why do you need PPE?

The working conditions in construction are in most cases such that, despite all preventive measures in project planning and work design, some personal protective equipment (PPE), such as a helmet, hearing and eye protection, boots and gloves, is needed to protect workers. However, there are disadvantages in using PPE:

– Wearing some forms of PPE may involve discomfort to the user and slow down the work.
– Extra supervision is called for to see that PPE is worn.
– PPE costs money.

Wherever possible, it is better to try to eliminate the hazard rather than providing PPE to guard against it.

Some PPE such as safety helmets and footwear should be used on all construction sites. The need for other PPE will depend on the sort of work you do. Remember, too, that proper work clothes will provide protection for the skin.

Point to remember:

- It is safer and in most cases cheaper to eliminate hazards than to provide personal protective equipment.

Discussion

- What hazards are there on construction sites which could be removed instead of using PPE?
- How could you make people wear PPE when it is needed?
- Why is PPE often uncomfortable?

12.2 Head protection

Falling objects, overhead loads and sharp projections are to be found everywhere on construction sites. A small tool or bolt falling from 10 or 20 m high can cause serious injuries or even death if it strikes an unprotected head. Head injuries often occur when moving and working in a bent position, or when arising from such a position.

Safety helmets protect the head effectively against most of these hazards, and you should wear a helmet whenever you are on site and particularly when you are in an area where overhead work is going on. These areas, known as “hard-hat areas”, should be clearly marked with safety signs at entrances and other suitable places (figure 52). The same rule applies to managers, supervisors and visitors. Only safety helmets which have been tested to national or international standards should be used. A chin-strap on the helmet prevents it from failing off and should be used when appropriate.

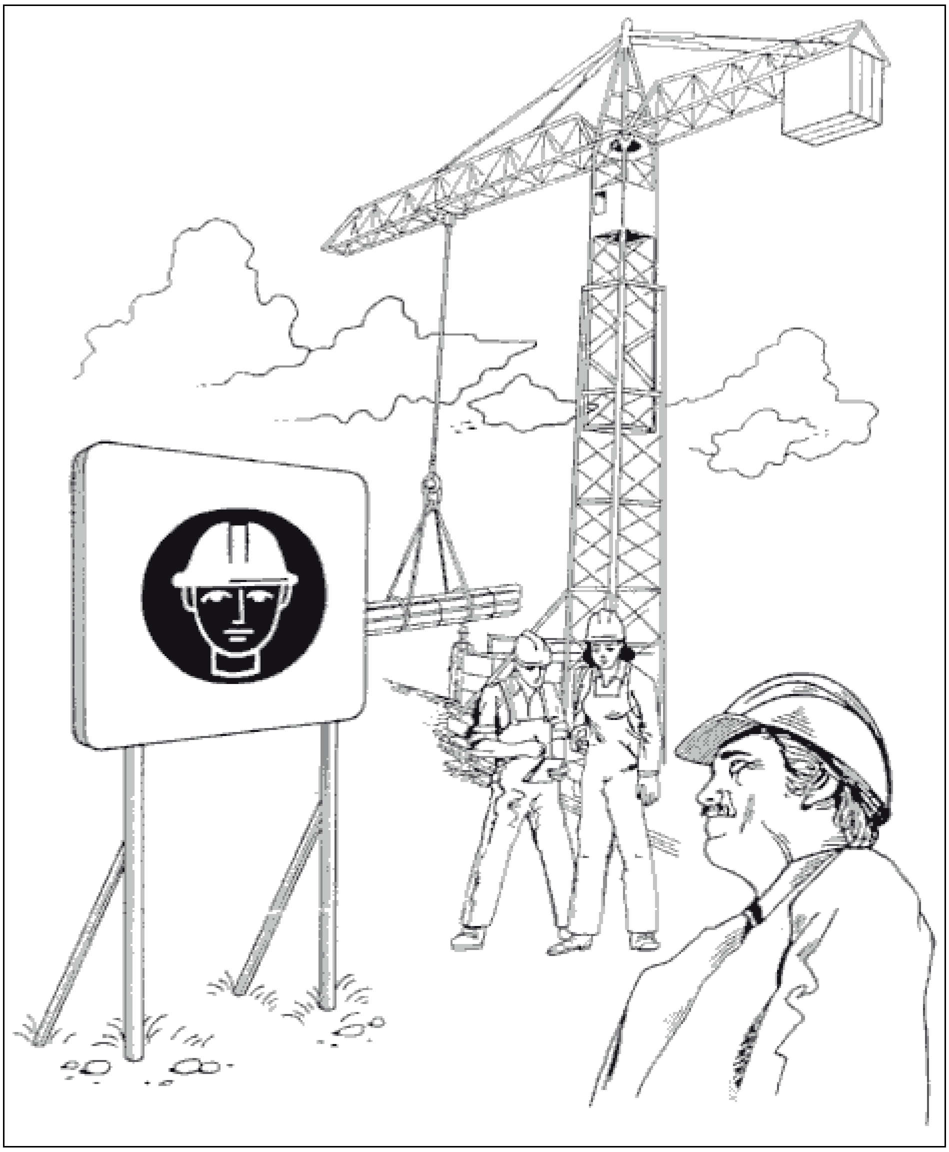
Point to remember:

- Your safety helmet protects you only if you have it on.

12.3 Foot protection

Foot injuries fall into two broad types: those due to penetration of the sole by nails which have not been knocked down or removed, and those due to crushing by falling materials, which can be minimized by wearing protective footwear. The type of safety shoes or boots to be used will depend on the nature of the work (e.g. the presence of ground water on construction sites), but all safety footwear should have an impenetrable sole and uppers with a steel toe-cap.

Figure 52. "Hard-hat" areas – all or most parts of construction sites should be marked by signs as "hard-hat" areas



There are many types of safety footwear now available such as:

– light, low-cut leather safety shoes for climbing jobs;
– normal safety shoes or boots for heavy-duty work;
– rubber or plastic safety wellingtons or gumboots which provide protection against corrosive substances, chemicals and water.

Point to remember:

- There are designs of safety footwear to suit all needs.

Discussion

- Should the wearing of safety footwear and safety helmets be a rule for everyone on site?

12.4 Hand and skin protection

Hands are extremely vulnerable to accidental injury, and in construction more injuries are caused to hands and wrists than to any other part of the body. Open wounds, abrasions, fractures, dislocations, strains, amputations and burns occur. They are largely preventable by better manual handling techniques and equipment, and by wearing suitable hand protection such as protective gloves and gauntlets.

Among the common hazardous tasks where hand protection should be provided are:

– operations involving contact with rough, sharp or jagged surfaces;
– contact with or splashes from hot, corrosive or toxic substances such as bitumen and resins;
– working with vibratory machines such as pneumatic drills where some cushioning of the vibrations is desirable;
– electrical work in humid and cold weather.

Skin trouble is common in the construction industry. Contact dermatitis is the commonest type of skin disease. It feels itchy and looks red, scaly and cracked, and can become so bad that it affects your ability to continue working. Wet cement is one of the main skin hazards, but other substances include tar and pitch, which can cause skin cancer after prolonged exposure, paint thinners, acids for masonry cleaning and epoxy resins. In addition to gloves, use barrier creams and wear long-sleeved shirts, full-length trousers and rubber boots.

Point to remember:

- If you notice any skin trouble, report it to your supervisor at once.

Discussion

- What common tasks in construction produce hand injuries?
- What could be done to avoid or minimize the dangers?
- Are there any risks attached to the wearing of gloves?

12.5 Eye protection

In industry many eye injuries occur as a result of flying material, dust or radiation when the following jobs are being carried out:

– breaking, cutting, drilling, dressing or laying of stone, concrete and brickwork with hand or power tools;
– chipping and dressing painted or corroded surfaces;
– cutting off or cutting out cold rivets and bolts;
– dry grinding of surfaces with power grinders;
– welding and cutting of metals.

In some industrial processes there may also be a risk from the spillage, leakage or splashing of hot or corrosive liquids.

Some of these hazards can be removed permanently by proper machine guarding, exhaust ventilation or work design. For many hazards, for example, stone cutting or dressing, personal eye protection (goggles, safety glasses or shields) is the only practical solution. Sometimes workers are aware of the danger they run and the consequences if their eyes are damaged, but do not wear eye protection. This is because the type chosen interferes with vision or is uncomfortable to wear, or is not immediately at hand when needed (figure 53).

Figure 53. Eye protection must be suitable, comfortable and available to encourage workers to wear it

Point to remember:

- Ninety per cent of all eye injuries can be prevented by suitable eye protection.

Discussion

- Which jobs on your site require eye protection?
- How would you convince employers to provide eye protection and workers to wear it?
- What different types of eye protection are needed by workers doing the various tasks carried out during construction?

12.6 Respiratory protection

On construction sites there are often tasks where harmful dust, mist or gas may be present, such as:

– rock crushing and handling;
– sandblasting;
– dismantling buildings containing asbestos insulation;
– welding or cutting materials with coatings containing zinc, lead, nickel or cadmium;
– paint spraying;
– blasting.

12.6.1 Correct choice of respirator

Whenever there is doubt about the presence of toxic substances in the atmosphere, a respirator must be worn. The correct type of respirator will depend upon the hazard and the work conditions, and you need to be trained in its use, cleaning and maintenance. Advice on suitable types of respirator and filter should be sought from appropriate safety and health authorities.

The simplest masks are disposable paper types. Remember that these are only effective against nuisance dusts.

There are three types of half-face mask with filters (figure 54):

– for protection against airborne particles, e.g. stone dust, with a coarse filter fitted in the cartridge (note, these filters have a specific lifetime and should be changed as necessary);

– for protection against gases and fumes, e.g. when using paints containing solvents, with a filter containing activated carbon;
– a combination filter containing both a dust and a gas filter. Cartridges must be replaced regularly.

A full-face mask can be fitted with the same types of filter, and it also protects the eyes and face.

Self-contained breathing apparatus with a full-face mask fed with air at positive pressure always gives the best protection, and must be used in confined spaces and whenever a sufficient supply of air or oxygen at the working place is in doubt. The air may be supplied from a compressor with a filter, or air/oxygen bottles (figure 55). In a hot climate, the full-face type is the most comfortable mask because it is looser fitting around the face and the air itself has a cooling effect. Users must be trained in the use of self-contained breathing apparatus and must keep to the manufacturers' specifications.

Points to remember:

- Respirators which are of the wrong type and not properly fitting are positively dangerous.
- Filters and canisters have a useful lifetime. Follow the specification and do not he tempted to use the respirator beyond its stated lifetime.

Figure 54. Three types of half-face mask with filters

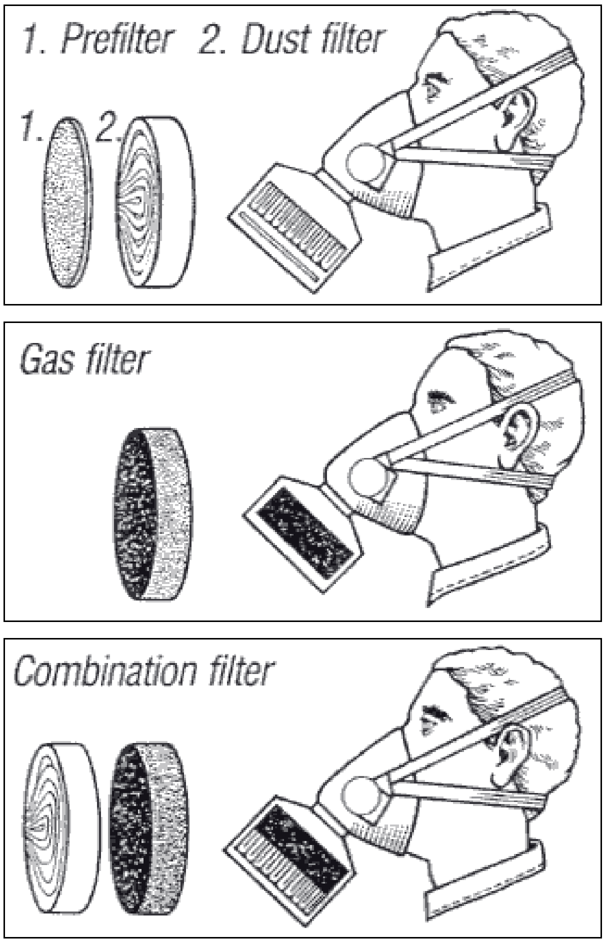
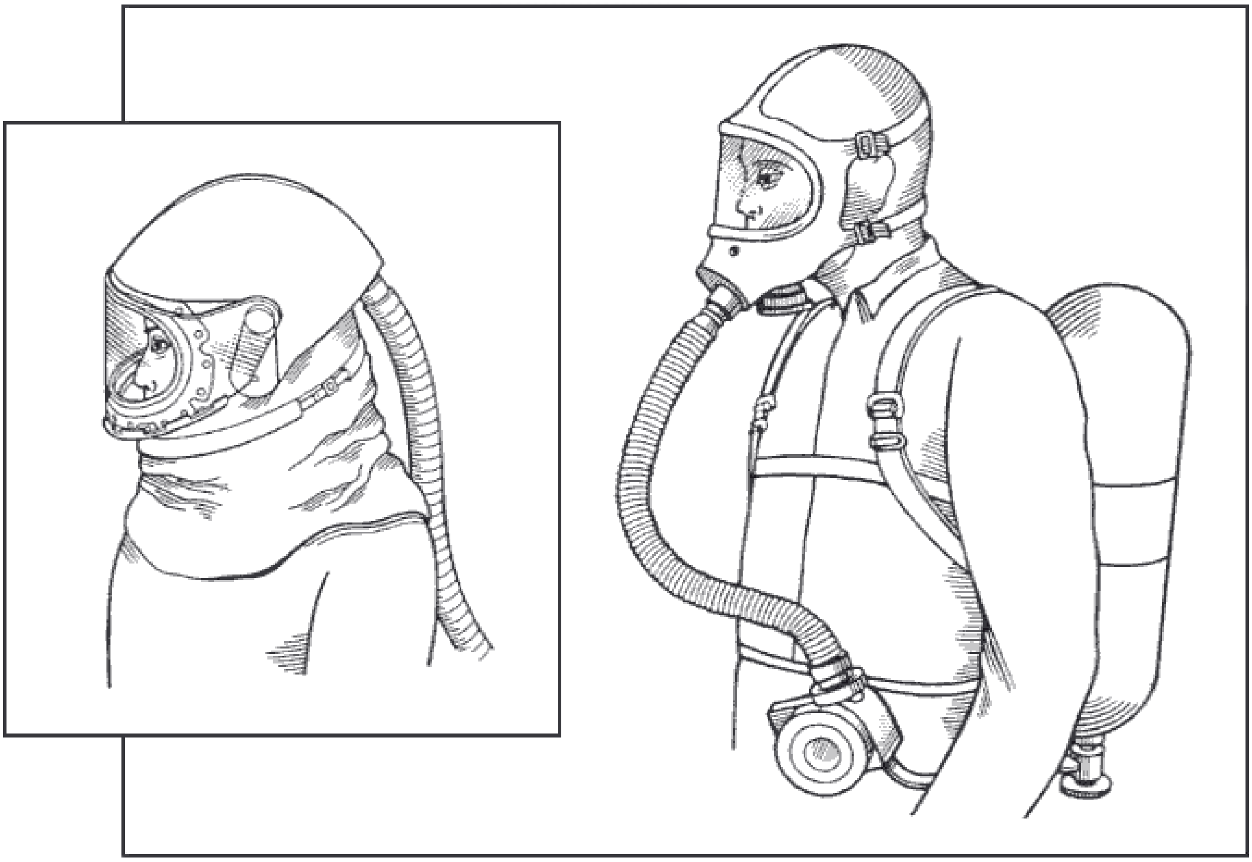


Figure 55. Self-contained breathing apparatus, with air supplied from either a compressor or air bottles



12.7 Safety harness

The majority of fatal accidents in construction are due to falls from heights. Where work cannot be done from a scaffold or ladder, or from a mobile access platform, the wearing of a safety harness may be the only way to prevent serious injury or death.

Circumstances in which a safety harness may be worn were discussed in Chapter 7. Another common situation in which a safety harness may be used – sometimes supplemented by the use of a safety net – is maintenance work on steel structures such as bridges and pylons.

There are many types of safety belt and safety harness available. The manufacturer or supplier should be asked for advice on suitable types for the intended purpose and for instructions on use and maintenance. A full safety harness should always be used in preference to a safety belt.

A safety harness and its lanyard must:

– limit your fall to a drop of not more than 2 m by means of an inertia device;
– be strong enough to support your weight;
– be attached to a strong structure through a firm anchorage point above the place at which you are working.

Point to remember:

- Make a habit of using the safety harness provided.

Discussion

- Which jobs on your construction site need a safety harness?
- Why are they not used?

13. Welfare facilities

13.1 Why welfare facilities?

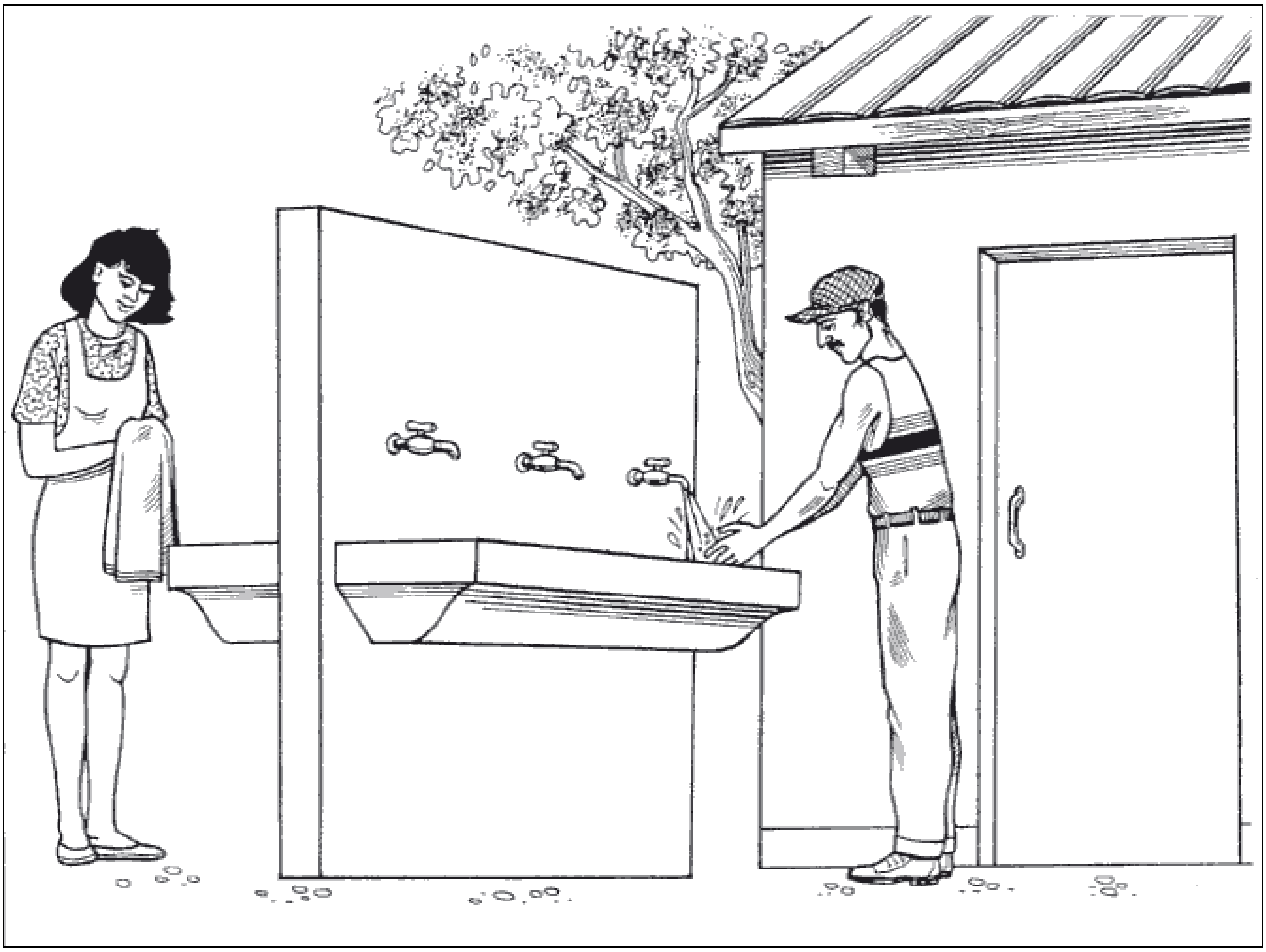
Work in the construction industry is arduous; it involves much manual or physical activity. It is also hazardous and dirty. Good welfare facilities not only improve workers' welfare but also enhance efficiency.

Welfare facilities such as the provision of drinking-water, washing, sanitary and changing accommodation, rest-rooms and shelter, facilities for preparing and eating meals, temporary housing, assistance in transport from place of residence to the work site and back, all help to reduce fatigue and improve workers' health (figure 56). The facilities may be provided and maintained by one contractor for all workers or by individual contractors.

Point to remember:

- Welfare facilities improve morale and consequently improve efficiency.

Figure 56. Suitable washing facilities and lavatories help protect the health of workers



13.2 Sanitary facilities

National laws usually prescribe the type, number and standard of sanitary facilities which should be provided, but as a general guide the following should be regarded as a practical minimum:

– a sufficient number of water flush-type lavatories for men when this is practicable, including sufficient urinal accommodation; chemical lavatories may be used otherwise;
– a sufficient number of separate water flush-type lavatories for women when this is practicable; again, chemical lavatories may be an alternative;
– the accommodation should be designed and constructed so as to screen the occupants from view and afford protection against the weather;
– the accommodation should be separate from any messroom or rest-room;
– a smooth and impermeable floor;
– effective natural and/or artificial lighting and ventilation;
– at least 30 m from any well;
– constructed for easy maintenance and cleaned out at least daily.

Point to remember:

- Play your part in keeping the facilities clean.

13.3 Washing facilities

Work in the construction industry is often dusty and dirty; it may also involve handling chemicals and other dangerous substances, so that you need to wash your hands and bodies regularly:

– to prevent chemicals contaminating food and so being eaten during snacks or meals, being absorbed through the skin or being carried home;
– to remove dirt and grime, which can also be ingested and cause sickness and disease;
– as a basic hygiene measure.

When construction work involves the maintenance of or alterations to existing buildings, it is often possible to use the facilities which form part of the building. Otherwise, washing facilities should be provided to the following standards:

– one wash-basin for every 15 workers with a sufficient supply of water and an adequate means of removing waste water;
– soap, in the form of cake soap, or liquid or powder soap in a special dispenser, to facilitate quick and proper washing, nail-brushes are needed where poisonous substances are used;
– suitable drying facilities such as paper towels, roller towels (or individual towels for each worker) or electric hand-dryers;
– for facilities likely to be of longer duration, mirrors and shelves at each washing point which will help to keep the place tidy and clean;
– where workers are exposed to skin contamination by chemical substances or by oil or grease, a sufficient number of showers, which should be disinfected daily;
– facilities should be covered to provide weather protection, and effectively ventilated and lit.

Points to remember:

- Always wash your hands before you eat meals.
- Do not take home dirt from the site on you or your clothes.

13.4 Facilities for supplying food and drink, and eating meals

Facilities for supplying food at construction work sites can be particularly important when sites are located in remote areas. Remoteness, together with inadequate temporary housing which lacks cooking facilities, may give rise to considerable problems for workers in the availability and regularity of hygienically prepared and nutritious meals. The problems of shiftworkers may be even greater.

To meet the need for proper meals, a choice of facilities should be made available:

– facilities to boil water and heat food;
– facilities (including provision of space, shelter, water, heating and rubbish bins) for vendors to sell hot and cold food and drink;
– a canteen supplying cooked meals or serving packed meals, snacks and beverages;
– arrangements with a restaurant or canteen near the work site to supply packaged meals.

13.4.1 The meal area

There should be accommodation with tables and seats, protected from the weather, where one can eat in comfort food brought from home or bought from vendors. It should be situated away from workstations to minimize contact with dirt, dust or dangerous substances.

Point to remember:

- Construction work is physically exhausting, and you need hygienically prepared and nutritious meals at regular times.

13.4.2 Drinking-water

Drinking-water is essential for workers in the construction industry, irrespective of the type of work they do. You lose several litres of water a day while at work and without replacement you gradually dehydrate, the loss is greater in a hot environment.

Arrangements for the supply of safe drinking-water may be:

– individual closed water bottles or containers when no other facilities are available, hung close to the workplace in a shaded place, free from dust and with plenty of air in circulation, cool water helps avoid heat exhaustion. Containers should be cleaned and disinfected at suitable intervals;
– drinking-water containers made of impermeable materials with suitable covers, kept in a cool, protected place. Unglazed pottery containers keep water cool, and they should be kept in dust-free places. The containers should be cleaned regularly by a designated person;
– drinking-water fountains from a public supply with the water outlet shielded in a manner that prevents the lips of the drinker from being placed against it. Drinking-water fountains are more hygienic than taps and drinking vessels;
– water taps from a public supply clearly labelled to distinguish between drinkable and non-drinkable water. It is preferable to use disposable cups or to provide a separate cup for each worker.

Drinking-water should not be placed in sanitary facilities, or in places where it can be contaminated by dust, chemicals or other substances. Whatever the source of water supply for drinking, whether at the mess accommodation or elsewhere on the site, it should be clearly marked as drinking-water in words or with a suitable sign.

Point to remember:

- Drink water only from sources clearly marked as drinking-water.

13.5 Facilities for changing, storing and drying clothes

Secure facilities at the work site for changing from street clothes into work clothes, and for airing and drying the latter, greatly assist workers with their personal hygiene and tidiness and relieve them of anxiety over the security of their possessions.

Changing-rooms are particularly important when workers change from street clothes into protective clothing and when working clothes become wet or dirty. The facilities should include provision for drying wet clothes, whether it be street or working clothing. Separate changing facilities for men and women workers should be provided, at least by adequate screening.

The provision of adequate seats, mirrors and rubbish bins in the changing rooms or close to the lockers will assist workers in paying attention to personal appearance and cleanliness.

13.6 Rest breaks

Construction workers begin work early. They start their day alert and productive but their activity level decreases as the day passes. Fatigue develops gradually before it begins to have marked effects. If you rest before you show signs of being really tired, recovery is much faster. Short breaks taken frequently are much better than infrequent long breaks. Productivity improves with frequent rest breaks.

13.6.1 Frequency of rest breaks

National law may prescribe the length of a working day which includes a period or periods for rest breaks. At least one ten-minute break in the morning and one in the afternoon, in addition to a longer break for lunch, are essential.

Workers are not just idle during rest breaks, but are recovering from fatigue and preparing for continued productive work. Getting away from a noisy or polluted workplace helps to relax and recover from fatigue, and an area with seating and out of direct sunlight should be set aside for rest breaks.

Point to remember:

- Breaks which are short and taken often are better than long breaks taken infrequently.

13.7 Child-care facilities

Working mothers employed at construction sites often need help with the special problems of caring for their children while they are at work.

13.7.1 Basic provisions

A clean and well-ventilated room, preferably with access to an enclosed space, is the main facility needed. A few items of simple furniture are necessary for the children to sit or lie down, and some toys help. There should be provision for feeding the children with nutritious meals at regular times and, for this, there should also be access to cooking facilities or a canteen.

It is essential for someone to care for the children while their mothers are at work, prepare their meals and feed them regularly. It may be possible for mothers themselves to take turns to look after the children. Mothers, especially nursing mothers, should be able to visit their children during recognized breaks from work.

13.7.2 Watch the children’s movements

Each year there are many tragic deaths of children on construction sites. Children should never be allowed to wander into or play on sites. There are excavations to fall into, scaffolding to fall from, hazardous equipment, loose and dangerous building materials, and chemicals lying about.

Point to remember:

- Child-care facilities pay for themselves by relieving working mothers on site of anxiety over the safety and welfare of their children.

Discussion

If you agree that good work-related welfare facilities improve workers' health and morale and their efficiency, resulting in improved productivity and better work relations, what measures have you seen taken to improve the following types of provision at construction sites?

– lavatories;
– washing facilities;
– eating facilities;
– facilities for changing and storing clothes;
– drinking-water;
– rest breaks;
– child-care facilities.

13.8 First aid

When there is an accident on site and someone is hurt, you can help by:

– calling for help from someone on site trained in first aid, or in cases of severe injury by calling an ambulance;
– preventing others (including yourself) from being injured from the same cause;
– providing life-saving first aid, even if you are not a trained first-aider;
– reporting the accident at once to your supervisor.

13.8.1 Emergency action

There are some situations where you cannot wait for a trained first-aider. Doing something at once might save an injured person's life. Here are some things you can do:

– check breathing: turn an unconscious person from his or her back to the side to prevent choking on the tongue; be cautious, keeping in mind the possibility of a neck injury;
– provide artificial respiration if breathing has stopped, using the mouth-to-mouth method;
– stop heavy bleeding by direct pressure on the wound and by raising the injured limb (do not try to use a tourniquet);
– cool a burn with water for some ten minutes, never with anything else – extinguish burning clothing by rolling the person on the ground or wrapping them in a blanket;
– flush a burn from corrosives, or contamination of the eyes from any chemical, with water for at least ten minutes;
– treat shock by lying the injured person on his or her side; loosen any tight clothing and cover the person with a blanket to keep him or her warm;
– immobilize a broken limb by bandaging it to two sticks if no splint is available; even tightly rolled newspaper will do.

You should not:

– move an injured person except to remove him or her from danger;
– remove any foreign object embedded in the body;
– give the person anything to drink – you may moisten the lips and tongue if asked to;
– move a broken limb.

Deep cuts and abrasions carry the risk of tetanus (lockjaw) and need to be treated by a doctor. Abrasions, even minor, carry a greater risk of infection than an open wound. After stopping bleeding, clean cuts and abrasions thoroughly with soap and water before covering them with a bandage. Make sure your hands are clean. Always wash your hands with soap after you have finished.

13.8.2 Equipment and training

Construction sites are dangerous places, and first-aid and rescue equipment should always be available. What is needed will depend on the size of the site and the numbers employed, but there should be at least a stocked first-aid box and a stretcher and blanket – the stretcher should be of a type which can be raised and lowered to and from upper floors. On large sites, and always where more than 200 people are employed, there should be a properly equipped first-aid room or hut.

On any construction site of size, at least one person on every shift should have been trained in first aid to a nationally recognized standard.

Point to remember:

- Serious cuts, abrasions and burns must be treated as soon as possible by a doctor or nurse. Limit first aid to a dressing and bandage, if these are necessary.

13.8.3 Moving an injured person

In principle, never move an injured person until a trained first-aider or a doctor can direct you. However, when someone is at risk of further injury and has to be removed to a safe place, lift him or her by using a stretcher or a blanket. If you are alone and must rapidly move an injured person out of danger, then a good way is to drag him or her head first by the clothes.

13.8.4 Investigation

After an accident, leave the site equipment undisturbed as far as it is safe to do so, so that the cause of the accident can be properly investigated. Make sure also that any objects and equipment involved remain untouched. This is important if proper measures are to be taken to prevent a repetition of the accident.

Discussion

- List the steps you would take if one of your workmates were injured.
- What facilities are there on your site to call for help and to treat injuries?
- How would you give artificial respiration?

13.9 Fire precautions

Fires on construction sites arise from the misuse of compressed gases and highly flammable liquids, from the ignition of waste material, wood shavings and cellular plastic materials, and from the failure to recognize that adhesives and some floor and wall coatings are highly flammable.

Every individual on site should be aware of the fire risk, and should know the precautions to prevent a fire and the action to be taken if fire does break out.

If fire breaks out, get someone to call the fire brigade. Do not continue trying to fight the blaze yourself if large quantities of fumes are being emitted in a closed space. Get out as fast as possible.

Fires are sometimes caused by carelessness in drying wet clothes. Heaters for this purpose, gas, oil or electric, should be mounted on and backed with non-flammable material, and enclosed in a stout wire mesh with effective air space to prevent clothing being placed directly upon them.

If you have to use a blow lamp or torch, or welding or burning equipment in the course of your work, first make sure that there is no fire risk to adjacent materials such as roof timbers. Many fires with disastrous consequences start from this source. Sparks can travel a long distance.

Points to remember:

- Make sure that all lights and heaters are extinguished at the end of each working day.
- Rubbish provides a good starting-point for fire. Keep your work area clean and tidy and do not allow rubbish of any description to accumulate.

Everyone on site should be trained to:

– know of two unobstructed ways off the site if there is a fire or other emergency;

– know how to raise the alarm;

– know where firefighting appliances are kept;

– be able to use the firefighting appliances; and be able to select the correct type of portable fire extinguisher for specific types of fire, as shown in the following table:

Type of portable fire extinguisher	Action	Suitability and dangers
Pressurized water	Cools fuels rapidly – for fires in ordinary combustible building materials	Conducts electricity – not to be used for live electrical equipment or oil fires
Carbon dioxide	Excludes oxygen	Displaces oxygen when used in confined spaces Re-ignition may occur in overheated liquids such as hot bitumen
Dry chemical powder	Interferes with the combustion process	Use in confined areas may lead to a reduction in visibility Non-conductor of electricity and may be used on live electrical equipment Re-ignition may occur in overheated liquids
Foam	Excludes oxygen, limited cooling Forms blanket over flammable liquids	Conducts electricity –- not to be used for live electrical components Gives better control over re-ignition than carbon dioxide and dry powder Better suited to extinguish fire in overheated liquids such as bitumen boilers and oil tanks

Point to remember:

- Be aware of at least two unobstructed ways off the site.

Discussion

- Have you been involved in any construction site fires? What was their cause?
- Were they quickly extinguished? If not, what was the reason?

Annex 1

Safety, health and welfare on construction sites: Check-list

The following pages list the main points to consider when you are checking the safety of your site. If a statement cannot be confirmed, for example that all excavations are properly shored, then you should state whether you propose action and what priority you have given to the action. In the "Remarks" section can be entered such comments as the work to be carried out and who is to do it.

Safety organization and management

1. The enterprise has a written safety policy which states the safety and health standards to which the employer should adhere.

   Do you propose action?
   No ☐ Yes ☐ Priority ☐
   Remarks ____________

2. Safety and health records are kept at the site.

   Do you propose action?
   No ☐ Yes ☐ Priority ☐
   Remarks ____________

3. Training is conducted at all levels, including for managers, supervisors, workers, subcontractors and contract workers.

   Do you propose action?
   No ☐ Yes ☐ Priority ☐
   Remarks ____________

4. Safety and health duties are specifically assigned on site.

   Do you propose action?
   No ☐ Yes ☐ Priority ☐
   Remarks ____________

5. Tool-box briefings and safety checks are used regularly on site.

   Do you propose action?
   No ☐ Yes ☐ Priority ☐
   Remarks ____________

6. There is an active safety committee at the site.

   Do you propose action?
   No ☐ Yes ☐ Priority ☐
   Remarks ____________

Site planning, layout and security

7. All workers are aware that the site manager has established a safety policy and what the policy is.

   Do you propose action?
   No ☐ Yes ☐ Priority ☐
   Remarks ____________

8. Safety aspects are included appropriately in site planning and layout.

   Do you propose action?
   No ☐ Yes ☐ Priority ☐
   Remarks ____________

9. There is a fence at least 2 m high at the boundary of the site.

   Do you propose action?
   No ☐ Yes ☐ Priority ☐
   Remarks ____________

10. Where this is not practicable, all excavations and openings are covered or fenced off at the end of the working day.

    Do you propose action?
    No ☐ Yes ☐ Priority ☐
    Remarks ____________

11. Ladders are removed from position or their rungs boarded at the end of the working day.

    Do you propose action?
    No ☐ Yes ☐ Priority ☐
    Remarks ____________

12. There is a traffic control system on site to control the movement of vehicles in order to avoid danger to pedestrians.

    Do you propose action?
    No ☐ Yes ☐ Priority ☐
    Remarks ____________

13. Everyone can reach their place of work safely – that there are safe roadways, walkways, gangways, staircases, ladders and scaffolds.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

14. There is edge protection at all open sides of gangways, floors, staircases and landings where there is a drop of 2 m or more.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

15. Holes and openings are securely fenced off or provided with fixed, clearly marked covers.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

16. There are no projecting nails in timber.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

17. There is adequate artificial lighting at places where persons work after dark and such lighting does not throw deep shadows.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

18. The site is kept tidy and materials are stored safely.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

19. Proper arrangements have been made for collecting and disposing of waste and scrap at frequent intervals.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

Excavations

20. An adequate supply of material such as timber, trench sheets and props with which to shore the sides of excavations has been delivered to the site before the excavation work is to begin.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

21. There are daily inspections of excavations to determine the possibility of a cave-in, and weekly recorded inspections of the shoring.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

22. The sides of excavations are sufficiently shored, or sloped back to 45 degrees.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

23. There is a method of work for putting in shoring which protects the shorer and does not rely on people working within an unsupported trench.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

24. A sufficiently long ladder for safely getting in and out of excavations is available and in use.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

25. There are barriers to stop persons falling into the excavations.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

26. There are no buildings whose stability might be affected by the excavations.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

27. There is no spoil or equipment close to the edge of the excavations likely to cause a collapse at the sides.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

28. Arrangements such as properly secured stop blocks have been made to prevent vehicles driving into the excavations.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

Scaffolding

29. Scaffolds are erected under the supervision of someone competent in scaffold erection.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

30. There is proper access to all parts of the scaffold platforms.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

31. All the uprights of the scaffold are mounted on proper base plates and timber sole plates if necessary, or prevented in some other way from slipping or sinking.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

32. No parts of the scaffold, including ties, have been removed after it was erected.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

33. The scaffold is secured to the building in enough places to prevent scaffold collapse.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

34. The uprights of the scaffold are vertical and securely braced to prevent swaying or displacement.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

35. The working platforms are close boarded with scaffold boards or planks of proper grade timber without obvious defects such as knots.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

36. There are effective barriers and warning notices to stop people using an incomplete scaffold, e.g. one that is not fully boarded.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

37. The boards are arranged so as to avoid the risk of tripping.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

38. Guard-rails and toe boards are erected to a safe height at the open sides and ends of scaffold platforms from which there is a drop of 2 m or more.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

39. Materials are evenly distributed over scaffolds designed to carry materials, and they are not overloaded.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

40. Unsecured tower scaffolds have a safe height-to-base area ratio of not more than 3 to 1.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

41. The wheels of mobile tower scaffolds are properly locked and secured.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

42. Access ladders for tower scaffolds are fitted internally and not externally.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

43. Workers on suspended scaffolds are using lifelines anchored overhead to the building and not to the scaffold.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

44. Scaffolds are inspected by a competent person at least once a week, and always after windy and bad weather.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

45. The results of scaffold inspections are recorded and signed by the person who carried out the inspections.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Ladders

46. Ladders are not being used for jobs which require a scaffold.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

47. Metal ladders are not being used near overhead power lines.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

48. The ladders that are in use are in good condition.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

49. Ladders are secured at or near the top whenever practicable even if only used for a short time.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

50. Where ladders cannot be secured at the top for technical reasons, they are secured near the bottom or footed.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

51. Ladders rise at least 1 m above their landing places or the highest rung used If this is not practicable, there are adequate handholds.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

52. Ladders are inspected regularly for signs of damage or corrosion.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

53. All ladders are marked for identification.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Roof work

54. Except where roof battens provide adequate handholds and footholds, crawling boards or crawling ladders are used to work on roof slopes of more than 10 degrees.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

55. Sufficient guard-rails and toe boards or other forms of edge protection are provided to prevent a worker or materials falling more than 2 m from sloping or flat roofs.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

56. There are crawling boards for work above fragile material such as asbestos cement sheets or glass.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

57. Precautions are taken during sheeting operations to stop persons falling from the edge of the sheets.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

58. Warning notices are displayed at all approaches to fragile roofs.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

59. There are guard-rails or covers at places where it is necessary to pass close to fragile material or to roof lights.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

60. Precautions are taken to stop debris falling onto others working under the roof work.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Steel erection

61. Steel erectors work from temporary access platforms wherever possible.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

62. Where temporary access platforms are not in use, steel erectors wear safety harnesses and lifelines attached to secure anchorage points.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

63. There are suitable anchorage points for the attachment of safety harnesses and lifelines.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

64. A tightly planked temporary floor is installed at heights above 10 metres or two storeys when steel erection is in progress.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

65. A safety net is used where the distance of fall exceeds two storeys.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

66. Safety lines are used to prevent the dangerous swing of steelwork when it is being raised or lowered by crane.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Work over water

67. A manned safety boat is in position.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

68. There are a sufficient number of lifebuoys and lines conveniently to hand.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Demolition

69. The construction characteristics of the building being demolished have been obtained before demolition begins.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

70. Demolition operations are being directly supervised by a competent person who has established a demolition plan.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

71. A safe working platform has been provided from which demolition workers are operating, and not directly from the building.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

72. Debris is not allowed to collect on floors to create a danger of collapse.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Confined spaces

73. The internal atmosphere of a confined space is tested before work begins, to assure an adequate level of oxygen in the air and freedom from toxic gases.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

74. Self-contained breathing apparatus is used and a safety harness and a lifeline worn by those working in a confined space.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

75. Any confined space is adequately ventilated with fresh air before anyone enters.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

76. It is not possible for vehicle exhaust fumes to collect in a manhole in which work is being carried on.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

77. Those working in a confined space are in direct communication with a worker outside the space who is equipped with reserve apparatus and trained in its use.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Piling

78. Underground services are located and made safe.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

79. There is a firm level base for the crane, or crane mats are provided.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

80. Proper personal protective equipment is used where necessary.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Transport

81. All site vehicles are in good repair.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

82. Roll-over protection is provided for vehicles that are liable to overturn.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

83. The steering, hand-brake and foot-brake of every vehicle in use works properly.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

84. Only workers who have received proper training drive site vehicles and hold recognized driving licences if they drive those vehicles on public roads.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

85. Drivers are trained to secure properly the loads of all site vehicles.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

86. Those working with tipping lorries are trained not to go beneath the raised body.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

87. Only authorized passengers are allowed to ride on site vehicles, and then in safe positions.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

88. Vehicles are equipped with a reversing signal where appropriate.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

89. When vehicles reverse with a load, the driver should be directed by a second trained worker or banksman.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

Cranes

90. Every crane (or excavator used as a crane) is inspected daily by the driver prior to use.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

91. Every crane is inspected weekly by a competent person, and a record is kept.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

92. Every crane is thoroughly examined at regular intervals of not more than 12 months by a competent person, and a record is kept.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

93. There is a test certificate for each crane.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

94. Every crane is regularly maintained.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

95. The crane operator is trained and competent, and is over the age of 18.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

96. The rated load capacities for varying radii of the jib, operating speeds and instructions are displayed and are visible to the operator.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

97. Crane cabins are safe and well designed, with safe means of access to them, and crane controls are clearly marked.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

98. Crane operators and signallers/banksmen are trained in the use of hand signals, and illustrations are displayed on site.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

99. Operators and banksmen find out the weight of a load which they do not know before lifting it. Banksmen have been trained in the attachment of loads.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

100. Every crane of more than 1 tonne capacity has an efficient automatic safe load indicator which is inspected weekly.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

101. Every crane is operating on a hard and level base and crane outriggers are being used when required.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

102. There is a safe means of access to all parts of the crane to which it is necessary to go for operation or maintenance.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

Goods or platform hoists

103. Every goods or platform hoist, including the hoisting rope, is inspected weekly by a competent person and a record kept.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

104. Every hoist is thoroughly examined by a competent person every six months and a record kept.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

105. Every hoist is surrounded by a substantial fence to a height of 2 m to prevent workers being struck by the hoist platform or falling down the hoistway.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

106. There are gates at all landings and points of access to the hoist platform.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

107. The gates are kept shut when the platform is not at that landing.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

108. There is a load-rating plate on the hoist platform, giving its safe working load.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

109. There is a notice prohibiting workers from riding on the platforms of goods hoists.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

110. The operator is trained and competent, and is aged over 18.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

111. There is overhead protection against falling material over the operator's position.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

112. Controls are arranged so that the hoist can be operated from one position only.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

113. The platform has brakes or devices which will hold it and the load in position if the hoisting rope or mechanism fails.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

114. There are at least three full turns of rope on the winch winding down when the platform is in its lowest position.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

115. A proper signalling system is in use.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

Gin or pulley wheels

116. The supporting beam is securely attached to two uprights.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

117. The lifting ropes are in good condition.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

118. The hooks are properly designed and constructed.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

Ergonomics

119. Mechanical power is used to replace heavy work where possible.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

120. Effective rest periods are included in the workday.

Do you propose action?
No ☐ Yes ☐ Priority ☐
Remarks ____________

121. Alternative methods are available to reduce strain in strenuous tasks.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

122. Work is done in a sitting position whenever possible.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

123. Materials, tools and controls are kept within easy reach of the worker.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

124. Machines with cabins are checked and maintained regularly.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

Machinery

125. All dangerous parts such as exposed gears, chain drives and projecting shafts are adequately guarded.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

126. All guards are secured and in good repair.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

Hand tools

127. Hand tools are regularly inspected for safe condition.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

128. Tool handles are free from splits and cracks.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

129. Tool handles are firmly fixed to the heads of all tools.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

130. Hammers, chisels and other impact tools do not have mushroomed heads.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

131. The edges or teeth of cutting tools are kept sharp.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

Cartridge-operated tools (or bolt guns)

132. The operators of bolt guns are properly trained so that they are able to deal with misfires.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

133. The operators are informed and trained on the basis of the manufacturers' instructions.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

134. Bolt guns and cartridges not in use are unloaded and kept in a secured place.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

135. Bolt guns are regularly cleaned and inspected each day before use.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

136. Safety helmets, safety goggles and safety shoes are worn by the operator and others within the vicinity.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

137. Ear protection is used by the operator, particularly when working in confined spaces.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Power-driven machinery

138. Circular saw blades are adequately guarded.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

139. The fence is locked securely in position before using a circular saw.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

140. Push-sticks are used when hand feeding material into a circular saw and when removing cut pieces.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

141. Compressed air tools are used with caution and are never directed at people.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Electrical equipment

142. Electrical equipment, including portable electric tools, is supplied from a reduced voltage supply, or special measures are taken to protect equipment and cables from mechanical damage and wet conditions.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

143. Electrical equipment, including wires and cables, is inspected for signs of damage or interference daily or before use.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

144. All connections to the power supply are made by proper connectors or plugs.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

145. All connections to plugs are properly made so that the cable grip holds the cable firmly and prevents the ground or earth wire from being pulled out.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

146. All electrical equipment is grounded or earthed.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

147. Where anything may touch overhead electric lines or cause arcing (such as crane jibs, tipper lorries or scaffolding), the electricity supply is turned off whenever possible.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

148. Where the supply to overhead power lines has not been turned off, ensure that other precautions such as the erection of "goalposts" have been taken to prevent contact with the lines.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

149. The pressure and route of underground cables has been marked and precautions taken to avoid contact with them.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Welding and cutting

150. Precautions are taken to protect welders, as well as others working near the welding process.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

151. Cylinders are stored properly and separately from one another.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

152. Precautions are taken to prevent an accumulation of toxic gases and fumes.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Compressed gas (LPG, acetylene)

153. Cylinders are properly stored.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

154. The valves of all cylinders are closed when the cylinder is not in use.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

155. No LPG cylinders are located inside huts.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

156. There are proper waste receptacles for combustible material and all waste is removed regularly from the site.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

Hazardous substances

157. All harmful materials such as asbestos and lead have been identified and suitable precautions taken.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

158. All containers of hazardous chemicals in use on site are properly labelled.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

159. Chemical safety data sheets are available for obtaining information about hazardous chemicals in use.

Do you propose action?

No ☐ Yes ☐ Priority ☐

Remarks ____________

160. Advice given by chemical safety data sheets is followed.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

161. Workers are aware of the hazards of the substances they are using and have been informed of the precautions to be taken by them, in particular when using cement.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

162. Workers have been trained in the handling and use of hazardous chemicals.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

Noise and vibration

163. All pneumatic drills/concrete breakers are fitted with silencer muffs.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

164. Exhaust systems of other machinery are fitted with silencers.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

165. Machinery covers are kept closed while the machinery is in use.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

166. Hearing protection is worn when working at or near noisy processes.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

167. Hearing protection is properly fitted and maintained in a clean and sanitary condition.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

Lighting; exposure to heat and cold

168. All parts of the work site are properly lit by natural or artificial light whenever work is going on.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

169. Adequate welfare facilities are provided in hot climates and suitable working-time arrangements are made.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

170. Workers are adequately protected when cold weather is experienced.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

Personal protective equipment

171. Personal protective clothing and equipment is provided to protect the head, eyes, hands and feet.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

172. Respiratory protective equipment is required, is available and workers are trained in its use.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________

____

173. The workers wear and use the protective clothing and equipment.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

Welfare facilities

174. There are sufficient and suitable lavatories, if practicable water closets, including urinals.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

175. There are sufficient and suitable washing facilities, including soap and means of drying.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

176. There are separate lavatories and washing facilities for men and women workers.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

177. There is sufficient and suitable accommodation for the storage and drying of both "street" and work clothing.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

178. There are sufficient and suitable facilities for preparing and eating food.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

179. There are sufficient and suitable provisions made for first aid and medical treatment.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

180. All workers are trained about action to be taken in emergency first-aid situations following an accident.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

Fire precautions

181. There are the right number and type of fire extinguishers on the site.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

182. There are adequate escape routes in case of fire.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

183. The amount of flammable liquids in actual use does not exceed a day's supply.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

184. Flammable liquids are kept in safe containers held in a proper store area.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

185. Smoking is prohibited while using flammable liquids.

Do you propose action?

No Yes Priority

☐ ☐ ☐

Remarks ____________
____

Annex 2

The Safety and Health in Construction Convention, 1988 (No. 167)

(extracts)

PART I. SCOPE AND DEFINITIONS

Article 1

1. This Convention applies to all construction activities, namely building, civil engineering, and erection and dismantling work, including any process, operation or transport on a construction site, from the preparation of the site to the completion of the project

2. A Member ratifying this Convention may, after consultation with the most representative organizations of employers and workers concerned, where they exist, exclude from the application of the Convention, or certain provisions thereof, particular branches of economic activity or particular undertakings in respect of which special problems of a substantial nature arise, on condition that a safe and healthy working environment is maintained.

3. This Convention also applies to such self-employed persons as may be specified by national laws or regulations.

Article 2

For the purpose of this Convention:

(a) The term “construction” covers:
  - (i) building, including excavation and the construction, structural alteration, renovation, repair, maintenance (including cleaning and painting) and demolition of all types of buildings or structures;
  - (ii) civil engineering, including excavation and the construction, structural alteration, repair, maintenance and demolition of, for example, airports, docks, harbours, inland waterways, dams, river and avalanche and sea defence works, roads and highways, railways, bridges, tunnels, viaducts and works related to the provision of services such as communications, drainage, sewerage, water and energy supplies;
  - (iii) the erection and dismantling of prefabricated buildings and structures, as well as the manufacturing of prefabricated elements on the construction site;

(b) the term “construction site” means any site at which any of the processes or operations described in subparagraph (a) above are carried on;

(c) the term “workplace” means all places where workers need to be or to go by reason of their work and which are under the control of an employer as defined in subparagraph (e) below;

(d) the term “worker” means any person engaged in construction;

(e) the term “employer” means:
  - (i) any physical or legal person who employs one or more workers on a construction site; and
  - (ii) as the context requires, the principal contractor, the contractor or the subcontractor;

(f) the term “competent person” means a person possessing adequate qualifications, such as suitable training and sufficient knowledge, experience and skill for the safe performance of the specific work The competent authorities may define appropriate criteria for the designation of such persons and may determine the duties to be assigned to them;

(g) the term “scaffold” means any temporary structure, fixed, suspended or mobile, and its supporting components which is used for supporting workers and materials or to gain access to any such structure, and which is not a lifting appliance as defined in subparagraph (h) below;

(h) the term “lifting appliance” means any stationary or mobile appliance used for raising or lowering persons or loads;

(i) the term “lifting gear” means any gear or tackle by means of which a load can be attached to a lifting appliance but which does not form an integral part of the appliance or load.

PART II. GENERAL PROVISIONS

Article 3

The most representative organizations of employers and workers concerned shall be consulted on the measures to be taken to give effect to the provisions of this Convention.

Article 4

Each Member which ratifies this Convention undertakes that it will, on the basis of an assessment of the safety and health hazards involved, adopt and maintain in force laws or regulations which ensure the application of the provisions of the Convention.

Article 5

1. The laws and regulations adopted in pursuance of Article 4 above may provide for their practical application through technical standards or codes of practice, or by other appropriate methods consistent with national conditions and practice

2. In giving effect to Article 4 above and to paragraph 1 of this Article, each Member shall have due regard to the relevant standards adopted by recognized international organizations in the field of standardization.

Article 6

Measures shall be taken to ensure that there is cooperation between employers and workers, in accordance with arrangements to be defined by national laws or regulations, in order to promote safety and health at construction sites.

Article 7

National laws or regulations shall require that employers and self-employed persons have a duty to comply with the prescribed safety and health measures at the workplace.

Article 8

1. Whenever two or more employers undertake activities simultaneously at one construction site –

(a) the principal contractor, or other person or body with actual control over or primary responsibility for overall construction site activities, shall be responsible for coordinating the prescribed safety and health measures and, in so far as is compatible with national laws and regulations, for ensuring compliance with such measures;

(b) in so far as is compatible with national laws and regulations, where the principal contractor, or other person or body with actual control over or primary responsibility for overall construction site activities, is not present at the site, he shall nominate a competent person or body at the site with the authority and means necessary to ensure on his behalf coordination and compliance with the measures, as foreseen in subparagraph (a) above;

(c) each employer shall remain responsible for the application of the prescribed measures in respect of the workers placed under his authority.

2. Whenever employers or self-employed persons undertake activities simultaneously at one construction site they shall have the duty to cooperate in the application of the prescribed safety and health measures, as may be specified by national laws or regulations.

Article 9

Those concerned with the design and planning of a construction project shall take into account the safety and health of the construction workers in accordance with national laws, regulations and practice.

Article 10

National laws or regulations shall provide that workers shall have the right and the duty at any workplace to participate in ensuring safe working conditions to the extent of their control over the equipment and methods of work and to express views on the working procedures adopted as they may affect safety and health.

Article 11

National laws or regulations shall provide that workers shall have the duty to –

(a) cooperate as closely as possible with their employer in the application of the prescribed safety and health measures;

(b) take reasonable care for their own safety and health and that of other persons who may be affected by their acts or omissions at work;

(c) use facilities placed at their disposal and not misuse anything provided for their own protection or the protection of others;

(d) report forthwith to their immediate supervisor, and to the workers' safety representative where one exists, any situation which they believe could present a risk, and which they cannot properly deal with themselves;

(e) comply with the prescribed safety and health measures.

Article 12

1. National laws or regulations shall provide that a worker shall have the right to remove himself from danger when he has good reason to believe that there is an imminent and serious danger to his safety or health, and the duty so to inform his supervisor immediately.

2. Where there is an imminent danger to the safety of workers the employer shall take immediate steps to stop the operation and evacuate workers as appropriate.

PART III. PREVENTIVE AND PROTECTIVE MEASURES

Article 13

Safety of workplaces

1. All appropriate precautions shall be taken to ensure that all workplaces are safe and without risk of injury to the safety and health of workers.

2. Safe means of access to and egress from all workplaces shall be provided and maintained, and indicated where appropriate.

3. All appropriate precautions shall be taken to protect persons present at or in the vicinity of a construction site from all risks which may arise from such site.

Article 14

Scaffolds and ladders

1. Where work cannot safely be done on or from the ground or from part of a building or other permanent structure, a safe and suitable scaffold shall be provided and maintained, or other equally safe and suitable provision shall be made.

2. In the absence of alternative safe means of access to elevated working places, suitable and sound ladders shall be provided. They shall be property secured against inadvertent movement.

3. All scaffolds and ladders shall be constructed and used in accordance with national laws and regulations.

4. Scaffolds shall be inspected by a competent person in such cases and at such times as shall be prescribed by national laws or regulations.

Article 15

Lifting appliances and gear

1. Every lifting appliance and item of lifting gear, including their constituent elements, attachments, anchorages and supports, shall –

(a) be of good design and construction, sound material and adequate strength for the purpose for which they are used;

(b) be properly installed and used;

(c) be maintained in good working order;

(d) be examined and tested by a competent person at such times and in such cases as shall be prescribed by national laws or regulations: the results of these examinations and tests shall be recorded;

(e) be operated by workers who have received appropriate training in accordance with national laws and regulations.

2. No person shall be raised, lowered or carried by a lifting appliance unless it is constructed, installed and used for that purpose in accordance with national laws and regulations, except in an emergency situation in which serious personal injury or fatality may occur, and for which the lifting appliance can be safely used.

Article 16

Transport, earth-moving and materials-handling equipment

1. All vehicles and earth-moving or materials-Handling equipment shall –

(a) be of good design and construction taking into account as far as possible ergonomic principles;

(b) be maintained in good working order;

(c) be properly used;

(d) be operated by workers who have received appropriate training in accordance with national laws and regulations.

2. On all construction sites on which vehicles, earth-moving or materials-handling equipment are used –

(a) safe and suitable access ways shall be provided for them; and

(b) traffic shall be so organized and controlled as to secure their safe operation.

Article 17

Plant, machinery, equipment and hand tools

1. Plant, machinery and equipment, including hand tools, both manual and power driven, shall –

(a) be of good design and construction, taking into account as far as possible ergonomic principles;

(b) be maintained in good working order;

(c) be used only for work for which they have been designed unless a use outside the initial design purposes has been assessed by a competent person who has concluded that such use is safe;

(d) be operated by workers who have received appropriate training.

2. Adequate instructions for safe use shall be provided where appropriate by the manufacturer or the employer, in a form understood by the users.

3. Pressure plant and equipment shall be examined and tested by a competent person in cases and at times prescribed by national laws or regulations.

Article 18

Work at heights including roofwork

1. Where necessary to guard against danger, or where the height of a structure or its slope exceeds that prescribed by national laws or regulations, preventive measures shall be taken against the fall of workers and tools or other objects or materials.

2. Where workers are required to work on or near roofs or other places covered with fragile material, through which they are liable to fall, preventive measures shall be taken against their inadvertently stepping on or falling through the fragile material.

Article 19

Excavations, shafts, earthworks, underground works and tunnels

Adequate precautions shall be taken in any excavation, shaft, earthworks, underground works or tunnel –

(a) by suitable shoring or otherwise to guard against danger to workers from a fall or dislodgement of earth, rock or other material;

(b) to guard against dangers arising from the fall of persons, materials or objects or the inrush of water into the excavation, shaft, earthworks, underground works or tunnel;

(c) to secure adequate ventilation at every workplace so as to maintain an atmosphere fit for respiration and to limit any fumes, gases, vapours, dust or other impurities to levels which are not dangerous or injurious to health and are within limits laid down by national laws or regulations;

(d) to enable the workers to reach safety in the event of fire, or an inrush of water or material;

(e) to avoid risk to workers arising from possible underground dangers such as the circulation of fluids or the presence of pockets of gas, by undertaking appropriate investigations to locate them.

Article 20

Cofferdams and caissons

1. Every cofferdam and caisson shall be –

(a) of good construction and suitable and sound material and of adequate strength,

(b) provided with adequate means for workers to reach safety in the event of an inrush of water or material.

2. The construction, positioning, modification or dismantling of a cofferdam or caisson shall take place only under the immediate supervision of a competent person.

3. Every cofferdam and caisson shall be inspected by a competent person at prescribed intervals.

Article 21

Work in compressed air

1. Work in compressed air shall be carried out only in accordance with measures prescribed by national laws or regulations.

2. Work in compressed air shall be carried out only by workers whose physical aptitude for such work has been established by a medical examination and when a competent person is present to supervise the conduct of the operations.

Article 22

Structural frames and formwork

1. The erection of structural frames and components, formwork, falsework and shoring shall be carried out only under the supervision of a competent person.

2. Adequate precautions shall be taken to guard against danger to workers arising from any temporary state of weakness or instability of a structure.

3. Formwork, falsework and shoring shall be so designed, constructed and maintained that it will safely support all loads that may be imposed on it.

Article 23

Work over water

Where work is done over or in close proximity to water there shall be adequate provision for –

(a) preventing workers from falling into water;

(b) the rescue of workers in danger of drowning;

(c) safe and sufficient transport.

Article 24

Demolition

When the demolition of any building or structure might present danger to workers or to the public –

(a) appropriate precautions, methods and procedures shall be adopted, including those for the disposal of waste or residues, in accordance with national laws or regulations;

(b) the work shall be planned and undertaken only under the supervision of a competent person.

Article 25

Lighting

Adequate and suitable lighting, including portable lighting where appropriate, shall be provided at every workplace and any other place on the construction site where a worker may have to pass.

Article 26

Electricity

1. All electrical equipment and installations shall be constructed, installed and maintained by a competent person, and so used as to guard against danger.

2. Before construction is commenced and during the progress thereof adequate steps shall be taken to ascertain the presence of and to guard against danger to workers from any live electrical cable or apparatus which is under, over or on the site.

3. The laying and maintenance of electrical cables and apparatus on construction sites shall be governed by the technical rules and standards applied at the national level.

Article 27

Explosives

Explosives shall not be stored, transported, handled or used except –

(a) under conditions prescribed by national laws or regulations; and

(b) by a competent person, who shall take such steps as are necessary to ensure that workers and other persons are not expose l to risk of injury.

Article 28

Health hazards

1. Where a worker is liable to be exposed to any chemical, physical or biological hazard to such an extent as is liable to be dangerous to health, appropriate preventive measures shall be taken against such exposure

2. The preventive measures referred to in paragraph 1 above shall comprise –

(a) the replacement of hazardous substances by harmless or less hazardous substances wherever possible; or

(b) technical measures applied to the plant, machinery, equipment or process; or

(c) where it is not possible to comply with subparagraphs (a) or (b) above, other effective measures, including the use of personal protective equipment and protective clothing.

3. Where workers are required to enter any area in which a toxic or harmful substance may be present, or in which there may be an oxygen deficiency, or a flammable atmosphere, adequate measures shall be taken to guard against danger.

4. Waste shall not be destroyed or otherwise disposed of on a construction site in a manner which is liable to be injurious to health.

Article 29

Fire precautions

1. The employer shall take all appropriate measures to –

(a) avoid the risk of fire;

(b) combat quickly and efficiently any outbreak of fire;

(c) bring about a quick and safe evacuation of persons.

2. Sufficient and suitable storage shall be provided for flammable liquids, solids and gases.

Article 30

Personal protective equipment and protective clothing

1. Where adequate protection against risk of accident or injury to health, including exposure to adverse conditions, cannot be ensured by other means, suitable personal protective equipment and protective clothing, having regard to the type of work and risks, shall be provided and maintained by the employer, without cost to the workers, as may be prescribed by national laws or regulations.

2. The employer shall provide the workers with the appropriate means to enable them to use the individual protective equipment, and shall ensure its proper use.

3. Protective equipment and protective clothing shall comply with standards set by the competent authority taking into account as far as possible ergonomic principles.

4. Workers shall be required to make proper use of and to take good care of the personal protective equipment and protective clothing provided for their use.

Article 31

First aid

The employer shall be responsible for ensuring that first aid, including trained personnel, is available at all times Arrangements shall be made for ensuring the removal for medical attention of workers who have suffered an accident or sudden illness.

Article 32

Welfare

1. At or within reasonable access of every construction site an adequate supply of wholesome drinking water shall be provided.

2. At or within reasonable access of every construction site, the following facilities shall, depending on the number of workers and the duration of the work, be provided and maintained –

(a) sanitary and washing facilities;

(b) facilities for changing and for the storage and drying of clothing;

(c) accommodation for taking meals and for taking shelter during interruption of work due to adverse weather conditions.

3. Men and women workers should be provided with separate sanitary and washing facilities.

Article 33

Information and training

Workers shall be adequately and suitably –

(a) informed of potential safety and health hazards to which they may be exposed at their workplace;

(b) instructed and trained in the measures available for the prevention and control of, and protection against, those hazards.

Article 34

Reporting of accidents and diseases

National laws or regulations shall provide for the reporting to the competent authority within a prescribed time of occupational accidents and diseases.

PART IV. IMPLEMENTATION

Article 35

Each Member shall –

(a) Lake all necessary measures, including the provision of appropriate penalties and corrective measures, to ensure the effective enforcement of the provisions of the Convention;

(b) provide appropriate inspection services to supervise the application of the measures to be taken in pursuance of the Convention and provide these services with the resources necessary for the accomplishment of their task, or satisfy itself that appropriate inspection is carried out.

Safety and Health in Construction Recommendation, 1988 (No. 175)

(extracts)

PART I. SCOPE AND DEFINITIONS

1. The Provisions of the Safety and Health in Construction Convention, 1988 (hereinafter referred to as “the Convention”‘), and of this Recommendation should be applied in particular to:

(a) building, civil engineering and the erection and dismantling of prefabricated buildings and structures, as defined in Article 2(a) of the Convention;

(b) the fabrication and erection of oil rigs, and of offshore installations while under construction on shore.

2. For the purposes of this Recommendation –

(a) the term “construction” covers:

(i) building, including excavation and the construction, structural alteration, renovation, repair, maintenance (including cleaning and painting) and demolition of ail types of buildings or structures;

(ii) civil engineering, including excavation and the construction, structural alteration, repair, maintenance and demolition of, for example, airports, docks, harbours, inland waterways, clams, river and avalanche and sea defence works, roads and highways, railways, bridges, tunnels, viaducts and works related to the provision of services such as communications, drainage, sewerage, water and energy supplies;

(iii) the erection and dismantling of prefabricated buildings and structures, as well as the manufacturing of prefabricated elements on the construction site;

(b) the term “construction site” means any site at which any of the processes or operations described in clause (a) above are carried on;

(c) the term “workplace” means all places where workers need to be or to go by reason of their work and which are under the control of an employer as defined in clause (f) below;

(d) the term “worker” means any person engaged in construction;

(e) the term “workers’ representatives” means persons who are recognized as such under national law or practice;

(f) the term “employer” means:

(i) any physical or legal person who employs one or more workers on a construction site; and

(ii) as the context requires, the principal contractor, the contractor or the subcontractor;

(g) the term "competent person" means a person possessing adequate qualifications, such as suitable training and sufficient knowledge, experience and skill for the safe performance of the specific: work. The competent authorities may define appropriate criteria for the designation of such persons and may determine the duties to be assigned to them;

(h) the term "scaffold" means any temporary structure, fixed, suspended or mobile, and its supporting components which is used for supporting workers and materials or to gain access to any such structure, and which is not a "lifting appliance" as defined in clause (i) below;

(i) the term "lifting appliance" means any stationary or mobile appliance used for raising or lowering persons or loads;

(j) the term "lifting gear" means any gear or tackle by means of which a load can be attached to a lifting appliance but which does not form an integral part of the appliance or load.

3. The provisions of this Recommendation should also apply to such self-employed persons as may be specified by national laws or regulations.

PART II. GENERAL PROVISIONS

4. National laws or regulations should require that employers and self-employed persons have a general duty to provide a safe and healthy workplace and to comply with the prescribed safety and health measures.

5. (1) Whenever two or more employers undertake activities at one construction site, they should have the duty to cooperate with one another as well as with any other persons participating in the construction work being undertaken, including the owner or his representative, in order to comply with the prescribed safety and health measures.

(2) Ultimate responsibility for the coordination of safety and health measures on the construction site should rest with the principal contractor or such other person as is primarily responsible for the execution of the work.

6. The measures to be taken to ensure that there is organized cooperation between employers and workers to promote safety and health at construction sites should be prescribed by national laws or regulations or by the competent authority. Such measures should include –

(a) the establishment of safety and health committees representative of employers and workers with such powers and duties as may be prescribed;

(b) the election or appointment of workers' safety delegates with such powers and duties as may be prescribed;

(c) the appointment by the employer of suitably qualified and experienced persons to promote safety and health;

(d) the training of safety delegates and safety committee members.

7. Those concerned with the design and planning of a construction project should take into account the safety and health of the construction workers in accordance with national laws, regulations and practice.

8. The design of construction equipment, tools, protective equipment and other similar equipment should take account of ergonomic principles.

PART III. PREVENTIVE AND PROTECTIVE MEASURES

9. Construction work should be planned, prepared and undertaken in such a way that –

(a) risks liable to arise at the workplace are prevented as soon as possible;

(b) excessively or unnecessarily strenuous work positions and movements are avoided;

(c) organization of work takes into account the safety and health of workers;

(d) materials and products are used which are suitable from a safety and health point of view;

(e) working methods are employed which protect workers against the harmful effects of chemical, physical and biological agents.

10. National laws or regulations should provide for the notification to the competent authority of construction sites of such size, duration or characteristics as may be prescribed.

11. Workers should have the right and the duty at any workplace to participate in ensuring safe working conditions to the extent of their control over the equipment and methods of work and to express views on the working procedures adopted as they may affect safety and health.

Safety of workplaces

12. Housekeeping programmes should be established and implemented on construction sites which should include provision for –

(a) the proper storage of materials and equipment:

(b) the removal of waste and debris at appropriate intervals.

13. Where workers cannot be protected against falls from heights by any other means –

(a) adequate safety nets or safety sheets should be erected and maintained; or

(b) adequate safety harnesses should be provided and used.

14. The employer should provide the workers with the appropriate means to enable them to use individual protective equipment and should ensure its proper use. Protective equipment and protective clothing should comply with standards set by the competent authority, taking into account as far as possible ergonomic principles.

15. (1) The safety of construction machinery and equipment should be examined and tested by type or individually, as appropriate, by a competent person.

(2) National laws and regulations should take into consideration the fact that occupational diseases may be caused by machinery, apparatus and systems which do not take account of ergonomic principles in their design.

Scaffolds

16. Every scaffold and part thereof should be of suitable and sound material and of adequate size and strength for the purpose for which it is used and be maintained in a proper condition.

17. Every scaffold should be properly designed, erected and maintained so as to prevent collapse or accidental displacement when properly used.

18. The working platforms, gangways and stairways of scaffolds should be of such dimensions and so constructed and guarded as to protect persons against falling or being endangered by falling objects.

19. No scaffold should be overloaded or otherwise misused.

20. A scaffold should not be erected, substantially altered or dismantled except by or under the supervision of a competent person.

21. Scaffolds as prescribed by national laws or regulations should be inspected, and the results recorded, by a competent person –

(a) before being taken into use;

(b) at periodic intervals thereafter;

(c) after any alteration, interruption in use, exposure to weather or seismic conditions or any other occurrence likely to have affected their strength or stability.

Lifting appliances and lifting gear

22. National laws or regulations should prescribe the lifting appliances and items of lifting gear which should be examined and tested by a competent person –

(a) before being taken into use for the first time;

(b) after erection on a site;

(c) subsequently at intervals prescribed by such national laws or regulations;

(d) after any substantial alteration or repair.

23. The results of the examinations and tests of lifting appliances and items of lifting gear carried out in pursuance of Paragraph 22 above should be recorded and, as required, made available to the competent authority and to employers and workers or their representatives.

24. Every lifting appliance having a single safe working load and every item of lifting gear should be clearly marked with its maximum safe working load.

25. Every lifting appliance having a variable safe working load should be fitted with effective means to indicate clearly to the driver each maximum safe working load and the conditions under which it is applicable.

26. A lifting appliance or item of lifting gear should not be loaded beyond its safe working load or loads, except for testing purposes as specified by and under the direction of a competent person.

27. Every lifting appliance and every item of lifting gear should be properly installed so as, inter alia, to provide safe clearance between any moving part and fixed objects, and to ensure the stability of the appliance.

28. Where necessary to guard against danger, no lifting appliance should be used without the provision of suitable signalling arrangements or devices.

29. The drivers and operators of such lifting appliances as are prescribed by national laws or regulations should be –

(a) of a prescribed minimum age;

(b) properly trained and qualified.

Transport, earth-moving and materials-handling equipment

30. The drivers and operators of vehicles and of earth-moving or materials-handling equipment should be persons trained and tested as required by national laws or regulations.

31. Adequate signalling or other control arrangements or devices should be provided to guard against danger from the movement of vehicles and earth-moving or materials-handling equipment. Special safety precautions should be taken for vehicles and equipment when manoeuvring backwards.

32. Preventive measures should be taken to avoid the fall of vehicles and earth-moving and materials-handling equipment into excavations or into water.

33. Where appropriate, earth-moving and materials-handling equipment should be fitted with structures designed to protect the operator from being crushed should the machine overturn, and from falling material.

Excavations, shafts, earthworks, underground works and tunnels

34. Shoring or other support for any part of an excavation, shaft, earthworks, underground works or tunnel should not be erected, altered or dismantled except under the supervision of a competent person.

35. (1) Every part of an excavation, shaft, earthworks, underground works and tunnel where persons are employed should be inspected by a competent person at the times and in the cases prescribed by national laws or regulations, and the results recorded.

(2) Work should not be commenced therein until after such an inspection.

Work in compressed air

36. The measures regarding work in compressed air prescribed pursuant to Article 21 of the Convention should include provisions regulating the conditions in which the work is to be carried out, the plant and equipment to be used, the medical supervision and control of workers and the duration of work in compressed air.

37. A person should only be allowed to work in a caisson if it has been inspected by a competent person within such preceding period as is prescribed by national laws or regulations; the results of the inspection should be recorded.

Pile driving

38. All pile-driving equipment should be of good design and construction taking into account as far as possible ergonomic principles, and properly maintained.

39. Pile driving should be carried out only under the supervision of a competent person.

Work over water

40. The provisions regarding work over water prescribed in pursuance of Article 23 of the Convention should include, where appropriate, the provision and use of suitable and adequate –

(a) fencing, safety nets and safety harnesses;

(b) life vests, life preservers, manned boats (motor driven if necessary) and lifebuoys;

(c) protection against such hazards as reptiles and other animals.

Health hazards

41. (1) An information system should be set up by the competent authority, using the results of international scientific research, to provide information for architects, contractors, employers and workers' representatives on the health risks associated with hazardous substances used in the construction industry.

(2) Manufacturers and dealers in products used in the construction industry should provide with the products information on any health risks associated with them and on the precautions to be taken.

(3) In the use of materials that contain hazardous substances and in the removal and disposal of waste, the health of workers and of the public and the preservation of the environment should be safeguarded as prescribed by national laws and regulations.

(4) Dangerous substances should be clearly marked and provided with a label giving their relevant characteristics and instructions on their use. They should be handled under conditions prescribed by national laws and regulations or by the competent authority.

(5) The competent authority should determine which hazardous substances should be prohibited from use in the construction industry.

42. The competent authority should keep records of monitoring of the working environment and assessment of workers' health for a period prescribed by national laws and regulations.

43. The manual lifting of excessive weights which presents a safety and health risk to workers should be avoided by reducing the weight, by the use of mechanical devices or by other means.

44. Whenever new products, equipment and working methods are introduced, special attention should be paid to informing and training workers with respect to their implications for safety and health.

Dangerous atmospheres

45. The measures regarding dangerous atmospheres prescribed pursuant to Article 28, paragraph 3, of the Convention should include prior written authority or permission from a competent person, or any other system by which entry into any area in which a dangerous atmosphere may be present can be effected only after completing specified procedures.

Fire precautions

46. Where necessary to guard against danger, workers should be suitably trained in the action to be taken in the event of fire, including the use of means of escape

47. Where appropriate suitable visual signs should be provided to indicate clearly the directions of escape in case of fire.

Radiation hazards

48. Stringent safety regulations should be drawn up and enforced by the competent authority with respect to construction workers engaged in the maintenance, renovation, demolition or dismantling of any buildings in which there is a risk of exposure to ionising radiations, in particular in the nuclear power industry.

First aid

49. The manner in which first-aid facilities and personnel are to be provided in pursuance of Article 31 of the Convention should be prescribed by national laws or regulations drawn up after consulting the competent health authority and the most representative organisations of employers and workers concerned

50. Where the work involves risk of drowning, asphyxiation or electric shock, first-aid personnel should be proficient in the use of resuscitation and other life-saving techniques and in rescue procedures.

Welfare

51. In appropriate cases, depending on the number of workers, the duration of the work and its location, adequate facilities for obtaining or preparing food and drink at or near a construction site should be provided, if they are not otherwise available.

52. Suitable living accommodation should be made available for the workers at construction sites which are remote from their homes, where adequate transportation between the site and their homes or other suitable living accommodation is not available. Men and women workers should be provided with separate sanitary, washing and sleeping facilities.

Other ILO publications

Safety and health in construction.
An ILO code of practice

Changes in working practices and conditions in the construction industry over the past decade have meant that competent authorities, health and safety committees, management or employers' and workers' organizations, in particular, should take a fresh look at such aspects as the safety of workplaces, health hazards, and construction equipment and machinery. This code of practice takes account of new areas in the sector which require improved health and safety practices and other protective measures.

ISBN 92-2-107104-9 (1992) 20 Swiss francs

The organization of first aid in the workplace
Occupational Safety and Health Series No. 63

This publication is intended for public authorities, employers, workers, safety and health committees, and all persons in charge of occupational safety and health at the enterprise level. It shows in detail how first aid may be organized in the workplace, especially in small enterprises. It also provides information on the duties and training of first-aid personnel, the necessary equipment, supplies and facilities, and the arrangements required beyond first aid for accidents demanding specialized medical care.

Second impression 1999
ISBN 92-2-106440-9 15 Swiss francs

Safety and health in the use of chemicals at work: A training manual, by Abu Bakar Che Man and David Gold

This non-technical manual offers clear guidance on the risks associated with chemicals at work, and ways of reducing them. It covers health hazards resulting from chemical exposure, fire and explosion hazards, principles of prevention, chemical emergency procedures and management of a chemical control programme. Although specially designed for use on training courses, it will be invaluable to all those who promote the safe use of chemicals at work. Includes numerous illustrations, suggestions for discussion and activities, and a comprehensive checklist.

ISBN 92-2-106470-0 (1993) 17.50 Swiss francs

Ergonomic checkpoints: Practical and easy-to-implement solutions for improving safety, health and working conditions

This unique compilation of 128 "ergonomic checkpoints" identifies simple and inexpensive solutions to ergonomic problems in a variety of workplaces and local situations. The checkpoints, which can be used to check working conditions or workplace plans, cover storage and handling, hand tools, machine safety, workstation design, lighting, premises, hazardous substances, welfare facilities and work organization. Each checkpoint is illustrated, and a complete ergonomic checklist is included. Prepared in collaboration with the International Ergonomics Association.

Second impression (with revisions) 1999
ISBN 92-2-109442-1 25 Swiss francs

Encyclopaedia of Occupational Health and Safety. Fourth edition.
Edited by Jeanne M. Stellman, PhD

Completely revised and greatly expanded, the new edition of the Encyclopaedia provides comprehensive and authoritative coverage of occupational health and safety. It was developed through an extensive process of consultation with leading professionals and worldwide health and safety institutions. A new CD-ROM version provides the benefits of computer-assisted search and retrieval capabilities. The Encyclopaedia consists of four printed volumes:

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- Volume 2: Psychosocial and organizational factors, hazards, the environment, accidents and safety
- Volume 3: Chemicals, industries and occupations
- Volume 4: Indexes by subject, author, chemical name; cross-reference guide and directory of contributors.

"Specialists and non-specialists alike will find the Encyclopaedia an invaluable reference book and indispensable primary resource when responding to critical questions involving health and safety in the workplace." (*Health and Safety*, January 1999)

ISBN 92-2-109203-8 (4 bound volumes, 1999): 550 Swiss francs
ISBN 92-2-109818-4 (CD-ROM, 1999): 550 Swiss francs
ISBN 92-2-110403-6 (Set (printed volumes & CD-ROM)): 1100 Swiss francs

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ISBN 92-2-108756-5 (Workbook) 15 Swiss francs

Building for tomorrow: International experience in construction industry development, by Derek Miles and Richard Neale

This book focuses on the institutional network required to ensure that the construction industry is effective and competitive. In industrialized countries this institutional framework has evolved gradually, but in developing and newly industrializing countries the process has been accelerated, and managers have had to embark on a "journey without maps". The authors provide a handbook of ideas, methods and techniques to assist pioneering institutions to develop the industry. Aimed at policy-makers faced with complaints about inadequate construction performance, and construction professionals and students, its analysis of the working of technical co-operation projects and the interaction between institutions will also be of interest to development specialists.

ISBN 92-2-107284-3 (1991) 30 Swiss francs

Safety, health and welfare on construction sites
A training manual

Known injuries, accidents and work-related illnesses on construction sites frequently exceed those in any other manufacturing industry. It is therefore imperative to improve the safety and health record in construction work.

If you are employed in construction – as a worker or a workers' representative, or as a supervisor – you will naturally be concerned that your work, and that of your colleagues, should be safe and healthy. This clear, easy-to-read manual helps you to consider safety, health and welfare conditions on construction sites in your country and to learn about possible solutions to the problems you encounter. It covers all aspects of work on construction sites:

- Safety organization and management
- Site planning and layout
- Excavations, scaffolding and use of ladders
- Hazardous processes
- Movement of materials
- Working positions, tools and equipment
- The working environment
- Personal protective equipment
- Welfare facilities

The manual will also be useful to employers and managers who are responsible for ensuring safe and healthy working conditions on site, and is particularly suitable for use on training courses. It is intended to complement the ILO code of practice Safety and health in construction.

- Numerous illustrations
- Includes topics for discussion
- Contains a comprehensive checklist on safety, health and welfare on construction sites

Price: 25 Swiss francs

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