



## Annex 2 - Technical Specifications

**“PUBLIC WORKS CONTRACT FOR THE DESIGN AND SUPERVISION OF CREATION OF CONFERENCE ROOM AND REHABILITATION WORKS IN WEST BANK”**

**REFERENCE NUMBER: PZA1303311-10042**

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# 1 General conditions

## 1.1 General

- TS-1 These specifications are to specify the quality of materials, level of workmanship, and methods to be followed and respected in executing and maintaining

## 1.2 Drawings

- TS-2 The contractor shall be provided with a list of drawings included in this bid. All expenses burned by the contractor, to execute the conditions included in this section, on the contractor own cost and his unit rates in the bills of quantity shall be deemed to include all costs and expenses.
- TS-3 In case the contractor asks for additional copies of the project drawings.

## 1.3 Shop drawings

- TS-4 If during executing the work or before, the Managing official found that the contractor needs shop drawings to execute a certain task, the contractor must prepare these drawings and submit them to the Managing official for approval. The Managing official has the right to instruct the contractor at any time to submit shop drawings, which the Managing official consider necessary for executing a certain task. The contractor is to abide by this instruction and don't proceed with the task before the Managing official approves the shop drawings.
- TS-5 The shop drawings must be fully detailed with a suitable scale and unless otherwise specified be submitted in four copies.
- TS-6 The Managing official shall within a reasonable time from receiving the shop drawings approve the drawings. If the Managing official returns the drawings with notes, the contractor shall adjust the drawings as instructed by the Managing official and resubmit to the Managing official for approval and he must point out the adjustment made to the first drawing according to the standard procedure.

## 1.4 Scaffolding

- TS-7 The contractor shall provide, erect and maintain the needed scaffoldings to execute the works of this project. Upon completion the contractor shall remove them. The contractor is to take all the necessary safety measures related to these scaffoldings and repair any damages caused by the scaffoldings to the permanent works during the execution period.

## 1.5 Protection of works

- TS-8 Organisation of the construction site of Tender Specifications document.

## 1.6 Materials and its equivalent

- TS-9 All materials and goods must be according to technical specification. In no instance will environmentally harmful products, such as asbestos, dangerous wood varnishes, etc. be used.
- TS-10 The contractor is to submit the specification and description of the materials that he intends to supply with all necessary information to the Managing official to investigate before supplying. These information include, but are not limited to, trade name, manufacturer address and the contractor is to submit samples if asked by the Managing official.
- TS-11 Wherever a trade name or catalogue number to any material or any item of work in the specification or bills of quantities or drawings, this is necessary to specify the level of specification required. The contractor can suggest alternatives for these materials provided it is with the same level of specification, and to obtain the Managing officials approval.
- TS-12 When an alternative material, other than mentioned in the contract, is approved and it was not in the same level of specification, the Managing official has the right to refuse deduction to the unit rate of these materials. No increase to the contractor prices should be made if better materials were provided (compared to the required specification).
- TS-13 Wherever, in the bills of quantity or specification or drawings, a trade name is mentioned or materials known by its manufacturer company or distributing company or catalogue number, it is to be automatically understood that the required is these materials or equivalent even if the phrase “or equivalent” is not mentioned.

## 1.7 Samples

- TS-14 The contractor must be always ready to submit samples for materials and workmanship according to the Managing official’s instruction. The Managing official shall test and inspect these samples to determine their compliance with the technical specification and contract documents. The contractor shall execute the works according to the accepted samples and following conditions:
1. The cost of all samples shall be on the contractor.
  2. The contractor is to submit samples before a reasonable time of starting the work to give the Managing official time to inspect the samples and make the required tests.
  3. The samples shall be submitted with a letter containing all the needed information to obtain the Managing officials approval.
  4. The samples shall be kept at the Managing officials office in the site.

## 1.8 Materials’ testing

- TS-15 The Managing official has the right to ask the contractor to accompany the required materials with a testing certificate from the source either from the manufacturer or a laboratory approved by the Managing official. See also Implementing documents, Preliminary technical acceptance (and Acceptance of the works performed , of the tender specifications.
- TS-16 The Managing official has the right to test samples from any material supplied to the site, and whenever needed, either in the lab specified by the Managing official inside the country or outside. Any materials that don’t pass the test shall be rejected.



*TS-17* The contractor is to make for the Managing official and his assistants all necessary assistance and services to test the materials brought to site and taking samples and checking measurements and weighs and provides on his own expenses whatever need from labor, tools, materials ...etc.

## **1.9 Temporary offices and warehouses**

*TS-18* The contractor must, from the day of the order to start works, bring or build in the site a movable or temporary office for the use of his staff, the supervision staff and the contracting authority when needed. The office shall be in the size suitable for the contractor's needs and requirements and he must obtain the prior approval of the Managing official on this office.

*TS-19* The warehouses needed for the contractor use sufficient to store all construction materials needed for the project including equipment and tools. These warehouses must have all the conditions required to protect the materials from the environmental conditions.

*TS-20* The contractor shall be responsible to guard and maintain all the above-mentioned temporary constructions that are used by the contractor. He shall also be responsible to provide the required services for these constructions.

*TS-21* The contractor shall bear all the costs of constructing these temporary constructions.

## **1.10 Removing the temporary constructions**

*TS-22* All temporary constructions for the contractor use shall be kept in all times in a good condition until all stages of works are completed and finally handed over. Afterwards, the contractor shall remove all these constructions and its residuals and cleaning its locations properly so that they leave no trace. If the contractor didn't fulfill this obligation, the Managing official has the right to execute these tasks on the contractor's account and deduct all the expenses from the contractor's payment and insurance with the Contracting Authority, whatever sum it reach without any legal procedure.

## **1.11 Temporary and permanent services**

*TS-23* The contractor shall, at his own expense, redirect public services if exist (like electricity, water, ...) which he found during work and according to Managing official's directions and approval. If existing services is connected to or related to or related to the works, the contractor shall maintain and keep in place until handing over the works.

*TS-24* The contractor shall, on his own cost, repair any damages to the public services like telephone, electrical , sewage and water services for the concerned authorities or a third party.

*TS-25* If the concerned authority or the third party decided to repair the damages by itself, or asking any of its representatives to do so, the contractor shall born the cost of these repairs don by the concerned authority or the third party. The Contracting Authority, according to the contract conditions, shall not be responsible for any claims for such actions.

## **1.12 Site meetings**

*TS-26* During executing the works and on a periodical base, site meetings shall be held every 2 weeks or whenever needed for the purposes to coordinate the works and to be sure that it is properly

executed according to contract conditions and technical specification. Minutes of the meetings shall be prepared by the Supervision Team or his representative and distributed to all parties and it shall be followed.

- TS-27 The contractor shall present in the meeting detailed of the works intended to be executed in the next two weeks, which shall be discussed and proper instruction shall be given, and these instructions and approval issued in the meeting shall be followed by the contractor.

### **1.13 Daily reports**

- TS-28 The contractor shall submit to the Managing official (or his representative) a daily report containing the required information on the labor (No.s types & hours), equipment and materials arrived to the site and works executed in that day.

### **1.14 Photographs of progress of works**

- TS-29 The contractor at his own expense shall submit once a month, or as the Managing officials find suitable, suitable number of colored photographs for the executed works or works under progress as directed by the Managing official.

### **1.15 Handing over works and removing residuals**

- TS-30 The contractor must hand over all works clean and insure removing all materials or construction residuals or rejected materials or remains in the site in general or in the buildings or nearby. The completion of the works as explained here shall be on the contractor's expense and according to the Managing official's approval. If the contractor didn't fulfill this obligation, the Managing official has the right to execute these works on the contractor expense and deduct it from the contractor payments or insurance.

### **1.16 Measurement of works**

- TS-31 The Engineering measurement (international measurements) shall be used for all works; all openings and intersection shall be deducted. Actual net distances shall be calculated but not exceeding the measurement reported in the drawings.

### **1.17 Codes and standards**

- TS-32 All building materials and equipment should be registered with an international recognized norm institution or correspond to an international recognized norm. The standards used shall be DIN, ISO, and B.S..Standard or approved equivalent.

- 2 Excavation and earthworks (Not Included in Scope of Works)**
- 3 Concrete work (Not Included in Scope of Works)**
- 4 Natural stone works (Not Included in Scope of Works)**
- 5 Block work (Not Included in Scope of Works)**
- 6 Roofing (Not Included in Scope of Works)**
- 7 Plaster work (Not Included in Scope of Works)**

## 8 Wall and floor tiling works

### 8.1 General

#### 8.1.1 Section includes

- TS-33 Ceramic and Terrazzo tile floor finish using the mortar bed application method. Approved Gravel bed under mortar for terrazzo tile, and for cement tiles.
- TS-34 Local marble tile stair treads using the mortar bed application method.
- TS-35 Interlock floor tile using the sand bed application.
- TS-36 Cements tiles.

#### 8.1.2 References

- ANSI
- TCA
- ASTM
- BSra

### 8.2 Materials

- TS-37 Portland cement, fine aggregate and water shall be as previously specified in concrete work section.
- TS-38 The marble chipping shall be of an approved quality in irregular pieces varying from 2 mm to 10 mm in size depending on the effect required. The pieces should preferably be roughly cubical in shape where flaky shaped pieces shall not be used.
- TS-39 The granite chipping shall be of an approved quality graded from 12 mm down with not more than 5 percent fine material passing a No.100 sieve.
- TS-40 Marble and granite aggregates shall comply generally with the table of grading. In connection with marble aggregates the percentages are approximate only. The actual grading should be selected to produce the surface effects required.

**Table 1. Table of Grading**

Bs 410 sieve no.	Approximate size . Mm	Percentage of aggregate passing through sieve	
		Granite	Marble
-	13	100	-
-	10	95-100	95-100
-	5	30-60	25-60
7	2.4	20-50	5-30
14	1.2	15-40	0-10
25	0.6	10-30	-

Bs 410 sieve no.	Approximate size Mm	Percentage of aggregate passing through sieve	
		Granite	Marble
59	0.3	5-15	-
100	0.15	0-5	-

TS-41 Note: the above figures represent the limits of percentages (by weight) passing sieves of the sizes mentioned.

### 8.3 Terrazzo tiles

TS-42 Terrazzo tiles shall be formed with a (1:2 1/2) mix of white or colored cement or white cement with a color pigment added and granular marble chippings applied as a facing not less than 5 mm thick to a Portland cement and sand (1:5) mix backing.

TS-43 The tiles shall be cast in heavy metal moulds under pressure to the proportions and sizes shown in the following table.

**Table 2. Terrazzo Tile Dimensions**

Size mm	Size tolerances mm	Minimum total thickness mm
200x200	0.5	20
250x250	0.5	25
300x300	1.0	25
400x400	1.0	30

TS-44 Tiles shall be cured as for cement and sand tiles and then ground, filled and polished before distribution to site.

TS-45 Grinding shall be done wet by means of a No. 80 carborundum stone. Filling shall be carried out with a neat cement grout of the same color as the facing mix and this shall be worked into the surface with a wooden shaper to fill all voids and air holes.

TS-46 Surplus grout shall be removed with a dry cloth. After a minimum period of 24 hours polishing shall be carried out wet by means of a No. 140 carborundum stone.

TS-47 Terrazzo skirting 100mm high with chamfered top edges shall be produced in the same way as for tiles using the same mixes.

TS-48 Terrazzo tiles shall be laid and bedded direct onto a proved gravel layer with a cement and sand (1:4) mix mortar. This mortar shall be 25mm thick in the case of 25mm tiles and 30mm thick in the case of 20mm tiles. The total thickness of the cement and sand screed and tiles shall not exceed 50 mm.

TS-49 All tiling shall be grouted up on completion; care being taken to fill all joints completely. The grout shall consist of neat cement of a color to match the tiling. Any surplus grout shall be cleaned off the face of the tiling and surrounding surfaces immediately and all tiling shall be carefully cleaned off.

TS-50 All terrazzo surfaces shall be polished on completion. Large areas such as floors shall be wet polished by means of approved machines using No. 140 carborundum wheel..Any surface too small for convenient machine polishing may be polished by hand using a No.140 carborundum

stone and water. Care must be taken during any polishing operation not to damage any of angles or arrises.

- TS-51* Terrazzo covering to items such as sills, treads and risers to steps, skirtings, etc., shall generally be applied in accordance with the foregoing specification except that the thickness of the facing shall be at least 10 mm (marble can be used if approved by the Managing official).

#### **8.4 Marble paving**

- TS-52* Marble pavings shall generally be 30 mm thick and the size, type and pattern shall be as stated in the Particular Specification and/or shown on the Drawings. The marble slabs shall be fixed solid on a bed of cement and sand (1:4) mix 30 mm thick with tight joints grouted in lime putty. A Protective slurry of lime putty at least 3 mm thick shall be applied to the marble pavings and subsequently cleaned off.
- TS-53* Treads shall be 30mm thick fixed solid on a bed of cement and sand (1:4) mix 30mm thick. Risers to stairs shall be 20mm thick fixed solid on a backing of cement and sand (1:4) mix 30 mm thick. Window sills shall be 40mm thick bedded hollow on plaster slabs. Skirtings shall be 10mm thick, in lengths of about 1.5 meters, fixed solid on a backing of cement and to coincide with joints in adjacent pavings. Rounded arrises, nosing and moldings shall be adequately protected by means of timber casings. Treads, risers, skirtings and window sills shall be grouted and protected in a manner similar to pavings.
- TS-54* The exposed faces and edges of all marble shall be polished smooth and be free from scratches or other defects. Concealed faces of marble shall be treated with shellac or bituminous paint.

#### **8.5 Marble lining**

- TS-55* Marble lining to walls, columns and the like shall generally be 20 mm thick and the size, type and pattern shall be as stated in the Particular Specifications and/or as shown on the drawings.
- TS-56* The marble slabs shall be cut square and true and shall be uniform in shape and thickness. Patterns and mouldings shall be accurately formed in accordance with the Drawings.
- TS-57* Exposed edges and mouldings shall be protected by means of timber casing or lime putty coating. The exposed edges and faces of all marble shall be polished smooth and shall be free from scratches or other defects.

#### **8.6 Ceramic, glazed and quarry tiling**

- TS-58* Clay floor quarries and fittings shall be in accordance with BS 1286 type A and the thickness and size shall be as stated in the Particular Specification or on the Drawings.
- TS-59* Ceramic floor tiles and fittings shall be in accordance with BS 1286 type B, vitrified or fully vitrified and the thickness and size shall be as stated in the Particular Specification or on the Drawings.
- TS-60* Glazed ceramic floor tiling shall be of the type, thickness and size as stated in the Particular Specification or on the Drawings.
- TS-61* The tiles shall be true to shape, flat and free from flaws, cracks and crazing and keyed on the reverse side and shall be of a manufacture approved by the Managing official.

- TS-62 Bedding mortar shall be cement and sand all in accordance with the materials stated in Concrete Work and Blockwork sections.
- TS-63 Any admixtures to the mortar must be approved before use.
- TS-64 Grout pointing shall be white or colored cement.
- TS-65 Cement and sand mortar bed of not more than 20 mm or thickness of the tile shall be laid.
- TS-66 Tiles shall be firmly tamped into mortar to form a level surface.
- TS-67 The Contractor shall ensure that when fixing tiles with thin bed adhesive, the base to receive tiles is clean level and dry, with no loose and friable areas and surface dusting.
- TS-68 Cement-based adhesive shall be prepared and used in accordance with the manufacturer's recommendations to form a bed not more than 3 mm thick.
- TS-69 Tiles shall be laid dry and tamped well down into the adhesive to ensure a proper bond with base and a level surface.
- TS-70 When bedding tiles on thick bed, semi-dry cement and sand (1:4) mortar bed shall be spread not less than 25 mm thick.
- TS-71 Before the compacted bed has set a cement and sand slurry (1:1) about 3mm thick shall be spread over the surface.
- TS-72 The tiles shall be laid dry and tamped into the slurry to form a level surface.
- TS-73 Joints shall be even and not more than 3mm wide, in both directions.
- TS-74 Joints shall be continuous both horizontally and vertically.
- TS-75 The tiles shall be grouted up with grey or colored cement mortar (1:1) worked well into joints when bed is sufficiently firm to prevent disturbances of the tiles; surplus grout shall be cleaned off from faces of tiles.
- TS-76 Movement joints shall be provided not less than 6 mm wide where shown on the Drawings or as directed by the Managing official.
- TS-77 Movement joints shall be carried through the depth of tile and bedding and partially filled with filling strip and finished flush with sealant to manufacturer's recommendations. Joints have to be made out of silicone.
- TS-78 Where tiling abuts against wood or metal frames or other tiling at angles and around pipes etc., it shall be carefully cut and fitted to form a close neat joint. Open irregular joints filled with cement and sand or plaster will not be permitted.
- TS-79 Tiles shall be cleaned off and polished at completion.
- TS-80 Water shall not be allowed on new tiling until bedding and grouting have completely set.
- TS-81 No traffic shall be allowed on the floor until 4 days after completion and then only light traffic for a further 10 days.

## **8.7 Glazed ceramic wall tiling**

- TS-82 Glazed ceramic wall tiles shall be in accordance with BS 1281 with or without cushioned edges and spacer lugs and shall be grey or colored as stated in the Particular Specification.

- TS-83* Glazed ceramic tile fittings shall be rounded edge or angle bead type to match plain tiles.
- TS-84* The tiles shall be true to shape, flat and free from flaws, cracks and crazing and keyed on the reverse side and shall be of a manufacture approved by the Managing official.
- TS-85* Bedding mortar shall be cement and sand (1:3) all in accordance with the materials stated in Concrete Work and Blockwork sections
- TS-86* Any admixtures to the mortar must be approved before use.
- TS-87* Mastic adhesives shall be of an approved manufacture and shall comply with the performance requirements of CP 212: Part 1, if approved by the Managing official.
- TS-88* Grout pointing shall be neat grey or colored cement.
- TS-89* The Contractor shall ensure that the cement render backing is at least 14 days old, firmly bonded to its background, free from dust, with surfaces plumb and true to 3mm in any 1800 mm.

## **8.8 Fixing tiles with cement and sand mortar**

- TS-90* The tiles shall be immersed in water for 6 hours or until saturated then stacked tightly together to drain with end tiles turned glaze outwards. Tiles shall be fixed as soon as surface water has drained.
- TS-91* The render coat shall be wetted sufficiently to prevent it absorbing water from the bedding coat.
- TS-92* Mortar bedding shall be applied to render background to an even thickness of approximately 10mm.
- TS-93* Each tile shall be buttered evenly with mortar and tapped firmly into position so that the bed is solid throughout.
- TS-94* Thickness of finished bed shall be not less than 6mm nor more than 12 mm.
- TS-95* Any necessary adjustment to tiles shall be made within ten minutes of fixing and tiles cleaned off after not less than two hours.

## **8.9 Fixing tiles with adhesive**

- TS-96* The tiles shall be fixed in accordance with the recommendations of the adhesive manufacturer.
- TS-97* Adhesive shall be applied not more than 1sq.m at a time to avoid premature drying out.
- TS-98* Adhesive shall be applied as a continuous screed to a thickness of approximately 3mm on the surface to be tiled.
- TS-99* Dry tiles shall be pressed on to the adhesive and tapped firmly into position to ensure solid bedding without voids.
- TS-100* Any necessary adjustment to tiles shall be made immediately after bedding.
- TS-101* Tiles shall be cleaned off as soon as bedding is complete.
- TS-102* Joints shall be even and not more than 2mm wide using spacer lug tiles or spacer pegs.
- TS-103* Joints shall be continuous both horizontally and vertically.
- TS-104* Tiles shall be fixed to a finished surface that is plumb and true to 2 mm in any 2m.



- TS-105* Joints shall be grouted up not less than 24 hours after fixing tiles to porous surfaces and not less than 3 days after fixing to impervious surfaces.
- TS-106* Tiles shall be grouted by pressing mix firmly into joints, working in areas of not more than 1sq.m.
- TS-107* Surplus grout shall be cleaned off as the work proceeds.
- TS-108* Where tiling abuts against wood or metal frames or other tiling at angles and around pipes etc., it shall be carefully cut and fitted to form a close neat joint.. Open irregular joints filled with cement and sand or plaster will not be permitted.
- TS-109* Tiles shall be cleaned off and polished on completion.
- TS-110* External tiling shall be protected from inclement weather until grouting is completely set.
- TS-111* No water is to be allowed on new tiling until bedding and grouting have completely set.

## **8.10 Protection**

- TS-112* All floor, wall and ceiling finishes shall be protected from damage during subsequent work, and shall be thoroughly cleaned before handing over the works.

## 9 Carpentry and joinery (Not Included in Scope of Works)

## 10 Ironmongery

### 10.1 Description

- TS-113* The Contractor shall provide and fix the ironmongery required by the Particular Specifications or shown on the Drawings complete, including all necessary screws, bolts, plugs and other fixings. The use of nails for fixing ironmongery shall not be permitted. The Contractor shall hand over all in a finished state and to the satisfaction of the Managing official.
- TS-114* Any fitting have to be heavy duty.
- TS-115* All ironmongery shall be of first quality and shall be obtained from an approved manufacturer. Butt hinges are to be aluminum alloy with silver anodised finish with double stainless steel washers, or as approved by the Managing official.
- TS-116* The Contractor shall be required to submit for approval samples of all items of ironmongery he proposes to use.
- TS-117* All doors shall be provided with an approved door stop plugged and screwed to the top wall mounted all opening areas of aluminum work shall be provided with appropriate friction stays. The size, materials, finishes, type and quality of ironmongery shall be as described and shown on the Drawings.

### 10.2 Quality assurances

- TS-118* Field Measurements: take field measurements prior to Preparation of shop drawings and fabrication, where Possible. Do not delay job progress; allow for timing and fitting where taking field measurements before fabrication might delay work.
- TS-119* Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassemble and coordinated installation.

### 10.3 References

- TS-120* Applicable Publications: The following publications of the issues listed below, but referred to thereafter by basic designation only form a part of this Section.
1. Federal Specifications. Naval Publications and Forms Center. 5801 Tabor Avenue, Philadelphia. Pennsylvania 19120. USA, FF-W-92B Washers, Flat (Plain).and RR-G-66'1 E Grating, Metal, Bar Type (Floor, Except for Naval Vessels).
  2. American National Standards Institute (ANSI). 1430 Broadway. New York. New York 10018. USA.A 14.3-1984 Fixed Ladders, Safety Requirements.
  3. American Society for Testing and Materials Standards 1916 Race street Philadelphia, Pennsylvania 19103. U.S.A
    - A 27 -83 Specifications for Steel Castings, Carbon, for General Application.
    - A 53-82 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc- Coated Welded and Seamless

- A 123-78 Specification of Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
  - A 153-82 Specification of Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - A 307 -83a Specification for Carbon Steel Externally Threaded Standard Fasteners.
  - A569-72(79)...Specification of Steel, Carbon (0.15 Maximum, Percent), Hot Rolled Sheet and Strip, Commercial Quality.
  - F593-82 Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
4. American Welding AWS. 2501 N.W. 7th Street. Miami. Florida 33125. USA, D1.1-85. Structural Welding Code -Steel.
  5. Military Specifications. Naval publications and forms center 5801 Tabor Avenue Philadelphia. Pennsylvania 19120 USA. MIL-P-21035A Paint, High Zinc Content, Galvanizing Repair (Metric).
  6. National Association of Architectural Metal Manufacturers. (NAAMM) 221 N. La Salle, Chicago. Illinois 60601, U.S.A Metal Bar Grating Manual -October 1979
  7. Steel Structures Painting Council. (SSPC), 440 Fifth Avenue. Pittsburgh, Pennsylvania 15213, USA
    - PA1 Shop, Field & Maintenance Painting, November 1, 1982.
    - Paint 20 Zinc-Rich Primers (Type 1-inorganic and Type 11- organic), November 1, 1982.
    - SP3 Power Tool Cleaning, November 1, 1982.

## 10.4 Submittals

- TS-121* Submit items in accordance with the contract provision Product Data: Submit Manufacturer's specifications, anchor Details and installation instructions for products used in Miscellaneous metal fabrications, including paint products.
- TS-122* Shop drawings: Submit shop drawings for fabrication and Erection of miscellaneous metal fabrications. Include plan, Elevations and details of sections and connections Show anchorage and accessory items. Provide templates for anchor and bolt installation in critical area. Where materials or fabrications are indicated to comply with certain requirement for design loading, include structural computations, material properties and other information needed for structural analysis.

## 10.5 Finish

- TS-123* The finish of the various items of ironmongery shall be as described as shown on the Drawings or as required and directed by the Managing official.

## 10.6 Fitting and testing

- TS-124* All screws used for fixing ironmongery shall be of a suitable type, material, finish, size and shape to the satisfaction of the Managing official.

- TS-125* The hinges on which doors, windows, flyscreen doors etc., are hung shall be carefully housed or let into the door, window, flyscreen door etc., and to the frames.
- TS-126* All fittings shall be removed before commencing any painting operations and shall be refixed in place after all painting works are completed and approved by the Managing official.
- TS-127* All ironmongery shall be carefully wrapped and protected until completion of the work and any items or parts which are damaged or defaced or found to be defective shall be replaced at the Contractor's expense before handing over.
- TS-128* On completion of all locks, catches and similar items of ironmongery they shall be clearly labeled, with metal tags approximately 50x20mm and securely fixed to the keys and handed to the Managing official.
- TS-129* Door closers shall be fitted a maximum of two weeks before handover.
- TS-130* All floor and door springs are to be fully charged with oil and their operation checked to the satisfaction of the Managing official.

### **10.7 Standard ironmongery for internal doors**

- TS-131* Ironmongery is to be hard satin anodised aluminum alloy of best quality with matching screws fully matching and integrated. Where a supplier cannot offer the particular required ironmongery the Contractor shall produce samples. All locks are to be provided with 2 keys on a key ring neatly labelled to indicate clearly the corresponding lock.
- TS-132* Any requirements for ' Master key ' locking systems will be stated in the contract provision and Drawings.
- TS-133* All knob sets shall include the appropriate mortice latch or lock with a 70 mm backset and with standard faceplates and roses unless otherwise noted.

### **10.8 Standard ironmongery for Trespa® doors and partitions**

- TS-134* All fittings of trespa doors shall be made exclusively out of stainless steel. Plastic fittings are not accepted.

## 11 Metal works

### 11.1 Cleanliness

- TS-135* All materials shall be free from scale, damage or defects. All welding, brazing or hot forging shall be carried out by approved processes.
- TS-136* Work includes fixing complete to the structure heavy duty dowels and three points to be fixed from each side, architrave, door stopper, ironmongery, cylindrical locks handles (Wally or equal), 6 mm Glazing, gaskets, automatic closing piston, accessories, Hammer Finish painting in three coats in addition to two primer coats as per detailed drawings and Supervision Consultants or the Managing official's instructions.
- TS-137* Metal work shall be approved by the Managing official before starting painting works.

### 11.2 Aluminum windows and doors

- TS-138* Extruded aluminium sections should be used as approved by the Managing official.
- TS-139* All visible surfaces of the sections shall be brilliantly polished prior to anodising. The color of anodising shall be as described in the Drawings and /or 8. Samples of color shall be submitted for the Managing official's approval before work commences.
- TS-140* The sections shall be anodised to a minimum thickness of 25 microns. The supplier must submit necessary evidence to the satisfaction of the Managing official that the thickness of anodisation is not less than 25 microns. In case of doubt the Managing official reserves the right to send sample pieces to independent testing laboratories, at the supplier's expense. If the testing laboratory report states that the thickness or quality of the anodisation is deficient, the Employer may ask the supplier to treat the order as cancelled and the supplier in such a case shall indemnify the Employer of any / all losses incurred by the supplier.
- TS-141* All frames shall be made to fit the actual openings with a 5mm clearance all round. Discrepancies in overall width or height exceeding 5mm will not be allowed and the frames will be rejected in such cases. All small discrepancies shall have the gaps suitably backed and then filled with gun-applied mastic / sealant UV resistance as approved by the Managing official.
- TS-142* At all opening windows and doors and where there are louvered screens and approval of the Managing official, constructed following the principles and specifications as described elsewhere in this Specification.
- TS-143* Insect screens shall be in aluminum mesh, 18x16 meshes per inch..The gap between the insect screen and the shutter shall be covered with an adaptor PVC section.
- TS-144* For reference to window types see general arrangement drawings and elevations.
- TS-145* Tolerances are to be approved by the Managing official before manufacture.
- TS-146* All ironmongery which is to have the same finish as the frames it is to be installed on shall be approved by the Managing official.
- TS-147* The Contractor shall provide shop drawings for aluminium windows and doors which shall be submitted in quadruplicate to the Managing official for approval.

- TS-148* Approval by the Managing official of the shop drawings shall not relieve the Contractor of his responsibilities under the Contract.
- TS-149* All assembly screws shall be in 18-8 stainless steel.
- TS-150* Glazing sections shall be in special heat-resisting PVC and of channel type. Separate glazing sections on each side of the glass will not be permitted.

### **11.3 Sliding windows and doors**

- TS-151* Weatherstripping - highdensity acrilan or wool weather - pile shall be used. There shall be double brushes at every contact between shutter and frame sections for complete insulation. These shall be present consistently throughout the unit between the inside and the outside and no portions without it are permitted.
- TS-152* The rollers for sliding shutters for windows and doors shall be of an adjustable type. The adjusting screws shall be accessible in the assembled state of the shutters and a vertical adjustment of 7mm shall be possible.
- TS-153* All sections for sliding windows and doors shall be of tubular shape and the cross sectional dimensions of same shall be not less than 60x 40 mm.
- TS-154* The outer frame must be suitable for accommodating sliding flyscreens as required or as directed by the Managing official.
- TS-155* The handle-latch set shall have all visible surfaces of anodised aluminum or similar non-rusting material to approval. The handle shall have a proper grip. A small projecting flange or a recess in the shutter sections shall not be accepted to serve as a handle. The latching mechanism shall not be surface mounted but shall be concealed within the sections.

### **11.4 Side hung windows, doors and ventilators**

- TS-156* All windows and doors shall be weather-stripped with heat resistant PVC sections. The weather fighting action shall be achieved by a positive compressive action against the PVC section and shall not depend on an external contact with the PVC section. At every contact between two profiles two weatherstripping sections shall be provided for complete weather protection.
- TS-157* The bottom sections of hinged doors shall be capable of being adjusted vertically if necessary. The gap between the bottom section and the floor shall be covered with a pair of special flay-type PVC sections.
- TS-158* The shutter sections for windows and doors shall be of tubular type and shall be of overall size 57x45mm for windows and overall size 81x45mm for doors (including flanges).
- TS-159* The shutters of the windows and doors shall be assembled with concealed corners of high rigidity. Hinges shall be concealed within the sections.
- TS-160* Hinges shall be in anodized aluminum with stainless steel pins and nylon washers. Handles shall be in anodized aluminum and mounted with self - lubricating nylon washers.
- TS-161* A mortice cylinder rim automatic deadlock of high quality with double pin tumbler shall be used.
- TS-162* Windows shall have anodized aluminum handles and a latching mechanism securing the shutter to the frame both at the top and bottom.

*TS-163* The glazing vinyl shall be in heat resisting PVC and of channel type to the approval of the Managing official.

### **11.5 Mosquito screens**

*TS-164* Flyscreens shall be fitted to all opening leaves of windows, consisting of a separate metal sub-farme filled in with fly wire as previously described. The flyscreens shall be adequately secured with suitable clips, set screws or turn buckles and shall be removable for maintenance purposes. sections to the metal casement doors and shall be fitted with removable panels of flywire, in a manner similar to that described for window flyscreens. Flyscreen doors shall be mounted where indicated on the Drawings or as directed by the Managing official. with better system for fixing and moving fly screens.

### **11.6 Sealing joints**

*TS-165* The Contractor shall ensure that joints are dry and shall remove all loose material, dust and grease.

*TS-166* Joints shall be prepared in accordance with sealant manufacturer's recommendations using recommended solvents and primers where necessary as approved by the Managing official.

*TS-167* Backing strips shall be inserted in all joints to be pointed with sealant.

*TS-168* When using backing strips, the Contractor shall not leave gaps and shall not reduce depth of joint for sealant to less than the minimum recommended by the manufacturer.

*TS-169* Cavities shall be filled with sealant /mastic joint has to be uv- resistance in accordance with the manufacturer's recommendations.

*TS-170* Joints between frames and walls have to be closed with pre –compressed polyuthean foam sealant Sealant shall be tooled to form a smooth flat bed.

*TS-171* Excess sealant shall be removed from adjoining surfaces using cleaning materials recommended by the sealant manufacturer, and shall be left clean.

### **11.7 Expansion joint trims, etc.**

*TS-172* The Contractor is to provide at all expansion joints in floors , roofs, ceilings , walls and columns extruded aluminum expansion joint cover systems as appropriate and as shown on the Drawings and fixed in accordance with their printed instructions including all necessary components and fixings.

### **11.8 Steel pipe railings and handrails.**

*TS-173* Fabricate Steel pipe railings and handrail to design, dimensions, and details indicated. Furnish railings and handrail members formed of the sized indicated conforming to ASTM A53, standard weight, galvanized.

*TS-174* Fabrication jointing of post, rail, and corners shall be by one of the following methods:



1. Flush-type rail fittings of commercial standard welded and ground smooth with railing splice locks secured with 10 mm hexagonal-recessed-head set screws.
2. Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight-fitting interior sleeve not less than 152 mm (6 inches) long.
3. Railings may be bent at corners in lieu of jointing, provide bends are made in suitable jigs and that the pipe is not crushed.
4. Furnish wall returns at ends of wall-mounted handrails.
5. Close exposed ends of pipe by welding 5mm (3/16-inch) thick steel plate in place or by use of prefabricated fittings.
6. Furnish removable railing where indicated.
7. Handrails shall be capable of withstanding a concentrated load of 91 Kg. (200 pounds) applied at any point in any direction.
8. Pipe 50mm dia. meter steel pipe welded joints.
9. Posts 25mm diameter steel pipe; welded joints.
10. Fitting Flanges fixed by screws.
11. Mounting Adjustable flanges, with screws casting in concrete.
12. Exposed Fasteners flush countersunk screws or bolts; consistent with design of railing.
13. Splice Connectors Steel welding collars.
14. Galvanized or stainless screws to be used

*TS-175* Floor joint covers shall be 5cm deep. Butt joints within continuing runs shall be a maximum of 6.00m apart and will be sealed during installation.

*TS-176* Wall and ceiling joint covers shall be standard grey.

*TS-177* Transition pieced at changes of direction and at joints between horizontal and vertical joint covers shall be factory fabricated.

## 12 Painting and decorating

### 12.1 General

- TS-178* Every possible precaution shall be taken to keep down dust before and during painting processes. No paint shall be applied to surfaces structurally or superficially damp and all surfaces must be ascertained to be free from condensation, efflorescence etc. before the application of each coat.
- TS-179* Primed or undercoated woodwork and metalwork should not be left in an exposed or unsuitable situation for an undue period before completing the painting process. No exterior or exposed painting shall be carried out under adverse weather conditions, such as rain, extreme humidity, dust storms etc.
- TS-180* Any external paints have to be UV-Resistant.
- TS-181* Metal fittings such as ironmongery etc. not required to be painted shall first be fitted and then removed before the preparatory processes are commenced. When all painting is completed the fittings shall be cleaned and refixed in position.
- TS-182* The contractor will be required to repaint at his own expense any work on which the paint is found to be incorrectly applied. The contractor shall be responsible for protecting from damage the paint work and all other work during and after painting operations including the provision of all necessary dust sheets, covers etc.
- TS-183* Brushes, pails, bottles etc., used in carrying out the work shall be clean and free from foreign matter. They shall be thoroughly cleaned before being used for different types or classes of material.
- TS-184* The number of coats stated in this specification is the minimum, and the Contractor must apply sufficient coats to achieve a proper even finish to the approval of the Managing official.

### 12.2 Materials

- TS-185* The decorating materials shall be obtained from approved manufacturers and shall be supplied in the manufacturers' sealed and branded containers.
- TS-186* All materials must be thoroughly stirred before use, unless not recommended by the manufacturer.
- TS-187* All paints shall be environmentally friendly and for the use in internal rooms.
- TS-188* Details of mixing and application shall be in accordance with the specifications of the manufacturers concerned and to the approval of the Managing official.
- TS-189* The mixing of paints etc. of different brands before or during application will not be permitted. No dilution of painting materials shall be allowed except strictly as detailed by the manufacturers and as approved by the Managing official.
- TS-190* Mordant solution shall be of approved manufacture.
- TS-191* Rust inhibitors shall be of approved manufacture.

- TS-192* Stopping for woodwork to receive clear finish shall be tinted to match surrounding woodwork, to the approval of the Managing official.
- TS-193* Stopping for internal woodwork, plywood, hardboard, and fiberboard, shall be linseed oil putty, tinted to match the color of the undercoat.
- TS-194* Stopping for external woodwork shall be white lead paste and gold size well mixed.
- TS-195* Thinners shall be approved turpentine or white spirit.
- TS-196* Priming paints shall be:
1. For woodwork: Leadless grey priming paint in accordance with the recommendations of the decorative coating manufacturer.
  2. For steelwork: red oxide priming paint.
  3. For galvanized, zinc or aluminum alloy surfaces: grey zinc chromate priming paint.
  4. For plaster, concrete and brickwork, ceiling boards etc.: alkali resisting priming paint in accordance with the recommendations of the decorative coating manufacturer.
- TS-197* Knotting shall be in accordance with BS 1336.
- TS-198* Undercoating shall be:
1. Zinc oxide based undercoating paint;
  2. White lead based undercoating paint. Colors shall approximate to the finishing paint.
  3. Synthetic alkyd based undercoating in accordance with the recommendations of the decorative coating manufacturer.
- TS-199* Finishing paints shall be:
1. Zinc oxide based oil paint;
  2. White lead based oil gloss finishing paint.
  3. Synthetic alkyd-based finishing paint as approved by the Managing official.
- TS-200* Petrifying liquid shall be used undiluted as supplied by the manufacturer. a small quantity of water paint of the finishing color may be mixed with the petrifying liquid.
- TS-201* Water paint shall be an approved brand of washable oil-bound water paint. Thinning shall be done with petrifying liquid or fresh water only.
- TS-202* Emulsion paint shall be of the Polyvinyl Acetate (PVA) type obtained from an approved manufacturer. The precise specification shall comply with the manufacturer's normal practice. In all cases thinning shall be done with thinners supplied by the manufacturer or fresh water only.
- TS-203* Stain for woodwork shall be an approved brand of oil stain.
- TS-204* Polyurethane lacquer for woodwork shall be in accordance with the recommendation of the manufacturer.

## 12.3 Preparation process

### 12.3.1 Internal plaster, fair faced concrete and blockwork

- TS-205* Surfaces shall be allowed to dry out completely and cracks shall be cut out and made good with suitable hard plaster or cement and sand mix as appropriate, such repaired portions shall be allowed to dry out. No painting shall be carried out on plastering less than five weeks old.
- TS-206* Efflorescence shall be completely removed by rubbing down with dry coarse cloths followed by wiping down with damp cloths and allowed to dry. All surfaces shall be rubbed down with fine glass paper and brushed free of dust before applying any form of decoration.
- TS-207* Surfaces which are to receive water paint shall be treated with one coat of petrifying liquid applied by brush and allowed to dry for at least 24 hours before the application of water paint. A period of 24 hours or longer if necessary, shall be allowed between subsequent coats.
- TS-208* Fair faced concrete and/or cement and sand plastered surfaces which are to receive oil paint shall be given one thin coat of oil putty and allowed to dry for at least two days .
- TS-209* The surfaces shall then be rubbed down with fine glass paper and given a second thin coat of oil putty and when completely set The surfaces shall then be rubbed down with fine glass paper and given a second thin coat of oil putty and when completely set
- TS-210* All surfaces which are to receive oil paint shall be treated with one coat of alkali resisting priming paint applied by brush and allowed to completely harden.

### 12.3.2 Fiber acoustic boards etc.

- TS-211* Execution only by instructions and approval of the Managing official in accordance with the recommendations of the manufacturer.
- TS-212* SOFT BOARDS: where used externally or under humid conditions will receive one coat of priming paint and one coat of undercoat on back face and edges.
- TS-213* SOFT BOARDS: where used internally will receive one coat of priming paint and one coat of emulsion paint on back, face and edges.
- TS-214* HARD BOARD: composite panels will be treated in the same way as soft boards under humid conditions.
- TS-215* ACOUSTIC BOARDS: will be treated on the face in the same way as plaster, but the paint may be applied by spray; the backs and edges should not be treated.

### 12.3.3 Steelwork including windows, louvers etc. Internally and externally

- TS-216* Execution only by instructions and approval of the Managing official in accordance with the recommendations of the manufacturer.
- TS-217* If delivered galvanized, the surfaces shall be cleaned to remove grease and dirt before priming. Where rusting has occurred through damage to the galvanizing, such rust shall be removed by wire brushing back to clean metal and the galvanizing made good with a rust inhibiting agent.
- TS-218* The surface shall then be treated with one coat of mordant solution and one coat of zinc chromate priming paint.

- TS-219* If delivered primed, the surfaces shall be examined to ascertain that the priming paint is hard, firmly adhering and in good condition. If not satisfactory, the priming paint shall be removed and the surfaces cleaned to remove rust, and reprimed. If the condition of the priming paint is satisfactory, the surfaces shall be cleaned to remove grease and dirt, minor damage to the priming paint being made good with red oxide priming paint after removal of rust.
- TS-220* If delivered unprimed and not galvanized, the surfaces shall be cleaned to remove grease and dirt, and wire brushed and scraped to remove all rust and scale before applying a red oxide priming paint.
- TS-221* Priming paint shall be brushed well into the surface and shall be allowed to dry and harden thoroughly before the application of subsequent coats.
- TS-222* Items of steelwork such as frames to roller shutters, covers to expansion joints etc., which are to be built into walls, shall first be primed.

#### **12.3.4 Exposed service pipes**

- TS-223* Copper and brass pipework shall have the surfaces slightly abraded with glass paper and white spirit or similar solvent and wiped clean. No priming paint will be necessary, the surfaces being finished in two coats of gloss paint.
- TS-224* Steel pipes will be treated as for steelwork with the exception that galvanized pipes are to be treated with a zinc-chromate priming paint.
- TS-225* Coated soil pipes shall be wiped clean and treated with two coats of knotting followed by priming paint as described below.

#### **12.3.5 Woodwork required to be painted**

- TS-226* Surfaces shall be cleaned to remove grease and dirt. The surface of teak shall be cleaned with white spirit to remove free oil. Tropical timber should be avoided The preparation process shall then be:
- KNOT: all knots shall be treated with shellac knotting
  - PRIME: one coat of primer shall be thoroughly applied by brush to all surfaces and when dry a further coat to be applied to end-grain surfaces.
  - STOP : when priming paint is hard , all cracks , holes , open joints etc. shall be made good with hard stopping and all open grain surfaces filled smooth with linseed oil putty or an approved filler and rubbed down with fine glass paper .
- TS-227* No joinery shall be primed until it has been approved by the Managing official Priming shall be carried out on the site and not in the factory.
- TS-228* Items of carpentry work which are to be built into walls etc. shall be first treated by twice coating with creosote or other approved preservative. And shall be environmentally friendly and for the use in internal rooms.

#### **12.3.6 Woodwork required to be not stained**

- TS-229* Surfaces shall be cleaned to remove grease and dirt. The wood shall then be stopped, filled and rubbed down. In the case of teak free oil shall be removed by cleaning with white spirit.

## 12.4 Finishing processes

### 12.4.1 Internal plaster

- TS-230* Where emulsion paint is specified three coats shall be applied by brush or sprayed in addition to any priming paint.
- TS-231* Where water paint is specified two coats shall be applied by brush or sprayed, in addition to the Petrifying liquid. The water paint shall be thinned to the consistency of thick cream.
- TS-232* Where oil paint is specified this shall be two or three coat work as detailed in the particular Specification, applied by roller or brush , but not by spray , to produce hard gloss , oil gloss , eggshell or flat finish As required .
- TS-233* The finishing coat of paint to walls and ceilings shall be applied after the completion and testing of the electrical installation. Any paint splashes on electrical fittings shall be carefully cleaned off.

### 12.4.2 Fiber Boards etc.

- TS-234* Both acoustic and plain soft or hard boards will be treated as for plaster, but the paint has to be applied by spray.
- TS-235* Water paint or emulsion paint shall be applied by brush to the specification of the manufacturers. Where a board is likely to be exposed to extreme humidity, i.e kitchen and external corridors and covered ways, an oil paint shall be used on the face after fixing.

### 12.4.3 Unplastered blockwork or concrete

- TS-236* As for internal plastered surfaces.
- TS-237* Externally a cement type paint may be used, and shall be applied keeping a constantly wet edge, in strict accordance with the manufacturer's instructions.

### 12.4.4 Steelwork and Exposed Service Pipes

- TS-238* Internally, apply one coat of hammer finished paint over two undercoats.
- TS-239* Non-ferrous pipes shall be finished in two coats of gloss paint.
- TS-240* Externally, apply two coats gloss paint over one undercoat.
- TS-241* Paints has to be avoided high maintenance and to apply the paint according to manufacturer recommendation.

## 12.5 Woodwork required to be stained and polyurethaned

- TS-242* The woodwork, internally and externally, shall be stained as directed on site, rubbed down, brushed off, and treated with two coats of polyurethane.

## 12.6 Protection of factory finished work

TS-243 The contractor is to allow for protecting all factory finished doors, frames windows, suspended ceilings and the like at all times to ensure that factory finishes are not damaged and must make good or replace a defective component at his own expense.

## 13 Glazing

### 13.1 Sheet glass

TS-244 Sheet glass shall be flat-drawn clear sheet glass, of the substances shown below.

Nominal Substance or thickness	Limits of thickness		Approximate Weight	Normal .Maximum Size
	mm	inch	lb/ft <sup>2</sup>	inch
20 oz	2.75-3.05	0.108-0.120	1 1/2	80x48
26 oz	3.1-3.50	0.122-0.138	1 3/4	80x48
32 oz	3.8-4.20	0.150-0.165	2	80x48
3/16 in	4.65-5.25	0.183-0.207	2 1/2	50 ft <sup>2</sup> max width 84 in
7/32 in	5.3-5.80	0.209-0.228	3	50 ft <sup>2</sup> max width 84 in
1/4 in	6.25-6.75	0.246-0.266	3 1/2	75 ft <sup>2</sup> .max width 84 in

### 13.2 Plate glass

TS-245 Plate glass shall be cast, rolled or drawn glass ground and polished on both .surfaces, of the thickness shown below.



**Table 3. Limits for Clear Plate Glass**

Nominal Substance or thickness	Limits of thickness		Approximate Weight lb/ft <sup>2</sup>	Normal .Maximum Size inch
	mm	inch		
3/16	3.97-5.56	0.156-0.219	2 1/2	100x72
1/4	5.56-7.94	0.219-0.312	3 1/4	175x98
3/8	9.13-10.72	0.359-0.422	5	280x130
1/2	11.91-13.49	0.469-0.531	6 1/2	156x96

### 13.3 Obscured glass

TS-246 Obscured glass shall be figured rolled glass, and of the thicknesses shown below.

Nominal Substance or thickness	Limits of thickness		Approximate Weight lb/ft <sup>2</sup>	Normal .Maximum Size inch
	mm	inch		
1/8	2.94-4.4	0.116-0.173	1 1/2	100x48
3/16	4.5 -6.1	0.177-0.240	2 1/2	100x48
1/4	6.0 -7.0	0.237-0.276	3 1/2	100x48

### 13.4 Wired glass

TS-247 Wired glass shall be polished Georgian wired having both surfaces ground and polished and with square mesh inserted during rolling, of the thicknesses shown below.

**Table 4. Limits for Wired Glass**

Nominal thickness	Limits of thickness		Approximate Weight lb/ft <sup>2</sup>	Normal .Maximum Size inch
	mm	inch		
1/4	5.5-7.2	0.216-0.283	3 1/2	130x72

### 13.5 Heat - absorbing glass

TS-248 Heat-absorbing glass shall be floated glass substantially opaque to infra-red radiations of the thicknesses shown below.

TS-249 Limits for Heat Absorbing Plate Glass

- Nominal thickness:.. 6mm
- Light transmittance:.. 0.49
- Reflectance:..0.10
- Absorptance:..0.34
- Shading coefficient:..0.76
- Normal maximum size:..4500 x 2500mm

### 13.6 Armor-plated glass

TS-250 Armor-plated glass shall be toughened safety glass made of heat-treated polished plate of the thickness shown below.

**Table 5. Limits For Armor-plated Glass**

Nominal thickness	Limits of thickness		Approximate Weight	Normal Maximum Size
	mm	Inch	lb/ft <sup>2</sup>	inch
1/4	5.56-7.94	0.219-.312	3 1/2	2600x1520
3/8	9.13-10.72	0.359-0.422	5	3950x1520
1/2	11.91-13.49	0.469-0.531	6 1/2	3950x1520

### 13.7 Mirror glass

TS-251 Mirror glass shall be silvering Quality polished plate glass silvered on one side, copper-backed, varnished and painted of the thickness given in clause 2.02. Edges of mirrors shall be beveled.

### 13.8 Putty

TS-252 Putty for glazing to metal shall be tropical grade metallic glazing quality and shall be approved.

### 13.9 Glazing beads

TS-253 Wooden glazing beads shall be of teak, splayed and rounded to the sizes shown in the Drawings and neatly metered and braded .No tropical timber shall be used.

TS-254 Metal beads shall be supplied with metal windows and doors and these shall be sprung or screwed on according to design.

### 13.10 Glazing to wood without beads

TS-255 The rebates shall be previously treated with one coat of priming paint and the bedding putty inserted. The glass shall be embedded in the putty and secured by sprigs .The front putty shall be inserted to form a triangular miter filling from the edge of the rebate to 2mm from the sight line. The bedding putty shall be trimmed off level with the sight line to form neat back putty.

TS-256 When the putty has hardened sufficiently the painting shall be carried out and care shall be taken to seal the joint between putty and glass by painting up to the sight line.

### 13.11 Glazing to wood with beads

TS-257 The rebates shall be previously treated with one coat of priming paint and the bedding putty inserted. The glass shall be embedded in the putty and secured by the beads.

TS-258 The bedding putty shall be trimmed off level with the sight line to from neat back putty and the painting shall be carried out.

### **13.12 Glazing to metal without beads**

TS-259 The rebate shall be previously treated either by rust proofing or priming as described elsewhere and the bedding putty inserted. The glass shall be embedded in the putty and secured by pegs or clips inserted in holes in the rebates.

TS-260 The front putty shall be inserted to from a triangular mitred filling from the edge of the rebate to 2mm back from the sight line. The bedding putty shall be trimmed off level with the sight line to from a neat back putty. When the putty has hardened sufficiently the painting shall be carried out and care shall be taken to seal the joint between putty and glass by painting up to the sight line.

### **13.13 Glazing to metal with beads**

TS-261 The rebates shall be previously treated by rust proofing or priming as described elsewhere and the bedding putty inserted. The glass shall be embedded in the putty and secured by the Beads. The bedding putty shall be trimmed off level with the sight line to from neat back putty and painting shall be carried out.

### **13.14 Glazing without putty**

TS-262 Where specified, wash leather, ribbon velvet, flannel, felt, of putty for internal glazing in conjunction with beads. The material should be fitted so that it covers all parts of the glass which will be covered by the rebate and bead.

### **13.15 Mirrors**

TS-263 Mirrors shall be fixed to walls with compressive spacers, fiber washers and chromium plated dome - headed screws, screwed into prepared plugs let into walls and set flush with surrounding wall finish.

TS-264 Mirrors used as wardrobe doors or as wall linings are to be bedded with an approved mastic on a painted block - board backing not less than 12mm (1/2") thick to walls and 18mm (3/4") thick to doors. Glass sizes will be whole size to doors and minimum 900mm (3'0") wide to wall linings unless otherwise detailed, and backings continuous where possible.

TS-265 Joints in backings must coincide with joints in mirrors.

### **13.16 Cleaning, etc.**

TS-266 The Contractor shall replace all scratched, cracked or broken glass and clean all glazing on both sides and all mirrors before handing over.

## 13.17 Tempered glass

### 13.17.1 Definitions

TS-267 Heat-treated glasses are classified as either fully tempered or heat strengthened. According to Federal Specification DD-G-1403B, fully tempered glass must have a surface compression of 10,000 psi or more or an edge compression of 9,700 psi or more. Heat-strength glass must have a surface compression between 3,500 and 10,000 psi, or an edge compression between 5,500 and 9,700 psi. The fracture characteristics of heat-strengthened glass vary widely from very much like annealed glass near the 3,500 psi level to similar to fully tempered glass at the 10,000 psi level.

### 13.17.2 Heat treatment principle

TS-268 Glass can fracture when its surfaces or edges are placed into tension. Under these conditions inherent surface or edge fissures may propagate into visible cracks.

TS-269 The basic principle employed in the heat-treating process is to create an initial condition of surface and edge compression. This condition is achieved by first heating the glass, then cooling the surfaces rapidly. This leaves the center glass thickness relatively hot compared to the surfaces. As the center thickness then cools, it forces the surfaces and edges into compression. Wind pressure, missile impact, thermal stresses or other applied loads must first overcome this compression before there is any possibility of fracture.

### 13.17.3 Strength

TS-270 Under wind pressure, tempered glass is approximately four times as strong as annealed glass. It resists breakage by small missiles traveling approximately twice as fast as missiles which break annealed glass. Tempered glass is also able to resist temperature differences (200 ° F - 300 ° F) which would cause annealed glass to crack.

	Annealed Glass	Tempered Glass
Typical Breaking Stress (large light 60 sec. load)	6,000 psi	24,000 psi
Typical Impact Velocity Causing Fracture (1/4" light 5 gm missile, impact normal to surface)	30 ft/sec	60 ft/sec

### 13.17.4 Safety

TS-271 Fully tempered glass is used in many applications because of its safety characteristics. Safety comes from strength and from a unique fracture pattern. Strength, which effectively resists wind pressure and impact, provides safety in many applications. When fully tempered glass breaks the glass fractures into small, relatively harmless fragments. This phenomenon called "dicing," markedly reduces the likelihood of injury to people as there are no jagged edges or sharp shards.

TS-272 Fully tempered glass is a safety glazing material when manufactured to meet the requirements of the ANSI Z97.1 Standard and Federal Standard CPSC 16 CFR 1201. Federal Standard CPSC 16 CFR 1201, as well as state and local codes, require safety glazing material where the glazing might reasonably be exposed to human impact. This includes doors, tub and shower enclosures, side lights, and certain windows. Applicable building codes should be checked for specific information and requirements.

### **13.17.5 Uses for tempered glass**

- TS-273* Fully tempered glass is used traditionally in place of other glass products in applications requiring increased strength and reduced likelihood of injury in the event of breakage. The building industry, motor vehicle industry and certain manufacturing industries find tempered glass is effective and economical in a wide range of applications. Fully tempered glass can satisfy federal, state and local building code requirements for safety glazing in such applications as doors, side lights, shower and tub enclosure, and interior partitions. It is also used in storm doors, patio-door assemblies, and escalator and stairway balustrades. As a glazing product it is used in windows and in spandrel areas (for wind pressure, small missile impact and thermal stress resistance). Special building applications include sloped glazing, racquetball courts, skylights (see below), and solar panels.
- TS-274* Any conditions or requirements imposed in the applicable safety glazing laws and building codes limiting such special uses should be determined prior to glazing.
- TS-275* The domestic motor vehicle industry employs tempered glass as side and rear windows in automobiles, trucks, and multi-purpose vehicles. Manufacturing industries use tempered glass in refrigerators, furniture, ovens, shelving, and fireplace screens.
- TS-276* Tempered glass should not be used where building codes require wired glass for fire-spread resistance. Tempered glass should not be used, alone, where the objective is to provide security against forced entry or bullet passage. Combinations of annealed and tempered glass can be effective barriers against forced entry and bullet impact, if properly designed and constructed. When using tempered glass in fireplace screens, provisions must be made for expansion and edge insulation

### **13.17.6 Tempered glass in sloped glazing and skylights**

- TS-277* Because of its high resistance to thermal stresses and small missile impact, tempered glass is used in skylights and sloped glazing. On rare occasions when tempered glass in these applications fails, it may fail completely from the opening, individual fragments from tempered glass are relatively small and harmless. A number of these fragments may be loosely joined and fall in this manner. Such pieces do not have the sharp edges normally associated with broken glass but may have significant weight. Some building codes may require the use of screens under skylights. The use of screens may also be dictated by considering the risk of breakage and the resulting consequences.

### **13.17.7 Handling and installation**

- TS-278* Tempered glass should receive the same care as annealed glass. Unfortunately, familiarity with the greatly improved strength of tempered glass may mislead people to exert less care in handling it. Careless handling and improper installation sometimes produce edge damage. Delayed breakage can ensue when edge-damaged tempered glass is subjected to a moderate thermal or mechanical stress. Full penetration of the compression layer will likely produce instantaneous total fragmentation of tempered glass. Hence, tempered glass cannot be cut or modified following heat treatment.

### **13.17.8 Imperfections**

- TS-279* Inclusions in glass originate from impurities in the batch or cullet, or are combined from furnace refractories. Common forms of inclusions include aluminous stones, iron stones, and silicon. Nickel sulfide stones are uncommon, microscopic defects in glass, and may cause breakage.

Delayed breakage may occur when a nickel sulfide stone is present near the center of the glass thickness.

*TS-280* The tempering process rarely introduces imperfections into glass. The basic glass may contain bubbles, vents, chips, and inclusions which, if accepted or not revealed by inspection before tempering can cause breakage in the initial heating or final quench operations. If inclusions are not eliminated by self-destruction during the tempering process, in rare cases they may lead to failure at a later time.

### **13.17.9 Visual appearance**

*TS-281* Tempered glass possesses the basic optical qualities of annealed glass. The induced stress condition sometimes produces a slight bow in tempered glass lights. Tempered glass that has been manufactured in a vertical tempering oven contains small surface depressions resembling dimples along one edge. These marks are caused by the pointed metal tongs which support the glass during its passage through the oven. Glass which is passed horizontally through an oven may contain a very slight surface wave caused by contact with the rollers. The waviness can sometimes be detected when viewing reflected images from a large distance. Finally, the air quench nozzles discharge air in a fixed, reciprocating or rotating motion. The area of air quench can be seen through polarized glass as arrays of iridescent spots or lines. Under some lighting conditions these patterns can be seen in ordinary light.

## 14 Drainage

### 14.1 Scope

- TS-282* This Specification deals with the installation of the materials, fittings and equipment, the design and performance, the workmanship and the testing and commissioning of the below ground drainage.
- TS-283* This Specification is in addition to and will be read in conjunction with the Contract Drawings and relevant parts of the Contract Documents.

### 14.2 General

- TS-284* Works shall be constructed in accordance with BS CP 301: 1971 Building Drainage. The Contractor shall notify the Managing official of discrepancies between BS CP 301 and the working drawings and specifications.
- TS-285* Pipes and fittings shall be jointed and laid in accordance with the manufacturer's recommendations. The Contractor shall notify the Managing official of discrepancies between the manufacturer's recommendations and the design.
- TS-286* Unless otherwise stated, the provisions of the latest revised additions of relevant British Standards and Codes of Practice shall be held to be incorporated in the specification of materials and workmanship.
- TS-287* Drains shall be accurately laid, true to line and grade from point to point. Manholes shall be provided at changes of direction or gradient and at points of connection. Drain runs between manholes should be absolutely straight. Lines and falls shall be accurately set as shown on Drawings or as directed on Site.
- TS-288* Pipe work materials shall be as stated in the Particular Conditions or on the Drawings.
- TS-289* The Contractor shall perform all necessary excavation for drains, manholes, septic tanks, soak ways etc., uphold sides, level or .grade bottoms , return fill and ram and remove surplus spoil as directed .
- TS-290* The system shall be maintained in accordance with Clause 6 of CP 301.

### 14.3 Pipework

- TS-291* Excavation of any section of the work shall not start until a complete set of the pipes and components for that section is available.
- TS-292* The trench shall be as narrow as practicable but not less than the pipe diameter plus 300 mm from each side to permit adequate compaction of side fill. Adequate working space shall be left for pipe jointers and joint holes shall be formed where necessary.
- TS-293* The trench sides shall be kept vertical unless the approved use of a batter is unavoidable. In the latter case the sides of the trench shall be kept vertical up to 300mm above the top of the pipe. If over width excavation occurs at or below this level the trench shall be reformed using concrete

to 300mm above the level of the top of the pipe or the Managing official's approval shall be obtained for the proposed bedding for the wider trench condition.

*TS-294* Bedding material shall be:

- (a) Local karkar .
- (b) Sand to BS 882 Zones 1 - 4.

*TS-295* Pipes and fittings shall be inspected before fixing, and defective items shall be rejected.

*TS-296* Pipes shall be laid with the socket ends against the flow and shall rest on a solid and even bearing for the full length of the barrel .

*TS-297* Trenches shall be back-filled only after drains have been tested to the satisfaction of the Managing official.

*TS-298* Flexible pipes including pitch fiber pipes, UVC pipes, steel pipes and tubes and ductile iron pipes shall be laid on a granular or sand bed. The trench shall be excavated below the invert level of the pipe to depth that will allow a minimum thickness of 200mm of Sand as bedding material which shall extend to the full width of the trench.

*TS-299* In rocky ground a minimum of 200mm of granular or sand bed shall be used.

*TS-300* The bedding material shall be well tamped down on the trench bottom which shall be free from hard or soft spots.

*TS-301* The finished bottom shall be true to line and gradient.

*TS-302* Rigid pipes including vitrified clayware, cement pipes, grey iron pipes and concrete pipes shall either be laid on a granular or sand bed or on a concrete base in the trench bottom. The type of base provided shall depend on the nature of the trench formation and the presence of ground water.

*TS-303* Where the nature of the ground is such as to allow the trench formation to be trimmed to provide a uniform and solid bearing, pipes shall be laid upon the formation. Socket and joint holes shall be as short as practicable and shall be scraped or cut into the formation.

*TS-304* Where because of the nature of the ground or the presence of ground water pipes cannot be laid directly on the trench formation, the trench shall be excavated below the invert level of the pipe to a depth to allow a minimum thickness of 200mm of granular bedding material which shall extend the full width of the trench. The bedding material, trench, etc., shall be as for flexible pipes.

*TS-305* Where pipes are to be laid with a concrete bed, bed and haunch or surrounds, the trench bottom shall be prepared as for the laying of pipes on a granular bed but with a layer of concrete at least 50mm thick. The pipes shall be supported clear of the trench bottom by blocks or cradles placed under the pipe and immediately behind each socket for short small pipes with a second block near the spigot end for long or large pipes.

*TS-306* The support should yield under load sufficiently to permit the barrel of the pipe to rest uniformly on its bed after the normal setting shrinkage of the concrete has occurred. The clearance under the barrel before placing the concrete should be not less than 100mm. The concrete bed or haunch should extend to 150mm on each side of the pipe.

*TS-307* Concrete shall not be laid until the drain has been approved by the Managing official.



- TS-308* Where rigid pipes with flexible joints are employed with a concrete bed, haunch or surround a simple constructional flexible joint shall be provided in the concrete and at the face of a pipe joint at intervals of not more than 5 meters to reduce the natural rigidity of the concrete.
- TS-309* The first 300mm of filling above the top of pipes and the filling around the pipes shall be placed by hand over the pipe and compacted by hand in finished layers of 150mm to a maximum of 300mm and shall be selected material, carefully rammed around the pipes. The material shall be distributed equally to both sides of the pipe to buttress it to the sides of the trench. Subsequent filling shall be placed, rammed and watered if necessary in 300mm thick layers. Drains shall be kept free from earth, sand, surplus mortar and other obstructions during laying. Adequate cover shall be provided before using power compactors or heavy rollers.
- TS-310* Vitrified clay pipes and concrete pipes with more than 4.25 m of earth cover shall be laid on a 150mm thick bench of concrete and be haunched with concrete 150mm thick to at least the horizontal diameter of the pipe and above that level splayed tangentially to the extrados.
- TS-311* Where vitrified clay pipes and concrete pipes with more than 6 m of earth cover are used or where the pipes are laid in a heading or the cover is less than 1.2m if the pipes are laid in roads or 0.90 m elsewhere, the pipe shall be completely surrounded with concrete to a thickness of not less than 150mm.
- TS-312* The width of concrete beds shall be 150mm greater than the external diameter of the pipe on both sides.
- TS-313* Where drains run beneath buildings they shall be constructed of UPVC-SN8 pipe and shall be encased in concrete on bottom, top and both sides to a thickness of 150mm greater than the external diameter of the pipe and adequate flexibility in the pipeline shall be allowed.
- TS-314* The Managing official shall be consulted if pipes are to be laid with less than 600mm of cover or within 150mm of the underside of a concrete slab.
- TS-315* The head of every drainage system shall be ventilated and such ventilating pipes shall, where possible, be fixed against the outside face of an external wall unless otherwise shown on the Drawings and carried up to a height of 900mm above that part of the structure immediately adjacent to it. The ventilating pipe shall be fitted with a galvanized or copper wire balloon at the top.
- TS-316* Except where branches or other fittings occur, the top length of each ventilating stack shall consist of a complete length of pipe which shall be anchored 1.20 m from the top by means of wrought steel strap fixed as described elsewhere and painted to match the pipe. Any short length required to make up the length of the stack shall be fitted immediately below the top length.

#### **14.4 UPVC pipes and fittings**

- TS-317* UPVC-SN8 pipes and fittings shall comply with BS 4660.
- TS-318* All pipes and fittings on all soil, waste and vent pipes shall be in Unplasticised Polyvinyl Chloride, with solvent weld cement joints, to pipes and fittings.
- TS-319* All branch waste and vent pipes from basins and sinks to stacks, floor gullies, collection boxes and manholes shall be in modified UPVC-SN4 with seal ring joints suitable to receive high temperature water discharge.
- TS-320* Fittings and coupling for use with UPVC pipes shall be jointed with solvent cement in accordance with manufacturer recommendations.

- TS-321* Fittings and coupling for use with UPVC pipes on movement joints shall be jointed with an incorporate synthetic rubber rings in accordance with the manufacturer recommendations.
- TS-322* Slip on cover plates shall be provided as a finish to pipe work, up to and including 50mm diameter, emerging from a wall in occupied areas other than service voids. Samples shall be first submitted to the Managing official for approval.
- TS-323* On pipe work up to and including 50 mm diameter union type fittings shall be provided to make up to outlets of basin, bath and sink wastes.
- TS-324* Access plates shall be fitted at the roof of each vertical stack at changes, to enable the complete disposal system to be internally cleaned and ridded.
- TS-325* Soil, waste and vent stacks above their highest branches shall be continued up words, at their full diameter, above roof level.

## **14.5 Safety**

- TS-326* The Contractor shall provide, maintain and uphold safety measures adequate for the particular hazards of drainage works for all his employees. All safety measures taken by the Contractor should be approved by the Managing official.
- TS-327* Such approval will not affect the full responsibility of the contractor toward the safety of all his employees, the supervision staff and any other third party existing on site.
- TS-328* The Contractor shall ensure that all timbering, shuttering, staging, strutting, ladders etc., used in drain trenches and pits are adequate for the duty involved .

## **14.6 Manholes**

- TS-329* Manhole dimensions shall be as shown on Drawings.
- TS-330* Manholes shall be constructed from approved precast concrete rings.
- TS-331* Manholes, chambers, Septic tanks, disintegration and settling tanks and percolating pits shall be constructed in the positions and to the dimensions shown on the Drawings or as directed by the Managing official . The method of execution of all work in connection with these shall be as elsewhere described in the appropriate trades.
- TS-332* Manhole base slabs shall be according to drawings, and .at least 150mm thick grade (A) concrete or as directed and approved by the Managing official.
- TS-333* Manhole cover slabs shall be a minimum of 150mm thick suitably reinforced grade (A) concrete, where also approved precast covers can be used.
- TS-334* Precast concrete manholes shall comply with BS 556.
- TS-335* Manhole sections shall be jointed using a cement and sand mortar, 1 : 2 , proprietary bituminous or resin fillers . Where flexible fillers are used their shape, thickness and location in the joint shall be in accordance with the manufacturer's recommendations. The remainder of the joint shall be filled with a cement and sand mortar 1: 2, to prevent settlement of the sections with possible point contact and subsequent spalling of the concrete joint.
- TS-336* Precast concrete manholes used below water table level shall be surrounded with a minimum thickness of 150mm concrete which shall be not less than a 1:2:4 mix.

- TS-337* Sulphate resisting cements shall be used in concrete and mortar, or accepted epoxy paint should be made for all concrete and mortars facing the waste water.
- TS-338* Cast iron manhole covers and frames shall comply with BS 497 except that the bituminous based protective coating shall not flow or chip when exposed to temperatures in the range of 0OC to 76.7OC.
- TS-339* Manholes exceeding 1.00 meter deep internally shall have a minimum internal diameter of 80 cms.
- TS-340* Where required the channels in manhole bottoms shall be constructed of glazed earthenware channels jointed in a similar manner to the pipes. Alternatively when so described the channels shall be formed in fine concrete finished smooth. The channels shall be semi circular in section and the concrete shall then be carried up vertically for a distance of 80mm at each side and sloped back at a minimum fall of 1: 10.
- TS-341* The benching shall be of fine concrete and shall be rendered over in cement and sand (1: 3) mix. Pipes entering manholes shall not project beyond the face of the internal rendering. The invert of the pipes and the channels shall be continuous. All benching surfaces should be painted by approved epoxy paint.
- TS-342* Covers and frames shall comply with the following:
- GRADE A: Heavy duty covers suitable for heavy fast-moving wheeled traffic (25 tons)
  - GRADE B: Medium duty covers suitable where heavy commercial vehicles would be exceptional (8 tons).
  - GRADE C: Light duty covers suitable for pedestrian traffic only (5 tons).
- TS-343* Manhole covers situated inside buildings or on verandahs shall be as follows:
- Double seal type cover and frame or
  - Frame with ground - fit airtight cover manufactured for use inside buildings.
- TS-344* Manhole frames shall be bedded and pointed with cement and sand mortar and the rebates sealed with manhole grease.
- TS-345* Step irons shall be located and comply with BS CP 301, Clause 3.12.5.1.
- TS-346* Channels and benching shall comply with BS CP 301.
- TS-347* Where cast iron inspection chambers are shown on the Drawings these are to comply with BS 1130 using caulked joints and gasket sealed covers set in concrete block manholes benched to top of cover level. The manhole cover required can be single seal in lieu of double seal.

## **14.7 Septic tanks**

- TS-348* Septic tanks shall be sized and constructed of reinforced concrete for all sides with a block layer around the tank and according to drawings and specification mentioned in the.POQ as shown and constructed as stated in BS CP 302 unless otherwise stated.
- TS-349* External Walls of septic tanks shall be at least 300mm thick.
- TS-350* Where indicted on the drawings the Contractor shall provide an intercepting trap with cleaning arm and lever-locking stopper to be set in cement mortar in the intercepting manhole adjacent to the septic tank or inside the site boundary in the case of main drainage. The normal drop from

inlet to outlet of trap shall be preserved . A fresh air inlet shall be taken to the intercepting manhole with 100mm cast iron drain pipes with an easy bend to a point just below ground level.

*TS-351* Septic tanks shall meet the requirements of the local Authority.

## **14.8 Soakaways**

*TS-352* Soakaways shall be constructed in one of the following ways:

- Precast concrete rings to BS 556.
- 200mm (min) cast in situ concrete.

*TS-353* Cover and base slabs shall be at least 150mm thick Grade (A) reinforced concrete, or precast covers according to Specification and as directed and approved .by the Managin Official.

*TS-354* Removable covers shall be as described for manhole covers.

*TS-355* Soakaways shall be of the sizes and in the positions shown on the Drawings or as directed on site by the Managing official.

*TS-356* Soakaways constructed in cast in site concrete shall have walls of at least 200mm thicknesses.

*TS-357* Soakaways shall meet the requirements of the Local Authority.

## **14.9 Connections to existing manholes and drains**

*TS-358* When work is being undertaken on existing drains and manholes including the construction of new manholes, building in pipes , cutting through manhole walls , cutting out and reforming benching , completing pipe entries and making good the Contractor shall keep existing drains open to flow and reasonably free from debris at all times during the progress of works .

*TS-359* On completion all work shall be in a watertight condition.

## **14.10 Cleaning, protection and testing of drains**

*TS-360* The Contractor shall remove all silt and foreign matter from drains and manholes and leave the whole in a clean and workable condition.

*TS-361* In the event of delay between the laying of a drain and the placing of the first 300mm of back filling over the top of the pipe, precautions shall be taken to protect the pipes from damage arising from differential exposure to sun or wind.

*TS-362* Lengths of drain, manholes and inspection chambers shall be capable of withstanding the test. The test shall be applied after laying and before back filling or placing concrete surround and bedding concrete.

*TS-363* Leakage of the section under test, including sweating, which causes a drop in the test water level shall be noted and the defective part of the work shall be rectified on the Contractor's own expenses.

*TS-364* The test shall be repeated after back filling and any faults in the bedding or support of the pipe, inadequacies in design or accidental damage during, or subsequent to, back filling, shall be noted and the defective part of the work shall be rectified on the Contractor's own expenses .

TS-365 Whenever possible testing shall be carried out from manhole to manhole.

TS-366 Testing shall not be started until at least 48 hours after completion of the last joint.

TS-367 Tests before back filling:

- The section shall be filled with water and after about one-hour test readings shall be taken.
- A test pressure of 1.2m head of water shall be applied at the high end of the section (but not less than 2.4m at the low end). Steeply graded mains shall be tested in sections.
- The loss of water over a period of 30 minutes shall be measured by adding water from a measuring vessel at regular intervals of 10 minutes and noting the quantity required to maintain the original water level in the standpipe.
- The average quantity of water added shall not exceed 0.06 liters per hour per 100 linear meters per
- Millimeter of nominal bore of the drain.
- For sections of drain where the highest point is more than 1.2m below the water table the following infiltration test shall be undertaken.
- Inlets to the system shall be closed. Visual inspection at manholes or inspection chambers will reveal any flow the cause of which shall be investigated and the faults rectified.
- Tests for line, level and freedom from obstruction shall be applied by means of a mirror at one end of the drain and a lamp at the other.

TS-368 Final test:

- The water test shall be repeated in accordance with the requirements of the Local Authority or the Managing official.

TS-369 Tests have to be carried out only in company of the Managing official or his representative.

## 15 Asphalt works (Not Included in Scope of Works)

## 16 Plumbing & sanitary installations

### 16.1 Layout

- TS-370* The Layout of the fitting and pipe work is approximate and diagrammatic only. The Contractor shall be responsible for laying out the fittings and equipment together with the service pipe work to satisfaction of the Managing official.

### 16.2 Pipe work and fittings for services

#### 16.2.1 Piping

- TS-371* Each part of the piping systems shall be complete in all details and provided with all control valves and accessories necessary for satisfactory operation.
- TS-372* The drawings indicate generally the sizes of all main piping, and while the sizes are not to be decreased the Managing official reserves the right to change the runs and sizing of piping to accommodate conditions arising during construction.
- TS-373* All pipe work, valves, fittings etc. are to be as detailed for various services in the Schedules.
- TS-374* All piping shall be grouped wherever practical and shall be erected to present a neat appearance. Pipes shall be parallel to each other and parallel or at right angles to structural members of the building and shall give maximum possible headroom .
- TS-375* Pipe work shall generally be set around all columns and shall follow the contour of the building. Piping shall not pass in front of doorways or windows, nor be installed passing through ductwork or directly under electric light outlets.
- TS-376* Unless otherwise shown on the drawings or instructed on the site, all pipes shall have a minimum clearance of 75mm from floors and ceilings and 25mm from the finished face of walls or other surfaces.
- TS-377* All pipe drops shall be truly vertical, drain piping shall pitch down in direction of flow, and all pipework shall be installed with a continuous gradient to allow natural circulation, air venting and drainage. Levels are to be approved by the Managing official.
- TS-378* Run outs shall be graded in such a manner as to prevent air traps being formed within them when the mains expand or contract.
- TS-379* Pipes erected in plant rooms, vertical shafts or false ceiling spaces shall be arranged to provide maximum access, and generally all pipe work installed in voids, shafts or false ceilings and in other places where subsequent access is likely to be difficult and where ease of dismantling is not required, shall have welded joints.
- TS-380* Sufficient space is to be allowed for accessibility for servicing. No joints shall be formed in the thickness of walls, floors or ceilings.
- TS-381* Where pipes are to pass through reinforced concrete this must be ascertained before the concrete is cast and approval must be obtained for size of hole to be formed.

- TS-382* The Contractor is responsible for ascertaining the thickness of plaster and other wall finishes, skirting heights, sill lengths and floor finishes and routing pipe work to suit.
- TS-383* Where pipework is to be insulated , it shall be fitted in such a manner as to allow each pipe to be insulated the full circumference and also to allow the prescribed clearance, after insulation between the insulation and walls, floors, ceilings, other pipes or the insulation on other pipes , to any other surfaces.
- TS-384* Where pipes pass through or near walls, partitions or in chases, sufficient space must be left for the complete insulation treatment to be continued without interruption.
- TS-385* The Contractor shall be deemed to have included in his tender for work in setting pipes around all work and apparatus connected with other trades such as piers, wastes , drains , girders etc.
- TS-386* All reductions in sizes of horizontal piping shall be installed with eccentric fittings to maintain a level bottom.
- TS-387* Overflow and other warning pipes shall be fitted so that they discharge in obvious positions. Lightweight hinged weather flaps shall be provided which will close against wind pressure and open when discharging.
- TS-388* Pipe connections to equipment and valves shall be flanged for sizes 65 mm and above and with unions for other sizes, and shall be arranged for easy dismantling and removal.
- TS-389* All branches from mains shall be taken from the top of the main wherever practicable and shall be made in such a manner as to allow for expansion and contraction in both main and branch.
- TS-390* All sets, double sets and springs shall be formed on long lengths of tube with as large a radius as possible and shall be free from distortion.
- TS-391* The Contractor shall supply and install malleable iron unions for all pipes, up to and including 50 mm nominal bore to form removable joints at intervals of approximately 18 m and wherever difficulty in dismantling might occur.
- TS-392* All pipework shall be free of corrosion and without any signs of scaling pitting or excessive weathering, to the satisfaction of the Managing official.
- TS-393* Pipes stored on site shall be kept clean and off the ground and where possible stored under cover. Pipes corroded beyond normal "stock rust" conditions shall not be used.
- TS-394* The Contractor shall ensure that all tubes are free from internal obstructions. All burred and cut ends of pipes shall be well reamed and filed to ensure that the full bore of the pipes is maintained. The Contractor shall take special care to prevent dirt or rubbish entering the open ends of all pipework during storage and erection. Screwed iron caps or plugs or plastic caps shall be used for this purpose.
- TS-395* Wood, rag, paper or other inadequate material will not be permitted. A valve fitted at an open pipe end shall not be considered adequate protection. Should any stoppage in the circulation occur after the various systems have been put into operation owing to non-compliance with these requirements the Contractor shall attend and rectify the matter at his own expense. Further information regarding flushing out of pipework system is given elsewhere in the Specification.
- TS-396* The Contractor will ensure that at no part of any one system does he include, either in contact or at a distance, dissimilar metals which will promote chemical or electro - chemical action, causing a weakening or failure of the service. This applies not only to the internal surfaces but also the external surfaces of all pipes, fittings, valves, plant , vessels , pumps and any other item of equipment in the installation.



- TS-397* Where pipes are held in vices, as when screwing, care shall be taken to ensure that the pipe surface is not damaged. Any pipework so damaged shall not be fitted.
- TS-398* The average depth of the inverts of mains below ground level shall be 60 cm minimum. The Contractor shall mark out and accept the entire responsibility for the correct positioning of the trenches required, both as regards line and level, and shall collaborate to the best of his ability with the Main Contractor in order to ensure adherence to the program, and to avoid lengths of trench being opened up unnecessarily soon or remaining open unnecessarily long after the pipes have been satisfactorily tested. Depths of mains and branches must be approved by the Managing official.
- TS-399* Where piping is buried underground it shall be wrapped with PE (High density polyethylene protection insulation) of thickness 1.5mm. factory applied. All wrapping shall be approved by the Managing official before the trench is filled in.
- TS-400* Any pipework which, in the opinion of the Managing official, does not conform as to material and workmanship with this specification shall be removed and refixed at the expense of the Contractor.

### **16.2.2 Joints**

- TS-401* Reduction in pipe diameters shall be made by using one fitting only, be it reducing elbow, tee or coupling.
- TS-402* Where standard fittings are not available in the configuration required reductions to the run and branch connections shall be made with reducing sockets. Bushes will not be permitted.
- TS-403* Branch connections to mains may be employed where the sizes of the branch is two or more smaller than the size of the main. Generally sweep branches shall be made except for tees on headers, or where a sweep fitting would cause air to be trapped.
- TS-404* Upon completion welded joints shall be thoroughly cleaned with a stiff wire brush and screwed joints shall have jointing compound removed.

### **16.2.3 Plastic piping**

- TS-405* Plastic pipes shall be used only if approved by the Managing official (in all cases UPVC SN4&SN8 pipes must be used).
- TS-406* Cleaning fluids and solvent cements shall be suitable for use in the local ambient air conditions and operatives shall be fully trained in their use by attendance at an installation course organized by the manufacturers of the particular piping system.

### **16.2.4 Valves and Cocks**

- TS-407* All valves and cocks for the services in which they are installed shall comply with the requirements of the appropriate Water Authority, and the Contractor shall include for any testing and stamping which the Authorities may require.
- TS-408* Valves are to be provided as indicated and at all places necessary for the proper working, regulation, control and maintenance of the installation.
- TS-409* Valves shall be either screwed or flanged in accordance with the Specification for the pipe work into which they are installed and as directed by the Managing official.

- TS-410* Where flanged valves are specified, flanges are to correspond to appropriate BS specified in respect of the piping.
- TS-411* Gate valves shall be used for shut-off purposes and globe valves shall be used for balancing purposes. All valves shall be designed for packing under pressure when fully open. Gate valves shall comply with BS 5154 or 5150. All valves must be approved by the Managing official.
- TS-412* Taps and stop cocks shall comply with BS 1010 and shall be marked with the manufacturer's name or trade mark and the nominal size. All taps and stops cocks must be approved by the Managing official.
- TS-413* Valves shall be marked with the manufacturer's name or trade mark , the .nominal size and the class number and must be approved by .the Managing official.
- TS-414* Mixing valves shall comply with BS 1415 and shall be marked with the manufacturer's name and trade mark and the nominal size, and must be approved by the Managing official.

### **16.3 Pipe installation**

- TS-415* All piping shall be properly supported or suspended on stands, clamps, hangers, etc. of approved design. Supports shall be designed to permit free expansion and contractions while minimizing vibration. Pipes shall be anchored as directed by means of steel clamps securely fastened to the pipe and rigidly attached to the building structure.
- TS-416* Screw threads shall be cut clean and true and joints made tight without caulking. No bushing shall be used. Reducing fittings shall be used to change pipe size, and reductions to be made with eccentric reducers, short radius fittings shall not be used.
- TS-417* The drawings indicated generally the size and location of piping as designed for space conditions; ceilings heights and may not be changed until coordinated other contractors. If it is seemed necessary to modify the piping system the contractor shall size the pipes on the basic of 3-6 fps. Velocity and re-check pump heads which are presently indicative and for purposes of an estimate.
- TS-418* Piping shall be properly graded to secure easy circulation and prevent noise and water hammer. As much pitch as space conditions allow must be given. Capped dirt pockets to be installed at all risers heel, low points, and other places where dirt may accumulate must be provided. Allowance must be made for proper provision for expansion and contractions in all portions of pipe work to prevent undue strain in piping or machines. Expansion joints to be installed as directed by the Managing official.
- TS-419* All fittings such as elbow, tees, bushes etc. shall be of best quality foreign made or local class "A" according local standard with smooth interior surfaces. Approved screw unions with bronze or steel bodies and ground brass taper or spherical joints shall be installed at traps instruments, etc. and where else directed to permit easy connection and disconnection.
- TS-420* Final connection to equipment and Fixtures shall be made in manner that will permit the complete removal of any fixtures or any piece of equipment without cutting of pipe line.
- TS-421* Each piece of pipe and each fitting shall be carefully inspected on the inside to see that there is no defective workmanship on the pipe or obstructions in the pipes or fitting. Joints in all screwed piping shall be made with red lead and boiled linseed oil completely covered the male threads.
- TS-422* Straight Elbows, bushing, long screws, or bull head tees shall not be installed, and all officets shall be made with fittings. Pipes shall not be bent at any time.

TS-423 Pipe work shall be installed in manner to allow for ease of air escape and system draining it shall be endeavored to obtain this naturally by gravity. However, where conditions do not permit it an automatic air vent shall be installed at all air pocket locations and drain gate valve shall be supplied and installed at all low points and risers legs.

TS-424 Materials for piping

Service	Material	Type
Domestic hot and cold water	Steel	Galvanized Schedule 40
Domestic water underground	Pex-pipe	Cross linked polyethylene
Vent, feed, expansion	Steel	Galvanized Schedule 40
Internal Drain	UPVC (SN4)	Polyvinyl chloride resin
Sewage	UPVC (SN8)	
Gas pipe	Copper	Type K

TS-425 All piping black steel up to 1 1/4" shall be screwed and socketed with threaded fittings. All piping including 1 1/2" and above shall be welded or screwed and socketed. All steel welding elbow shall be of the long radius type except where space conditions do not allow.

TS-426 Joints shall be but welded single V type, elbow and fittings formed of welded cut pipe section will not be acceptable. No piping shall be hung from other piping and all hangers shall be of heavy construction suitable for the size of pipe being supported. All piping in the machine room shall be provided with rubber in shear vibration eliminating

### 16.3.2 Screwed joints

TS-427 Screwed joints on steel piping shall be clean threaded, pulled up tightly and made with approved jointing compound and long strand hemp. After joints have been formed, all surplus hemp should be cut away and the joints wiped clean. Alternatively, P.T.F.E. Taps may be

TS-428 Hemps should be cut away and the joints wiped clean Alternatively, P.T.F.E. Tap may be used. Where galvanized piping is used, care shall be taken to ensure that threads are carefully cut, so that the number of exposed threads is minimized.

### 16.3.3 Flanged joints

TS-429 All flanged joints shall be flush and truly aligned and made with approved corrugated rings, compressed asbestos or composition joints. Flanges for connection to welded pipes shall be "slip on" or welding neck standard steel type made as indicated in the schedules. Flanges or unions shall be provided on straight runs at not greater than 12 meter intervals. Wherever possible, at piping connections to equipment, valves or other units requiring maintenance, servicing, or possible removal, the connecting joint shall be made by means of unions or flanges. Pressure rating or flanges shall match the pressure of the flanges on the equipment to which the pipe connected.

### 16.3.4 Unions

TS-430 Unions are required on pipe 50 mm and under. Unions shall be ground taper joint type good for 8.37 Kg/sq. cm working pressure. Unions shall have bronze conical seats ground in. Flat unions shall not be used.

*TS-431* Temperature midway between the high and low limits of normal service. Bellows expansion joints shall be provided with guides to ensure that all movement is taken up in the designed manner. The manufacturer's recommendations shall be closely followed. Guides shall be secured rigidly and shall provide free movement for expansion without undue tolerance. Means for lubrication shall be provided where necessary.

### **16.3.5 Pipe Supports and Anchors**

*TS-432* All supports for steel piping shall be ferrous. Supports for copper pipes shall be non-ferrous and chromium plated where chromium plated pipe is specified. Brackets or supports shall be set out so that they not obstruct the access to valves, flanges or other fittings requiring maintenance.

*TS-433* Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment valves and control valves. Piping shall be supported to allow for removal of equipment valves and accessories with a minimum of dismantling and without requiring additional supports after these items are removed. All channels, angles, plates, clamps, etc, necessary for the fastening of hangers shall be furnished and fitted by the contractor.

*TS-434* All hangers shall be properly sized for the pipe to be supported. Over-sized hangers shall not be permitted. Details of hangers and supports to be used by the contractor shall be submitted to the Managing official for approval before fitting. All hangers shall be provided with lock nuts and have provision for vertical adjustment pipes. Parallel groups of pipes shall be supported by trapeze type hangers of steel construction. Individual horizontal piping shall be supported by hangers consisting of malleable split rings with malleable iron sockets steel clevis type hangers, or roller hangers where specified or directed. Pipe standards with base flanges and adjustable type yokes shall be used for pipes supported from the floor. Vertical piping shall have wrought iron or steel clamps securely bolted on the piping with the end extensions bearing on the structure of the building.

*TS-435* Piping shall be anchored where required to localize expansion or to prevent strain on piping and branches. Anchors shall be entirely separate from hangers and shall be heavy forged or welded construction of approved design. Hangers for cold piping shall have hard wood inserts or high density insulation capable of withstanding the compression and allowing the hanger to support the pipe without any metal contact. No piping shall be hung from other piping and all hangers shall be of heavy construction suitable for the size of pipe being supported. All piping in the machine room shall be provided with rubber in shear vibration eliminating. hanger

### **16.3.6 Pipe sleeves**

*TS-436* All pipe openings through walls, partitions and slabs are to have sleeves having an interval diameter at least 1' larger than the outside diameter of the pipe or of the insulation passing through the sleeve. Pipes passing through external block work or concrete shall be provided with sleeves of galvanized standard weight steel pipe flush with walls and ceilings and extending one inch above finished floors. Pipes passing through internal partitions shall be provided with sleeves of gauge 22 galvanized sheet steel made flush with finished wall surfaces.

### **16.3.7 Flashing sleeves**

*TS-437* Flashing sleeves are to be provided where pipes pass through waterproof membranes. Flashing sleeves details are to be submitted to the Managing official for approval but generally they shall be provided with an integral flange set into the membrane. The associated pipe shall also have a flange and shield which shall extend beyond the insert and be sealed with approved mastic.

### **16.3.8 Pipe insulation protection saddles**

*TS-438* Insulation shields shall be used to protect the insulation on all pipes. Insulation protection saddles shall be welded to insulated hot pipes at roller supports. Wherever fiber-glass pipe insulation is installed, alternative high density insulation of equal thickness shall be installed in lieu thereof. Where hangers and insulation shields are installed the insulation shields shall bear only an insulation material which is of such density that it will not compress, crush or deform. Saddles shall consist of gauge 10 galvanized steel plates. The plate shall be curved to fit the contour of the insulation and shall cover the lower 180 deg. of the surface. Saddles shall be secure to the insulation by means of steel bands.

### **16.3.9 Strainers**

*TS-439* Approved "self-cleaning" strainers shall be fitted in the section line of each pump and at the inlet connections to each feeder and make-up connections, and each automatic control valve of all apparatus of an automatic character, whose proper functioning would be interfered with by dirt on the seat or by scoring of the seat. All strainers shall be suitable for pressures as stipulated for the system concerned and are to be inspected and pressure tested at the works. All strainers shall be cast iron or bronze bodied of ample strength for the pressure to which they shall be subjected with suitable flanges or tapping to connect with the piping they serve. Strainers basket screens shall be stainless steel and shall be of ample strength to prevent collapsing the basket under shock loading.

*TS-440* Each water strainer shall be provided with an approved valve dirt blow-out connection suitably piped to the nearest floor drain.

### **16.3.10 Automatic air vents**

*TS-441* Wherever possible, all water pipe work system is to have open venting. At all high points in the system where this is not possible an automatic air vent shall be fitted and connected to the nearest drain. Air vents shall be of the float type. Sizes and working pressures shall be as indicated on the schedule, and/or in the bill of quantities. They shall be fitted with a suitable sized gate type lock shield valve.

### **16.3.11 10. Valves**

#### **16.3.11.1 Shut-off valves and balancing valves**

*TS-442* Gate valves shall be used for shut-off purposes and globe valves shall be used for balancing purposes. All valves shall be designed for packing under pressure when fully open. Shut-off valves shall be installed in both sides of all equipment.

*TS-443* Regulating valves shall be installed where indicated on the drawings and shall be of the Hattersley type P1373EC pattern or equal for screwed fitting or type 4733DR pattern or equal for flanged fitting.

### **16.3.12 Pipe work Underground Protection**

*TS-444* Where pipe work is to be run underground it shall be wrapped with layer of PE (Poly Ethylene) applied by extrusion method 1.5 mm thickness wrapping from outside and fitting should be protected also ..

### **16.3.13 Union and Flanges**

*TS-445* Shall be provided on both sides of each piece of equipment. Also when required to facilitate removal of valve for repair. Union shall be provided for all piping 2" and smaller. Flanges shall be provided for all piping 2.5" and larger.

### **16.3.14 Cleaning of pipe**

*TS-446* During constructions, the contractor shall properly cap all lines so as to prevent the entrance of sand, dirt, etc... All pipe, fittings, valve etc. shall be cleaned of grease, dirt, scale, and foreign material before installation.

*TS-447* Before turning the project over to the Contracting Authority prior to start-up of any mechanical equipment, all piping system shall be thoroughly cleaned following the hereinafter specified instructions.

*TS-448* Piping shall be cleaned by operating system at normal operating pressure approximately 48 hours. At the end of the 48 hours period, contractor shall clean all strainers by removing baskets and flushing with clean water; Blowing down thru strainer blow down valve will not be acceptable.

### **16.3.15 Testing**

*TS-449* The piping system shall be tested by accepted method and under 150 psi hydrostatic pressure. Test shall be maintained under inspection by Managing official for a period of not less than 24 hours.

*TS-450* If leaks develop test shall be repeated after leaks are corrected. No part of piping system shall be covered or concealed until it has been tested inspected and approved by the Managing official.

*TS-451* See also Implementing documents, Preliminary technical acceptance and Acceptance of the works performed of the tender specifications.

## **16.4 Insulation**

*TS-452* All insulating materials required for general plumbing and equipment shall be furnished and installed according to this section of the specifications.

*TS-453* Insulation shall be installed in a smooth, clean, workmanlike manner and joints shall be tight and finished smooth.

*TS-454* All surfaces to be insulated shall be dry and free from loose scale, dirt, oil or water when insulation is applied.

*TS-455* Insulation shall be applied in such a manner that there will be no air circulation within the insulation or between the insulation and the surface to which it is applied.

*TS-456* Surface imperfections in the insulation such as clipped edges, small joints or cracks and small voids, or holes not over 25 sq.mm shall be filled with like insulating material or with insulating cement if approved by the Managing official.

*TS-457* Insulation for all services shall be continued through sleeves. The insulation on exposed risers shall extend through the floor.

## 16.5 Domestic water services

- TS-458* Generally water shall be supplied from the City Main and will connect either to the roof storage tanks or to the low level suction tanks. From the suction tanks water shall be pumped up to the tanks at roof level. Connection can also be made directly to the water network in the building if it is available continuously.
- TS-459* The city water supply to building by  $\phi 1$ " inch size galvanized steel seam less sch. 40 pipe wrapped from outside with layer of PE high density polyethylene insulated protection factory cover of thickness 1.5mm.
- TS-460* Laid underground with all necessary fitting and work from main city water supply pipe price completed with  $\phi 1$ " inch water meter, shut of valve, check valve and strainer work include.
- TS-461* Fees for city municipality, sheet metal cabinet, excavation, back filling.
- TS-462* The price of tank completed with mechanical floater, connection for booster pump supply, drain valve and angle steel painted base of height 20 cm.
- TS-463* Where the rising main is installed in an open-to-sky void, it shall be in cast iron to BS 1211 with flanged joints or as directed by the Managing official.
- TS-464* All hot and cold water services shall be in galvanized steel sch.40.
- TS-465* The use of flexible connectors between services and sanitary fittings will NOT be permitted.

## 16.6 Filter and water tanks

- TS-466* All cold water storage tanks shall comply with the relevant British and local standards, and must be approved by the Managing official.
- TS-467* Drinking water tank of row material linear low density polyethylene (food grade a drinking water) of white color and of capacity as indicated in P.O.Q the tank of cylindrical shape equipped with round screwed seated cover and supply with connection for city water supply, building network supply,pump water supply and rain pipe.
- TS-468* The price of tank completed with mechanical floater, connection for booster pump supply, drain valve and angle steel painted base of height 20 cm.
- TS-469* Tanks shall be fitted with a suitably sized ball valve and overflow
- TS-470* Before all pumps and control equipment and on the outlet from all tanks, a strainer shall be fitted.
- TS-471* The sizes of the tanks shall be as shown on the Drawings and noted on the schedules in the Particular Specification and the Contractor must allow in his rates for assembling, waterproofing, and providing holes, overflows and valves as required.
- TS-472* Alternatively the Contractor may provide fiberglass tanks subject to their suitability for the particular project and the approval of the Managing official.
- TS-473* All tanks must be provided with strong covers and adequate access points for maintenance and cleaning.

## 16.7 Tests at site

- TS-474* Pressure tests shall be applied to piping only before connection of equipment and appliances. In no case shall piping, equipment or appliances be subject to pressures exceeding their rating.
- TS-475* Tests shall be completed and approved before any insulation is applied or pipes, valves and fittings have been concealed. Tests shall be performed in the presence of and to the satisfaction of the Managing official. Any leaks or defects uncovered by the tests shall be repaired and the system re-tested at no additional cost to the Employer.
- TS-476* When the installation has been completed to the satisfaction of the Managing official, it shall be tested in the following manner:
1. The entire system shall be slowly filled with water, allowing any trapped air to escape
  2. When all outlets are closed the system shall be checked for water tightness.
  3. Each outlet must be checked for rate of flow and correct operation.

## 16.8 Cleaning

- TS-477* The Contractor shall carefully clean out all cold water and hot water tanks, service pipes, sanitary fittings throughout, traps and wastes. The Contractor shall also overhaul and make good all flushing valves, check regulating valves, check taps including rewashering as necessary and leave all works in perfectly clean and working condition to the satisfaction of the Managing official.

## 16.9 Sanitation and rainwater drainage

- TS-478* The soil and waste system shall be installed in accordance with this Specification and bill of quantities and must be approved by the Managing official.
- TS-479* Soil, waste and ventilation pipe work and fittings fixed in open-to-sky areas shall be in cast iron or UPVC as shown on the Drawings or directed and approved by the Managing official.
- TS-480* Soil, waste and ventilation pipe work and fittings fixed in internal ducts shall be in unplasticised P.V.C. and according to manufacturer's specification and as approved by the Managing official.
- TS-481* Expansion joints and brackets shall be fixed in accordance with the manufacturer's recommendations where required
- TS-482* Rain water pipes and fittings shall be as shown on the Drawings, Bill Of Quantities and as directed by the Managing official.

## 16.10 Testing

- TS-483* Tests shall be carried out at the Managing official's request during installation in accordance with manufacturer's specifications and to the approval of the Managing official. See also Implementing documents, Preliminary technical acceptance and Acceptance of the works performed of the tender specifications.



### **16.10.2 General**

- TS-484* The contractor shall submit to the Managing official prior to the date of commencement of the tests his proposed test procedure. The procedure method and points of measurement and the method of calculation shall be approved by the Managing official before any test is carried out.
- TS-485* The contractor shall supply skilled staff and all necessary instruments and carry out any test of any kind on a piece of equipment, apparatus part of a system or on a complete system if the Managing official requests such a test for determining specified or guaranteed data, as given in the specifications.
- TS-486* Any damage resulting from the tests shall be repaired and/or damaged material replaced, all to the satisfaction of the Managing official at the expense of contractor.
- TS-487* In the event of any repair or any adjustment having to be made other than normal running adjustment, the tests shall be void and shall be repeated after the adjustment or repairs have been completed.
- TS-488* The tests shall not be made void due to circumstances beyond the contractor's control
- TS-489* All testing, balancing and final adjustment shall be in accordance with the provision of the appliance B.S code of practice.

### **16.10.3 Water supply systems**

- TS-490* All water supply piping shall be tested under hydrostatic pressure of not less than 1.5 times (8Bar) working pressure p.s.i., maintained for twelve hours. This test shall be applied to separate lengths of pipe work before final connection of equipment and appliances but after all piping is completed. Systems shall also be flushed. Test shall be completed and approved before pipes, valves and fittings have been concealed. These systems shall be subject to a water test prior to being covered and also tested for water tightness before backfilling. On any section of the pipe under test, the head of water applied shall not be less than 3.00 meters and not greater than 6.00 meters. Tests shall be maintained for 20 minutes, and any defects shall be rectified and the test reapplied to the complete satisfaction of the Managing official.

### **16.10.4 Drainage, Soil, Waste and Ventilation System**

- TS-491* These systems shall be subjected to a water test prior to being covered and also tested for water tightness before backfilling. On any section of the pipe under test, the head of water applied shall not be less than 3.00 meters and not greater than 6.00 meters. Tests shall be maintained for 20 minutes, and any defects shall be rectified and the test re-applied to the complete satisfaction of the Managing official.

### **16.10.5 Final testing**

- TS-492* In addition to the above, final tests shall be carried out as directed by the Managing official, just before final completion of the works and during the maintenance period.

## 16.11 Sanitary fittings

### 16.11.1 General

- TS-493* Supply and install all sanitary fixtures shown on the drawings and as specified in these specifications.
- TS-494* Vitreous china fixtures shall be of the first quality with smooth glazed surfaces, free from wrap, cracks, checks, discoloration or other imperfections.
- TS-495* Fixtures shall be set in a neat, finished and uniform manner making the connection to all fixtures at right angles to the wall, unless otherwise directed by the Managing official. Fixtures are not to be set until so directed by the Managing official.
- TS-496* Ample application of petroleum jelly shall be applied to all surfaces of exposed chromium plated piping, valves and fittings and stainless steel fixtures immediately after installation.
- TS-497* All fixtures shall be set, true, level, and finished in an approved and uniform manner..
- TS-498* Concealed brackets, hangers and plates shall have a shop coat of paint.
- TS-499* All necessary supports for fixtures shall be installed before plaster work.
- TS-500* All exposed piping and trim shall be chrome plated and fully protected during installation. Strap or padded wrenches shall be used on chrome pipe fittings and valves.
- TS-501* All exposed metal parts in toilets rooms and bathrooms shall be chromium plated and fully protected during installation.
- TS-502* All valves in bathrooms, toilets and kitchens shall be chrome plated recessed type.
- TS-503* In the selection of the sanitary fixtures and their accessories, model numbers of manufacturer's catalogues are given. A model numbers is given to describe the type and the shape of the item requested and does not in any way limit the supply to the model listed. Any item of different make judged by the Managing official to be similar in quality and manufacture will be approved. Catalogues will be available at the Contractor's office for reference.
- TS-504* The location and disposition of all items shall be indicated on the relevant drawing
- TS-505* All sanitary fittings shall be of an approved quality obtained from an approved manufacturer. Sanitary fittings and their connections, services, wastes , overflows etc. shall be located as shown on the Drawings and shall be designed and installed to the satisfaction of the Managing official .
- TS-506* Details of the fittings are as shown in the Particular Specification and Drawings or as directed by the Managing official.
- TS-507* All sanitary fittings noted in the Particular Specification shall be properly assembled and the Contractor shall include for all waste fittings, traps, taps, plugs, chains, seats, handles, levers, fixings and brackets required to suit the installation.
- TS-508* All traps shall be of the correct size with a 3" deep seal and compression outlet connection.
- TS-509* When fixing washbasins (ceramic – with metal down pipes!), silicon or flexible putty is to be used. All washbasins are to be solidly affixed to the walls (using dowels, as appropriate).

### **16.11.2 Pipes and Fittings**

- TS-510* Potable water main between city mains and water collector in floor water cabinet shall be galvanized steel sch. 40, heavy weight. Fittings shall be of seamless pipe with same characteristics as pipe.
- TS-511* Domestic cold and hot water pipes shall be sch. 40. All pipe fittings (elbow, tees, crosses, unions, reducers, etc...) shall be galvanized forged steel of the same quality and weight as the pipes. Pipes and fittings shall be suitable for threaded connections.
- TS-512* All drainage pipes 1 1/4" in diameter and larger shall be UPVC –SN4 (Polyvinyl chloride) of approved quality UAP-Plast.
- TS-513* All rain water pipes shall be UPVC-SN4 pipe. All fittings and accessories shall be of the same quality, and material of the pipe. All joints shall be rubber sealed stainless steel and plastic. Pipes and fittings shall be in accordance with latest PALESTINE standards.

### **16.11.3 Local regulations**

- TS-514* All works shall be carried out to comply with the current local public health regulations, the latest BS 5572/BS 8301 and current local by-laws and shall be to the entire satisfaction of the Managing official.

## **16.12 Builders work**

- TS-515* Normally pipes will be fixed on the surface of walls and the Contractor shall perform all cutting and pinning for holder bats or plugging and screwing for pipe clips.
- TS-516* Where pipes are required to be concealed in the walls etc., the contractor shall perform all cutting and subsequent making good. Pipes passing through walls and floors shall be sleeved with metal.
- TS-517* The expression 'Builders Work' shall mean work to be carried out by the Main Contractor under the direction of the Managing official in connection with the plumbing installation.
- TS-518* The Contractor shall prepare accurate drawings giving details of all holes, fixings, bases, and other builders work requirements and shall be responsible for their accuracy. The cost of any unnecessary work due to failure to comply with this condition will be charged to the Contractor and deducted from his account when making payment. The cost of preparing builders work drawings shall be included in the tender price.
- TS-519* If, in order to progress the contract, the Managing official has prepared certain details in connection with the builders work, the Contractor, when appointed, must immediately check these details against the architectural and structural drawings and if any additional work or alterations are required the Managing official must be advised immediately.
- TS-520* The following is a summary of the work to be carried out by the Main Contractor:
- Cutting and forming of holes for pipes or pipe fixings through walls, floors, ceilings, partitions, roofs etc., and making good after the work is sufficiently advanced.
  - Building of concrete and/or brick ducts in floors, walls...etc.
  - Formation of concrete bases, plinths etc. for plant and equipment .
  - Building of manholes pits etc.
  - Excavation, forming of trenches for services etc., and the filling in of same after the pipes are laid.

- Cutting or forming of chases, recesses etc. in floors, walls...etc. for pipes and fittings, and making good.
- Excavation for and laying of pipes and ducts.
- The building in of brackets and supporting bars or other form of pipes after fixing unless specified to the contrary.
- Painting of all pipes after fixing unless otherwise specified
- Providing and building in of sleeves through slabs and walls

*TS-521* In general all holes through walls, floors and beams for pipes and ducts will be left out by the Main Contractor during the process of building.

*TS-522* Where pipes or fittings are fixed to concrete or woodwork by means of saddles or clips the Contractor shall himself execute the work necessary and shall include the cost of such work in the price given in the Form of Tender.

### **16.13 Solar water heater**

*TS-523* The contractor shall supply and install solar hot water heater of capacity as indicated in drawings vertical type. The heater install on roof as indicated in the drawings.

*TS-524* Completed with following item:

1. Solar panel of size 190\*90 cm consist of 11 galvanized pipes row black painted 0.5 inch diameter, insulated by 5 cm polyethylene layer and covered with 3 mm normal glass.
2. Hot water storage tank of capacity 200 Liter and thickness of sheet metal 3mm. Painted inside by epoxy paint treated by oven. Insulated by 5 cm polyethylene and covered by white paint galvanized sheet metal.
3. Electrical heater coil capacity 3000W with thermostat.
4. Plastic Water tank of capacity 1500 liter.
5. Steel structure base for solar panel, hot water storage tank. cold water tank of height 2 meter

*TS-525* Each heater shall be completed with all fitting such as valves, union, safety valve, non-return valve and all piping necessary for connection to city water, cold water and hot water electrical cable connected to heater coil with adjustable thermostat and electrical switch with indicated lamp

### **16.14 Water booster pump**

*TS-526* The contractor shall supply and install a booster centrifugal pumps as indicated on drawings and of capacities and ratings as indicated on drawings and bills of quantities.

*TS-527* All pumps shall be centrifugal type single stage directly coupled to a squirrel cage, totally enclosed fan cooled induction motor by a flexible coupling.

*TS-528* Both pumps and motor shall be mounted on a common steel base frame which shall be securely fixed to a concrete base frame, suitable isolation pads must be provided for each pump. The pump shall have cast iron casing stainless steel shaft for cold water and good quality bronze impellers. Pump shall be fitted with pressure gauges on its discharge. The gauges shall be equipped with approved type cocks in order to take reading when required.

*TS-529* Each pump shall be fitted with a check valve on the discharge and an approved type strainer in the suction. Furthermore, each pump shall include with it two shut-off valves, two gate valve in suction and discharge. Pump speed shall not exceed 1450 R.P.M.

*TS-530* Each pump shall be driven by a constant speed motor and be provided with a suitable starter as specified under motor and starter clauses in the electrical specifications in this tender book. Each pump shall be guaranteed not less than the quantity of water against the circulating head given in the schedule when operating continuously without over-heating the motor or bearings.

## **16.15 Grey water**

*TS-531* The rain water is the source of grey water in school collected from school roof only, The rain water stored in underground tank of capacity 125 m<sup>3</sup> (5X5X5)m, The rain water supply to tank from roof using rain manhole and rain water UPVC pipe of size 6", The gray water used for flushing toilet and irrigation purpose.

*TS-532* The system include booster pump, to discharge water from underground water tank to special roof tank.

## **16.16 Fans**

### **16.16.1 General**

*TS-533* Exhaust and return air fans shall be of approved quality and quite noise, supplied and installed by the contractor as shown on the drawings. The capacity, type and rating of the fans shall be as specified in the schedules. The fans motors and starters shall be in accordance with the specifications and electrical equipment.

### **16.16.2 Extractor fans**

*TS-534* The contractor shall supply and install as shown on the drawings a range of vent axia extractors or equivalent of ratings as indicated on the drawings.

*TS-535* Fan shall be either centrifugal or propeller type direct drive suitable for window or wall mounting. Fans shall be designed to ensure lowest noise level and each shall be supplied with its starter or switch and weatherproof hood. Fans shall be constructed from non corrodible materials. Fans shall be furnished with self acting louvers mounted on the face of fan.

*TS-536* The propeller will be strong and rigid giving large volinetric capacities and high efficiency, with non overloading characteristics and very quite operation.

*TS-537* The motor to be squirrel cage induced type suitable for continuous operation.

*TS-538* For wall mounted fan the motor to be attached to the fan ring by three arms of pressed steel.

*TS-539* Rubber inserts to prevent transmission of motor noise.

## 16.17 Split unit heat pump air condition unit

*TS-540* Split type air-conditioning unit, reversible cycle (heat pump), high wall mounted type indoor unit, air discharge directions, with adjustable air emitting the wall unit (indoor unit) depth not to exceed 35 cm. remote controller:

*TS-541* All operation of the remote control unit to be push button system. Each switch has a lamp which is illuminated when switch is pushed. The controller to include:

1. Three speed fan selector
2. Pre-heater/defrost lamp
3. Indication lamp for each switch
4. Operation On/Off switch
5. Thermostat control heat-cool

*TS-542* The Outdoor unit includes the condenser, condenser fan and the rotary type compressor, and all relays and safety switch as following:

1. Reversing valve
2. Defrost thermostat
3. Relay
4. Transformer
5. Thermostat
6. Bimetal thermostat for condenser fan
7. Over current relay for compressor contactor
8. Magnetic contactor for compressor
9. High pressure switch
10. Crankcase heater
11. Capacitors for fan
12. Safety fuses
13. Terminal board for main circuit
14. Terminal board for control circuit

*TS-543* The Indoor unit:

1. - Internal thermostat for fan motor
2. - Fan motor
3. - Capacitor for motor fan
4. - Drain up motor
5. - Earth terminal
6. - Float switch for line cut
7. - Transformer
8. - Terminal board for control circuit
9. - Terminal board for main circuit
10. - Relay for IC control
11. - Varistor

## 17 Electrical installations

### 17.1 General

- TS-544* The Contractor shall supply all labor, materials and equipment necessary for the installation of medium voltage switchboards, sub-main cables and distribution units, lighting and power, together with all other apparatus shown on the Drawings and as detailed in the Particular Specification, with the exception of those items stated specifically as being supplied by others.
- TS-545* All works shall be carried out in a manner satisfactory to the Managing official and all unspecified materials shall be of approved manufacture. The complete installation is to be to the entire satisfaction of the Managing official.
- TS-546* The whole of the electrical installation and all works appertaining thereto shall be carried out in strict accordance with the Regulations for the Electrical Equipment of Buildings current edition (including all amendments and supplements made and issued thereto) as issued by the Institution of Electrical Engineers, British or VDE Standards, and also to the national and local requirements.
- TS-547* The Contractor shall further make good, repair, replace all defective work and clear away on completion and leave all installations in perfect working order and to the satisfaction of the Managing official.
- TS-548* Building works shall include the preparation of trenches and provision and laying in such trenches of asbestos cement or salt-glazed stoneware pipes, having easy bends to form ducts for entry of main cables. The numbers, sizes and locations of such pipes shall be as required by the Particular Specification.
- TS-549* Manufacturer's Recommendations means the recommendations or instructions printed or in writing and current at the date of tender.
- TS-550* The phrase "or other approved" means that commodities of different manufacture may be substituted if prior approval has been obtained.
- TS-551* The Contractor shall be deemed to have included in his price for anything necessary to supply the installation described in the Specification, or as shown on the Drawings .If no figure is put against the item shown in the summary it shall be deemed to have been included elsewhere.
- TS-552* The Contractor shall handle, store and fix each commodity in accordance with the manufacturer's recommendations. He shall inform the Managing official if these conflicts with any other specified requirement and submit copies of manufacturers' recommendations to the Managing official when requested to do so.
- TS-553* When choice of manufacturer is allowed for any particular commodity the Contractor shall obtain the whole quantity required to complete the work from one manufacturer or obtain approval of any change in source of supply. He shall produce written evidence of sources of supply when requested to do so by the Managing official.
- TS-554* All the materials purchased for the work must operate satisfactorily at an ambient temperature of 50°C.
- TS-555* All electrical switches, conduits, plugs are to be properly (vertically) aligned, no wall openings are to be left uncovered.

TS-556 Progress reports shall be made by the Contractor, to be inspected and approved by the Managing official. Changes in plans or additional works shall be executed by written approval of the Managing official.

## 17.2 Builders work

TS-557 The following is a summary of the work to be carried out by the Contractor:

1. The cutting and forming of holes for conduits or pipes or conduit or pipe fixings through walls, floors, ceilings, partitions, roofs etc. and making good after the work is sufficiently advanced.
2. The building of concrete and/or brick ducts in floors, walls etc.
3. The building of manholes, pits etc.
4. The excavation, forming of trenches for services etc. and the filling in of same after the cables are laid.
5. Excavation forming for underground services of ducts and courses.
6. The cutting or forming of chases, recesses etc. in floors, walls etc. for conduits and fittings, and making good.
7. Excavation for and laying of cable carrying pipes.
8. The building in of brackets and supporting bars or other form of conduit or pipe suspensions.
9. The painting of all pipes, tubes and conduits etc. after fixing unless specified to the contrary.
10. The providing and building of sleeves through slabs and walls

TS-558 All supplied materials should be local made if available – Class A and free from defects and having supervisor certificate from Palestinian Standard Institution (PSI).

TS-559 Price to include submittal and obtaining approval of shop drawings, detailed and as-built drawings for all works as well as coordinating the same with the other services, activities and furniture complete ready for work in place and operable manner.

TS-560 Price to include also submittal of catalogues and manufacturer's instructions.

TS-561 Fixtures and appliances shall be measured in number. Supply and feeder cables, cable conduits and cable trays shall not be measured but included in DBs prices. Manholes handholds and the like shall be measured in number. All systems and devices shall be in lump sum including installations, testing and commissioning. Rates of fixtures and appliances shall include installations, wiring, switches, conduit works, carrying up all required tests and handling over to local Electric Authority. All systems equipment should be class A and approved by (PSI).

## 17.3 Testing

TS-562 The Contractor shall provide all necessary testing equipment as required by the Supervision Consultants and the Managing official to carry out tests as set out in the Regulations and as required by the relevant Electricity Authority. See also Implementing documents, Preliminary technical acceptance and Acceptance of the works performed of the tender specifications.

TS-563 The Contractor shall also be responsible for the payment of fees to specialists and manufacturers, for testing and commissioning required to bring all such plant and equipment into fully efficient operation as part of the installation. See also “Elements included in the price” of the tender specifications.



- TS-564* The Contractor shall thoroughly test each section of the Contract Works all generally in accordance with I.E.E. and Electricity Authorities regulations, and except where otherwise specified the tests shall include the following.
- TS-565* Insulation resistance tests to earth and between phases on all circuits and power consuming equipment by means of a 500-Volt insulation tester. During the test all lighting switches, except those controlling fluorescent fittings, shall be turned off and all lamps installed but no inductive apparatus shall be connected.
- TS-566* All insulation tests shall be made between phases, between each phase and earth, and between earth and neutral with the controlling switch neutral link removed.
- TS-567* Insulation tests shall be repeated between phases and between each phase and neutral with all switches off and all lamps removed.
- TS-568* Insulation resistances below 5 megaohms will not be accepted.
- TS-569* Earth continuity tests shall be made on each main, submain, circuit and sub circuit.
- TS-570* Polarity of switches and continuity of ring main circuits shall be tested.
- TS-571* Insulation resistance tests of all connected appliances shall be made
- TS-572* Tests of the effectiveness of earthing including resistance of main earth shall be made.
- TS-573* Any other tests the Managing official may reasonably instruct the Contractor to make. Such will include readings of potential drop and current balance between phases at full load conditions at various points in the installation.
- TS-574* The Contractor is to provide all necessary labor, materials, test media and instruments required and all instruments must carry a recent calibration certificate from an approved body.
- TS-575* All tests are to be witnessed by the Managing official, and triplicate test record certificates, signed by all test witnesses, are to be provided to the Managing official as the work proceeds, upon request, or in any event before the commencement of the Maintenance Period.
- TS-576* At least 7 days written notice is to be given of intention to perform any test.
- TS-577* In addition to installation testing the Contractor is to carry out operation testing of all sections and is to clean, set, calibrate and fully commission, demonstrate and hand over the entire contract works in a thoroughly complete and operational state to the satisfaction of the Managing official.

## **17.4 Main- switchgear and sub- main distribution equipment**

- TS-578* All main switchgear and sub-main distribution equipment to be provided and installed within the Contract shall comply with the relevant British Standards.
- TS-579* Main switchboards shall be 600 volt rating, of sheet steel construction of 2mm minimum thickness, finished in a suitable anti-rust cubicle type front access panels, epoxy-electrostatic painted (color to be approved by the Managing official), complete with all necessary incoming main isolators, low bars, outgoing fuse switches, distribution units, interconnection accessories, cable glands and entries. The main switchboard shall also be provided with a metering panel and all necessary interconnections as may be required by the Electricity Authority. Three ammeters and a voltmeter complete with an integral phase shift switch shall be provided and connected via the main incoming cable connections. The main switchboard shall also be

provided with all necessary labels for each item of switchgear stating the area service duty or equipment controlled there from both in Arabic and English.

- TS-580* All access panels; hinged doors etc. should be provided with rubber or similar gaskets to protect the interiors against ingress of dust.
- TS-581* An 'as installed' diagram of the electrical distribution shall be provided within a glazed frame and fitted adjacent to the main switchboard.
- TS-582* Switch fuses, isolating switches, fuse boards, miniature circuit breaker boards and main distribution panels are to be of the particular types, capacities and manufacture later specified in the Particular Specifications or as indicated on the Drawings and unless otherwise specified are to be generally in accordance with the following.
- TS-583* Switch fuses are to be of the 600 Volt "on-load" pattern with the switch blades mounted on to a solid insulating bar arranged for quick make and break action.
- TS-584* Fuses are to be H.R.C. type mounted independently of the switch mechanism.
- TS-585* Switch operating handles are to be of the 'free handle type' interlocked so that the access door may not be opened unless the switch is 'Off ' but with a means to circumvent this feature. The switch 'On ' or 'Off ' positions are to be clearly marked.
- TS-586* Miniature /mould case type circuit breakers shall have automatic tripping by means of a calibrated bi-metal mechanism for over-current protection and an electro-magnetic tripping device for short circuit protection. All three-phase circuit breakers shall have over-current and short circuit protection devices in each phase.
- TS-587* These devices shall be interlocked with each oh the other phases, such that the operation of a trip in any one phase will automatically cause all three phases to be isolated from the supply.
- TS-588* The Fuse /M.C.B. Boards shall be adequately and securely fixed to the surface of the building walls in the positions shown on the various Drawings by means of raw bolts or other metallic fixing devices as approved by the Managing official. All fixing bolts that can be accommodated in the fixing holes shall be used.
- TS-589* The positions of the Fuse M.C.B. Board as shown on the Contract Drawings shall be agreed with the Managing official before erection of any Fuse /M.C.B. Board.
- TS-590* The busbars of all Fuse /M.C.B. Boards shall be connected to the phases of the supply so that the standard arrangement of red, yellow, blue and neutral working from top to bottom of the Fuse /M.C.B. Boards is adhered to throughout the installation to ensure uniformity in phase coloring. The top busbar of the Fuseboard is to be tested to make sure it is fed from the red phase right the way back through the system to the source of supply.
- TS-591* The Fuse /M.C.B. Boards shall be supplied with charts mounted inside their doors and /or across the phase barriers. These charts shall be completed by the Contractor to give a clear and permanent indication of :
1. The circuit reference of each fuseway /M.C.B.
  2. The correct H.R.C. fuse /M.C.B. for each fuseway.
  3. The title of the plant protected by each H.R.C. fuse /M.C.B.
- TS-592* Sweating sockets or facilities for crimped terminals are to be provided for incoming phase and neutral cables.

*TS-593* All live metal parts are to be enclosed by insulating material including when the fuse carriers are withdrawn, and the carriers are to be arranged to protect persons handling them from electric shock or burns.

## **17.5 Earthing**

*TS-594* Earth leads and earth tapes shall be of high conductivity bare copper in internal dry conditions and where they are run underground or in damp locations they shall be tinned.

*TS-595* As far as possible they shall be continuous without joints, but where joints are unavoidable, they shall be bolted and soldered. All such joints shall be coated with anti-corrosive paint and wrapped with self-adhesive PVC tape.

*TS-596* Where earth leads and earth tapes are required to be buried, they shall be at a depth of not less than 500mm (1'8"). Where they are fixed to building surfaces they shall be fixed at intervals not exceeding 1.0 m (3'4") with copper or brass saddles of the spacing type. The saddles shall be tinned where necessary to correspond to the lead or tape being fixed.

*TS-597* An earth test link is to be provided adjacent to all switchboards. The link shall be a 13mm x 3mm copper strip secured across a 50mm (2") break in the earth lead or tape by high tensile steel bolts and nuts.

*TS-598* All earthing cables shall be installed in accordance with the relevant requirements called for in the Cables section of this specification.

*TS-599* All bonding leads in the form of cable having a standard conductor shall be terminated in 'sweated' sockets and shall be rigidly bolted to earthing terminals.

*TS-600* All earthing cables shall be insulated with a green PVC sheath. Where connection on the earth lead to the main earth is made with a standard cable, the earth lead shall be double insulated with PVC sheaths, the outer sheath being colored green.

*TS-601* Where a lightning protection scheme is installed the earth lead may be bonded to the lightning conductor earth.

*TS-602* The Main Contractor will execute any trenching and backfilling and erect and cement into position all electrode manholes to details provided by the Contractor.

*TS-603* Connections by means of copper earth tape shall be made between the main earth bars to the frame terminals of all items such as switchboards etc.

*TS-604* The main ground connection shall be to a grid of electrodes of galvanized water pipes buried in the ground, and shall provide a minimum ground resistance of 2 ohms.

*TS-605* The connections from the main ground to the switchboard shall be of 50 sq.mm copper cable.

## **17.6 Cables**

*TS-606* All cables shall be manufactured to comply with the relevant British Standards and are to be obtained from one of the approved manufacturers. All cables shall be XLPE, except that underground cables shall be NY.

*TS-607* Data and Ethernet cables should be superior cables four pairs 24AWG.HFFR.IEC 61156-5.CAT6. 450MHz.

- TS-608* Loud speakers cable should be single pair with solid copper conductor 1.25mm diameter in flat configuration with poly ethylene insulation and PVC jacket. Conductors to have a maximum DC loop resistance at 20F of. 28 OHM/KM and a nominal capacity of 91 PF/M.
- TS-609* Microphone cable should be single pair screened with standard copper conductor. 31/0.2mm with PVC insulation lapped copper screen and PVC jacket. Conductors to have a maximum DC loop resistance of 45.7 OHM/KM and a nominal capacity of 430PF/M.
- TS-610* The minimum size of conductor used for lighting sub circuits shall be 1.5 sq.mm and for local ring main circuits 2.5 sq.mm.
- TS-611* All cables shall be supplied to site on suitable drums with labels clearly indicating the origin and specification of cable.
- TS-612* Where cables are installed underground the Contractor shall mark out trenches for excavation by the Main Contractor, according to the Drawings and as directed by the Managing official.
- TS-613* The Contractor shall install the cables on a smooth bed of sifted sand 10 cm thick (minimum), and then cover the cables with another layer of sand up to 10cm above the top of the cable, and provide and install interlocking concrete cable covers engraved 'Electricity' in both English and Arabic along the complete underground length of the cables.
- TS-614* The cable clamps are to be fixed to the building structure by means of loose bolt type rawlbolts and by steel nuts and bolts to any other structure.
- TS-615* All cables run within the site buildings are to have the serving removed and the single wire armoured cleaned bright and left bare throughout the entire length of the cable, or alternatively the cable is to be taped with 50mm (2") wide PVC tape half lapped. This is to minimize the fire risk of the compound serving on the cable.
- TS-616* All cables shall be colored in accordance with the following:
- Red phase-Red
  - Yellow phase-Yellow
  - Blue phase-Blue
  - Neutral-Black

## **17.7 Lighting fittings:**

- TS-617* Lamps and Tubes: all lamps and tubes of the lighting have to be low energy system.
- TS-618* The Contractor shall supply all lighting fittings unless otherwise specified in the Schedule of Lighting Fittings. The Contractor shall provide all the lamps for lighting fittings, which he supplies as part of the Contract.
- TS-619* The Contractor shall allow for the installation of all the lighting fittings in the locations as shown on the Drawings. Where lighting fittings are recessed in ceiling panels he shall obtain from the Managing official detailed drawings of the ceiling layout prior to commencement of fixing.
- TS-620* Lighting fittings shall generally be fixed direct or suspended from the structural ceiling to heights as stated in the Particular Specification. In the case of wall mounted lighting fittings not above doorways or structural openings the mounting heights shall be as indicated on the Contract Drawings. In instances where they are mounted over doorways or structural openings they shall not be fixed more than 300mm (10") higher than the lintel of the doorway.

- TS-621* Where fluorescent lighting fittings are required to be suspended this shall be done by means of a 1" link galvanized heavy jack chain of the welded link type, the chain being attached to standard conduit box hook plates fixed to conduit boxes.
- TS-622* The conduit boxes from which any fluorescent lighting fitting is supported or suspended shall be securely fixed to the building structure by means of at least one 1/4" whitworth bolt , complete with flat washers, spring washer and full size nut or the equivalent diameter roundhead wood screw and /or toggle bolts of Rawlplug manufacture or other fixings as approved by the Managing official .
- TS-623* The supply to each lighting fitting shall be by means of 32/0.2mm 3-core circular, heat resistant butyle sheathed flexible 250 volt grade cable, to be connected to the circuit wiring by means of multiway P.V.C. connector blocks having brass mechanical screw clamp connections. Screwit type connectors will not be permitted. Taped and soldered joints will not be permitted.
- TS-624* The third core, earth conductor of the flexible cable is be securely earthed in the conduit box, socket or ceiling rose and the lighting fitting. These connections shall be effected in purpose made terminations and the fixing screws of the conduit box lid, hook plate or similar means not specifically intended as a conductor termination shall not be used for securing the earthing. The connection of the third core to the lighting fitting shall be effected in a similar manner as described above.
- TS-625* The Contractor shall allow in his tender for all the necessary supports steelwork and other accessories required for the supporting and /or mounting of all the lighting fittings as shown on the Contract Drawings.
- TS-626* Where fluorescent lighting fittings are mounted direct to purpose made lighting trucking, the lighting trucking manufacturer's purpose made fixings and supports are to be utilised for the mounting of the lighting fittings. The connection and earthing of the lighting fittings is to be effected as previously described herein.
- TS-627* At every lighting point an earthing terminal shall be provided and connected to the earth-continuity conductor of the final sub-circuit.

### **17.7.2 Pendant lighting fittings**

- TS-628* The Contractor is to supply and install all plain pendant lighting fittings as shown on the Drawings.
- TS-629* All ceiling roses containing permanently 'live' terminals shall be of such a manufacture that 'live' terminals are completely shielded and contact cannot be made there with the normal replacement of the flexible pendant.
- TS-630* Every ceiling rose shall be provided with an earthing terminal.

## **17.8 Switches and switch lighting**

- TS-631* The Contractor shall supply and install the lighting switches in accordance with the type specified. Where they are indicated on the Drawings, switches shall be of the two-way or intermediate type, and in some instances shall be ganged in various numbers in a single box with a common cover plate.
- TS-632* All switches shall have 15 Amp interiors for lighting circuit loads in excess of 600 watts.

- TS-633* The lighting switches shall be mounted at a height of 1.4m (4'-8") from finished floor level to the center of the switches unless deemed otherwise by the Managing official. The switches shall be fixed by any fixing device approved by the Managing official.
- TS-634* Where ceiling mounted cord operated "PULL" switches are called for on the Drawings they shall be positioned such that the cord will hang free at a distance of 75 mm (3") from any wall surface or door opening. The cords for such switches shall be of a length sufficient to reach a point 1.5m (5'0") above finished floor level.
- TS-635* All switches shall be wired in the live side of the circuit they control.
- TS-636* Where six or more switches are ganged together in one box with a common switch plate, the switch plate shall be engraved to indicate the area, row or points controlled.

## **17.9 Socket outlets**

- TS-637* All socket outlets unless otherwise specified or indicated on the Contract Drawings shall be of the 13 Amp shuttered rectangular pin type complying with BS 1363.
- TS-638* The contacts shall be housed in a track resistant moulding, controlled where indicated on the Drawings by integral A.C. type single pole switch.
- TS-639* The finishes of socket outlet plates may vary depending upon the area and these will be as specified in the Particular Specification. However, socket outlets in plant rooms shall have steel front plates.
- TS-640* Mounting boxes shall be either of aluminium or enamelled steel for flush installations, or aluminium only for surface installations. All boxes shall incorporate an earthing terminal.
- TS-641* The Contractor shall supply and install all socket outlets in accordance with the types and ratings specified and /or indicated on the Contract Drawings.
- TS-642* The positions of all socket outlets as shown on the Contract Drawings must be checked with the Main Contractor, attention being given to type of wall finish required and the method of mounting thereon.

## **17.10 Telephones and audio equipment:**

- TS-643* The Contractor shall be responsible for the supply and installation of the necessary enclosures, cable trays and draw wires for a complete telephone installation throughout the premises.
- TS-644* The Contractor shall ensure that the main cable entry duct is installed by the Main Contractor to the requirements of the local Telephone Company. In all cases the main duct shall have a minimum size of 10cm, be of plastic manufacture, and have no right angle bends.
- TS-645* Each 2.5cm telephone conduit will serve no more than 4 telephone outlets.
- TS-646* At the junction point of risers and conduits and at the main entry duct point the Contractor must ensure a clear wall space of at least 1 sq.m for the installation of the telephone company's distribution boxes.
- TS-647* If it is a requirement of the local Telephone Company that the Contractor is to install the necessary telephone cables, the Contractor shall liaise closely with the Telephone Company and obtain prior approval for any telephone cables installed.

- TS-648* Horn type loud speaker should be weather proof with matching transformer 45W European made.
- TS-649* Internal loud speakers should be 6/9W circular in a wooden box with matching transformer European made.
- TS-650* Audio amplifier 360W with charger and at least four outlets, built in CD and cassette player and recorder with prerecorded tones (piano), daily – weekly go off bill timer unit, tuner, rack cabinet 14U metal with aluminum and glass door for housing the system. European made.

### **17.11 Maintenance tools, keys and spare equipment**

- TS-651* The Contractor is to provide two sets of any special tools and keys necessary for the maintenance of the items of equipment supplied under the Contract.
- TS-652* Spare items of equipment shall only be supplied where particularly specified, as for fuses.
- TS-653* All keys, tools and spare equipment are to be handed over to the Employer, with a detailed list of all items. The Contractor is to obtain two receipted copies of the list and forward one to the Managing official.

### **17.12 Outside lighting (all lighting fixtures shall be low energy systems bulbs and tubes)**

- TS-654* The Contractor shall supply and install an outside lighting system as shown on the Drawings and in accordance with the Schedule of Lighting Fittings.
- TS-655* The Contractor shall be responsible for the supply and erection of the lighting columns, and shall also be responsible for advising the Main Contractor of the routes of the trenches for the mains cables to each column and the siting of the holes for the column bases.
- TS-656* The excavation and backfilling of the trenches and the concreting in of the column bases shall be carried out by the Main Contractor.
- TS-657* Each column shall be fitted with O.C.C. Bs manufacture connecting to the lighting units mounted on the column.
- TS-658* The termination of the cables to each column and the fusing of each column shall be as detailed in the Drawings.
- TS-659* Wiring to floodlights mounted on the building shall be routed on the inside of the building. Cables fixed to the outside face of the building will only be permitted at the discretion of the Managing official.

## 18 External works (Not Included in Scope of Works)