



TITLE
<b>COMPRESSED AIR SYSTEM</b>
<b>MARIB GTPS 400 MW</b>

SPECIFICATION NO. PE-TS-372-555-A001	
VOLUME	
SECTION	
REV 00	DATE 20/07/2012
SHEET	

# SECTION-C6

## SEAWORTHY PACKING

## SPECIFICATION


**VOLUME IIB**

**TECHNICAL SPECIFICATION  
FOR  
SEAWORTHY PACKING FOR EXPORT JOBS**

**SPECIFICATION NO. PE-TS-888-100-A001**



**BHARAT HEAVY ELECTRICALS LIMITED  
POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NEW DELHI, INDIA**

	<b>TITLE</b>  <b>TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS</b>	SPECIFICATION NO. <b>PE-TS-888-100-A001</b>	
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## 1.0 Purpose

The purpose of this specification is to describe minimum packing requirements for the different items/equipment for all export Project and also to define marking and shipping requirements during transportation by ship, road and air for all export jobs.

## 2.0 SCOPE

For export jobs, sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of outdoor storage in adverse weather conditions are required. Workmanship and materials used shall be of high standard meeting the technical requirements and in accordance with best commercial export packing practices. Vendor shall be responsible for sea worthy export packing, however it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the BHEL/Purchaser. Vendor shall submit the packing procedure for its equivalent for purchaser's approval during detailed engineering.

The scope this specification is to define VENDOR's responsibilities in terms of:

- Preservation of the GOODS/items/equipments before packing.
- Packing of the GOODS for road, rail, sea and/or air transportation to desired destination i.e. project site
- Making cases/crates
- Chemical Treatment/Fumigation before packing to prevent fungus, damage due to termite, borer, rats, etc.
- Marking of cases/crates.
- Other Services required.


## 3.0 Application

This specification is applicable to all the goods to be transported to project site and requires to be in transit for longer duration. *However, for "Misc cable erection items", "Fire sealing system" & "Exothermic welding material", the packing requirements shall be as per the procurement specification.*

## 4.0 Definitions

- "BHEL" : Main EPC vendor
- "OWNER" : Customer for a particular export project.
- "VENDOR" : Company(ies)/VENDOR(s) to whom the BHEL has placed Purchase Order for GOODS/ items/system/package.
- "GOODS": means all or part of the articles, material, equipment supplies including technical documentation, as described in the Purchase Order, to be supplied by VENDOR.
- "PACKER": Packaging Company to whom VENDOR intends to sub-contract the packing in case they do not have own packing capability/facilities .
- "FREIGHT FORWARDER" : Means the Company responsible for performing freight forwarding activities.

## 5. General Information

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The following requirements are intended as minimum requirements, and compliance to these requirements in no way absolves or relieves VENDOR of any responsibility or obligation outlined in the Purchase Order. In all circumstances, the packing will be designed and constructed in order to support GOODS during transportation as well as to prevent the Goods from damage due to impact, extreme climatic conditions, sun and rain. It must be ensured that the delivery of the GOODS to the jobsite by sea, road or air, in good condition.

GOODS shall be export packed in compliance with the best-established practices for international projects, in accordance with the following instructions. In the event of any conflict between these specified requirement and the established practices, specification requirement shall govern.

Due to climatic conditions and the complex transport operation(s), it is essential that protection and packing is of the highest standard. Packing means to efficiently protect the GOODS during the total transport operation; from the moment they leave the factory until they are delivered to the jobsite, including handling operations (loading/unloading) and storage.

When VENDOR do not have packing capabilities/facilities of their own and therefore intends to sub-contract, VENDOR have to inform BHEL/Purchaser of the name and address of proposed PACKER(s) for approval.

#### **6.0 Criteria for Selection of Packaging**

Packages are to be made according to categories, described in articles 8.1 to 8.5, depending on the type of materials, their fragility and size.

These categories have been established for the protection of equipment and material during multi-mode transports, i.e.: combination of overland and sea transport; containerization, air transportation.

In a general manner, the GOODS have to be packed in such a way that crates, bundles, pallets can be stored into General Purpose containers, wherever possible.

If VENDOR has any doubt about the correct method of protection or packing, he should contact BHEL/Purchaser in order to mutually agree on the adequate type of packing to be used.

Materials can be classified in following categories

- Hazardous Material
- Non-Hazardous Material
- 


Further to above categorisation, non-hazardous materials can be sub- categorised for selection of packing.

#### **6.1 Hazardous Materials**

Though handling of hazardous material may is not applicable in the scope of this specification. All hazardous material must be packed in adherence to the detailed requirement relating to packing, marking and labelling set out in the most recent report of the Board's Standard Advisory Committee on the Carriage of Dangerous Goods in Ships for sea freight, and the Restricted Articles Regulations, laid down by the International Air Transport Association for airfreight.

#### **6.2 Non-Hazardous GOODS**

The scope of this specification is to provide necessary guidelines for packing for power plant equipment, components, Pipings & Valves, Fittings, other structural items, electrical items, spare parts and erection materials. The procedure is defined in subsequent paragraphs in details in clause no. 8.0.

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## 7.0 Marking Instructions & Despatch details, Storage Code

### 7.1 Marking Instructions & despatch details

Packages and crates will be marked with indelible black paint, resistant to seawater. Marking must be perfectly legible.

The shipping marks, which will be as per fig-13, shall be stencilled on two sides and one end in clear characters at least 5 centimetres high (where crate size permits, otherwise use optimum size for each package dimension).

When the GOODS are to be shipped in containers then marking may be stencilled on one end only. However, packages must be stowed in a manner that shows these marks.

Crates containing fragile articles must be packed with special precaution against risk of breakage and must be stencilled on all sides "FRAGILE - HANDLE WITH CARE". Where crates are not to be overturned, VENDOR must show on the crates, clear and readily visible identification as per fig-12, to ensure they are kept in the correct position.

Packages/equipment of 2,000 kg or more must be marked with slinging points on all sides, in addition to the centre of gravity marks.

Number packages consecutively i.e. 1 of 10, 2 of 10, etc. Do not duplicate package numbers. VENDOR is responsible for any loss or damage caused by incorrect marking.

All cases/crates shall also be marked with the appropriate international standard graphic symbols for handling as shown in Fig 12.

As a minimum, all cases/crates are to be marked clearly on all four sides with:

- "HANDLE WITH CARE"
- "RIGHT SIDE UP"
- "KEEP DRY"

In the case of packages with a single gross weight totalling 2,000 kg and/or a height of more than 1m, the centre of gravity shall be clearly marked with the symbol on two adjoining sides. For all items of equipment with an eccentric centre of gravity this symbol shall be marked at the bottom, side and top of the package.


The slinging and lashing points shall be marked with a chain symbol.

When packing in cases/crates, these packages shall also have metal corners at the slinging points. (Fig-11)

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consigner/consignee address, contract and case details, country of origin, port of delivery, stacking instructions shall be written on one side of the boxes. An anodized aluminum plate as per details and specifications given in fig-13 shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminum packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag is to be kept inside the box at the pertinent place.

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## 7.2 Storage Code

The type of storage required is required to be specified, it will be shown on each packaging in **RED colour**.

- X Crates or packages to be stored outdoor without covers
- XX Crates or packages to be stored under tarpaulin
- XXX Crates or packages to be stored in covered or enclosed premises
- XXXX Crates or packages which must be stored in air-conditioned premises

## 8.0 GUIDELINES FOR PACKING GOODS

**8.1** In the subsequent paragraphs details of different types of packings for different types of GOODS are defined. Vendor shall make packing details/procedure based on the guidelines and submit for approval.

### 8.1.1 Packing for Pipe, Fittings, Flanges and Valves, Structural Steel

Particular attention should be brought to pipe, fittings, flanges, valves and structural steel. Packing categories for piping and fittings will differ according to the diameter and wall thickness of these products. VENDOR shall comply with the following established practice.

#### IMPORTANT NOTE:

*Depending on the project schedule and availability of ocean vessels, the piping and structural steel may be shipped in containers. In this event, VENDOR has to arrange the packages in such a way it allows the stuffing into Open Top in gauge containers.*

### 8.1.2 Pipe

Where practicable, pipe lengths shall be limited to 11.8 meters.

All pipes 2" included and below shall be packed in crates. All pipes to be capped and ends sealed with waterproof tape.

Pipes over 2" up to 6", shall be bundled and banded in bundles of uniform length. Bundling is carried out with U-IRON or traversal planks, joined with threaded connecting rods with locknuts. Quantities and strapping positions depend on the lengths, with a 120 cm spacing to prevent distortion. Bundle weight shall not exceed 2,000 kg. All pipes are to be capped and ends sealed with waterproof tape (tape is not necessary if end caps are of the pre-shrunk or self-sealing type).

Pipes larger than 6" shall be shipped as single lengths with the ends capped. End caps are to be of the recessed type to enable the use of soft faced hooks, but still completely sealing the end and also protecting the weld.


All stainless steel piping must be packed separately in wooden crates. Any banding of bundles is to be with the same material.

### 8.1.3 Pipe Fittings, Flanges and Valves

All pipe fittings, flanges and valves up to 6", are to be packed in cases/crates. For items over 6", these may be fixed securely to a pallet base and enclosed in a crate, for protection. Where valves have actuators attached, rigidity must be ensured for the valve and actuator. The vulnerable parts of the actuator are to be completely protected within a wooden crate.

All stainless steel fittings, flanges and valves of all sizes, must be packed separately in wooden crates. Any strapping is to be with the same material.

### 8.1.4 Structural Steel

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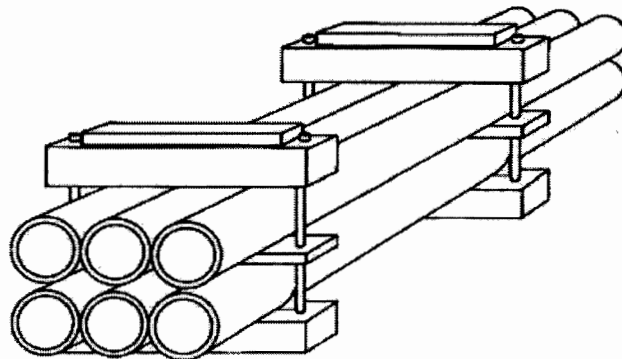
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long bolting to secure the load.

## 8.2 Bundling – Packing Category I

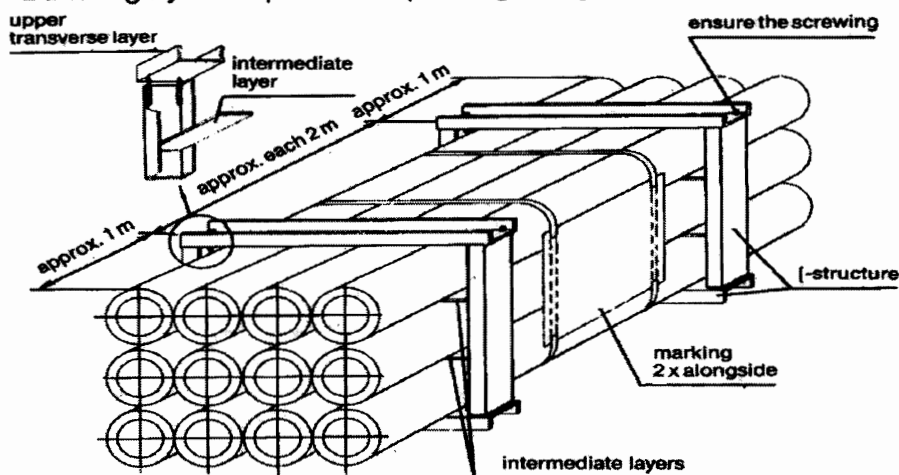
### 8.2.1 Type of Equipment

Equipment which is not subject to damage by corrosion or mechanical effect, i.e. pipes, piping, structural steel.


#### Packing category I



#### Bundling by U-shaped iron – packing category I A



### 8.2.2 Type of Construction

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- Bundling has to be effected
- By squared timber and threaded rods.
- With an intermediate layer (threaded on tightening bolts) according to the weight of the package.
- Wedge-shaped timbers must be added at the outer points of lower layer.
- Between the bolts a spacer must be nailed.
- The bolts must be secured (e.g. by locking nut).
- If single parts could protrude, an appropriate protection must be installed (flat iron or plates).
- Bundling with steel straps or PVC straps is not accepted.

### 8.3 Skids, Square Timber Constructions, Casings – Packing (Category II)

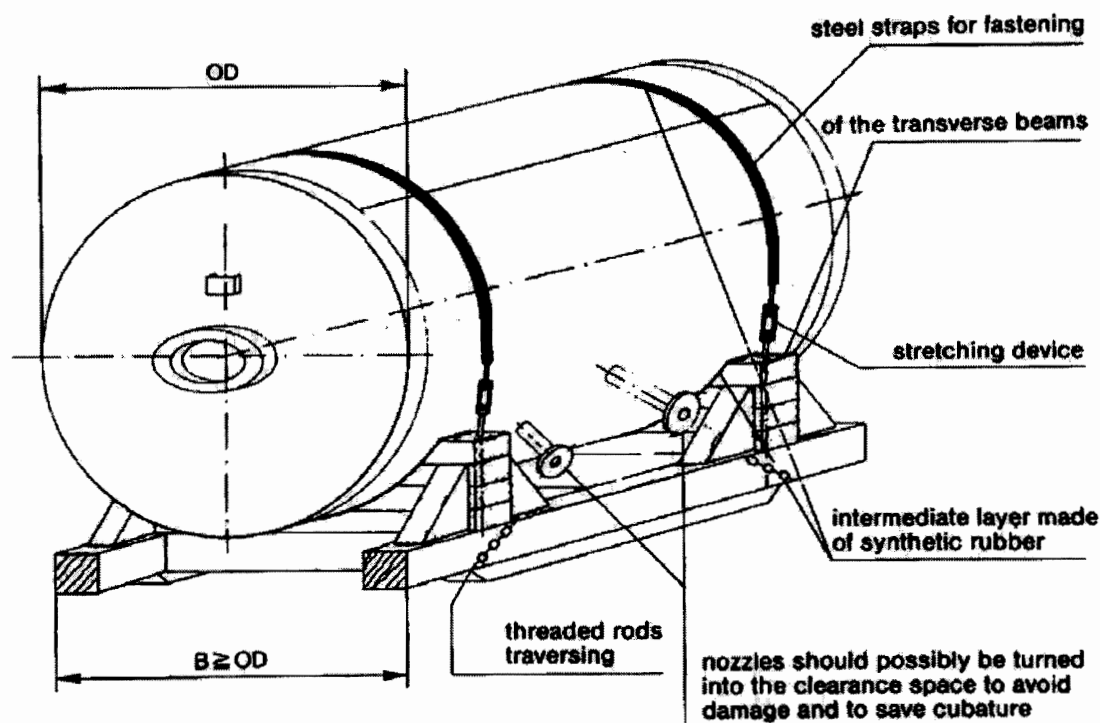
#### 8.3.1 Type of Equipment

Voluminous apparatus, tanks and/or heavy pieces those are not vulnerable to mechanical or corrosive effects.


#### 8.3.2 Type of Construction

- The construction skid can be made of wood or of metal.
- The fastening of the packages on the skid will be made by steel straps (flat iron) which have to be elastically lined, non-slip and securely bolted onto the skids.
- Flange openings have to be closed with gaskets and blind flanges or, if necessary, provided with cover.
- Skid constructions may not be less than the dimensions of the package in length or in width.
- Tanks and apparatus with their own support cradles must be supplied with an anti-slip lining.

#### PACKING CATEGORY-II





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#### 8.4 Packing of GOODS in Wooden Crates/Cases/Boxes

*The construction of wooden crate/cases/boxes shall be as per the details indicated in clause 9.0 & Fig 1 to 11. Details indicated in the sketches for different categories Packing crates/boxes are only for a typical equipment considered for illustration.*

##### 8.4.1 Packing Category III

###### 8.4.1.1 Type of Equipment

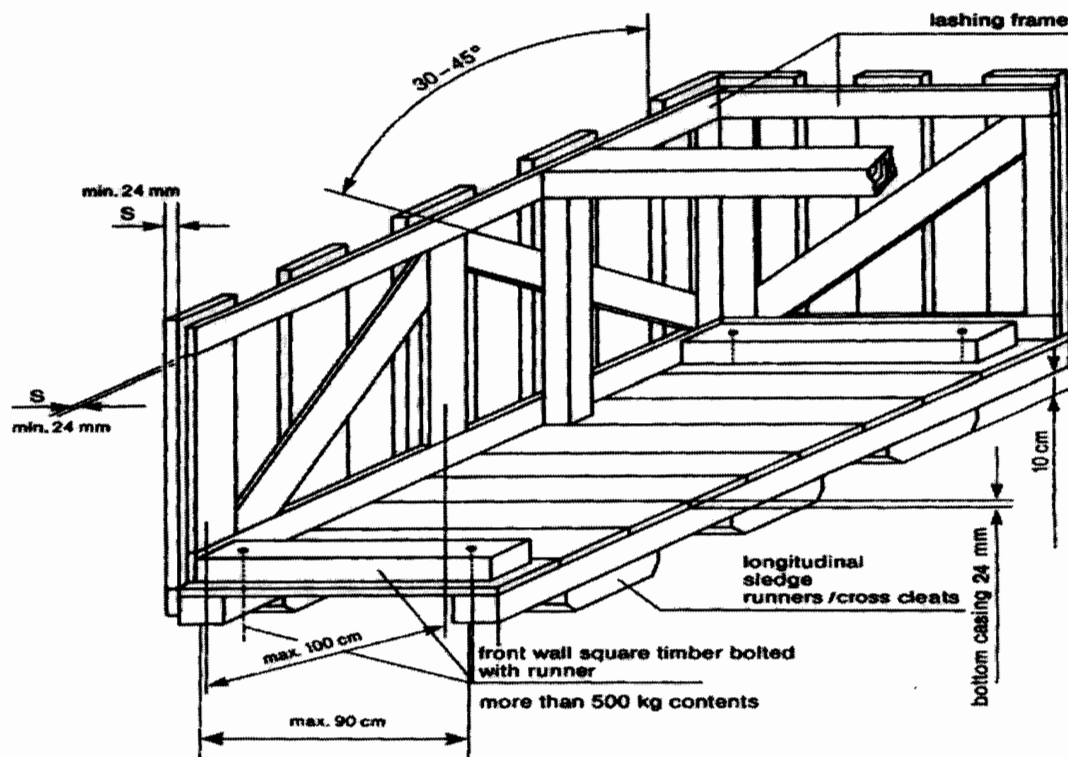
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

###### 8.4.1.2 Type of Construction

The equipment must be safely fastened to the bottom with bolts, possibly by the runners or to be spread in such a manner that no protruding parts are possible. For parts, sensitive to rainwater and/or debris, a protection has to be made by a foil cap.

If it is possible that single part could protrude through the front/back side wall, they shall be closed completely. The marking of the package shall be done on plywood plates at the prescribed sides.

##### Packing Category III



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## 8.4.2 Cases with Lining – Packing Category IV

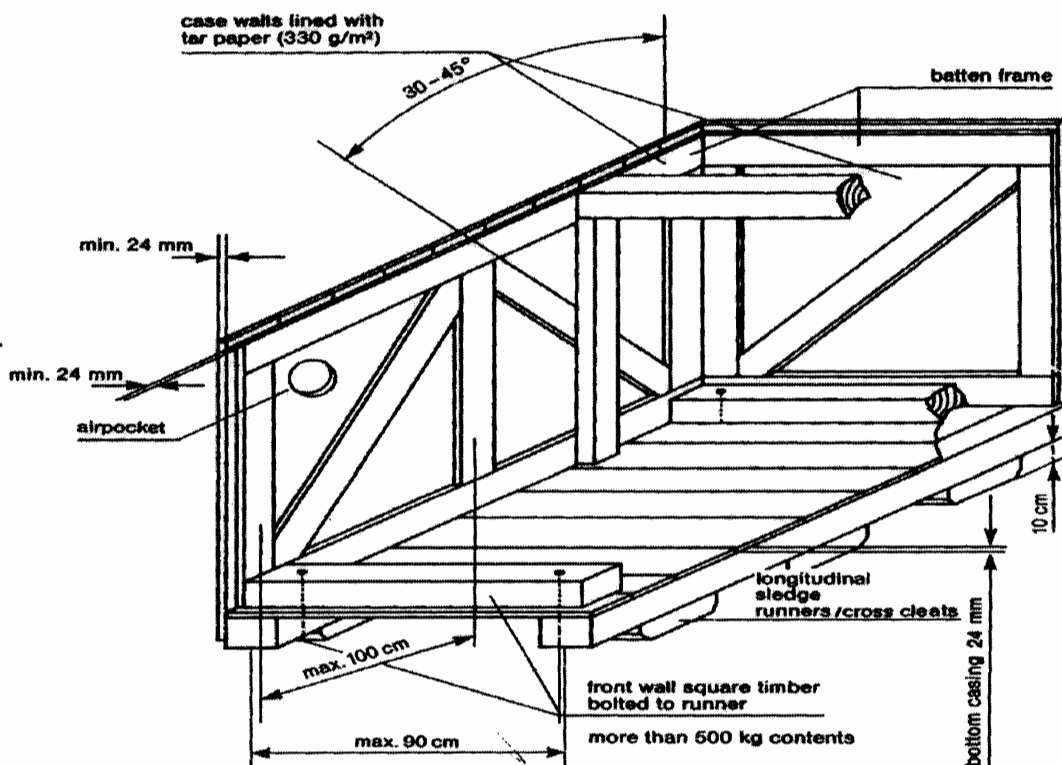
### 8.4.2.1 Type of Equipment

*Recommended for equipment and mechanical parts Equipment sensitive to mechanical damage or parts and components that are particularly at risk of theft or loss; pumps, elbows, flanges, fittings, tools, erection materials, etc.*

### 8.4.2.2 Type of Construction

The same type of construction as article 8.4.1.2, but with all sides completely boarded without space between the boards. Sides to be provided with waterproof lining; fabric-reinforced waterproof tar paper or polyethylene-foils resistant to ultraviolet rays can be used. Polyethylene-foil shall be fixed under the lid cover to avoid penetration of water. At weights of more than 500 kg the longitudinal runner must be bolted to the front all square timber. For ventilation inside the case, an opening in the waterproof lining must be placed between the diagonal battens and diagonal joists.

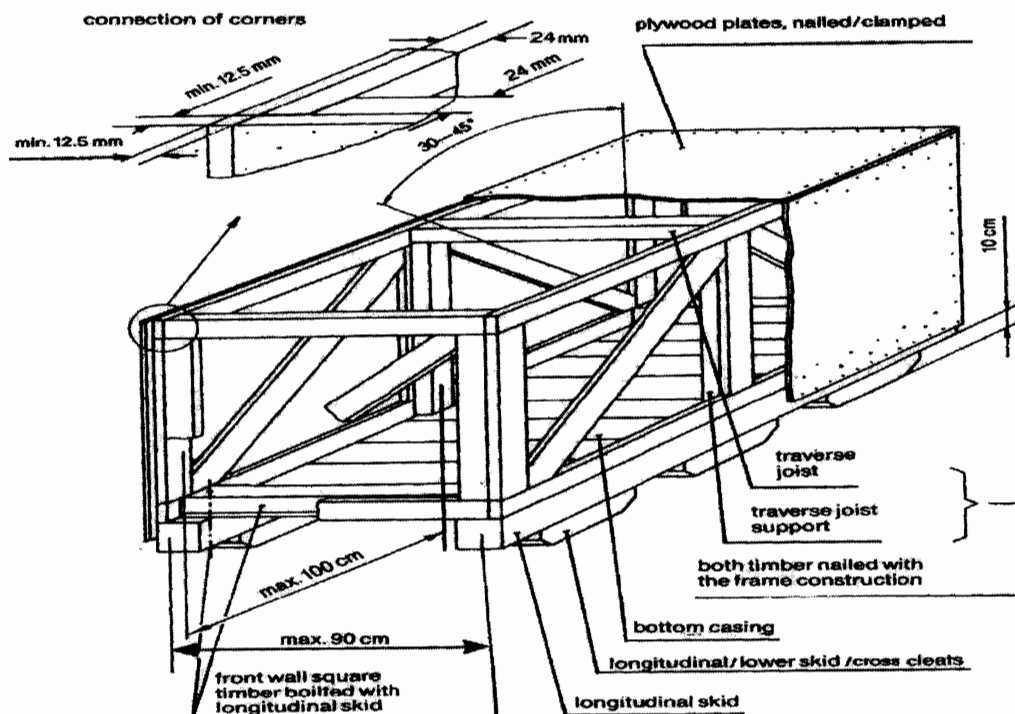
### Packing Category IV



## 8.4.3 Cases with Alternative Surface Materials

### 8.4.3.1 Plywood Box – Packing Category IV A

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Case constructed of 5 layers of watertight, glued plywood with a total thickness of 12.5 mm. The frame must be constructed from minimum 24 mm timber or as per guide lines given above against clause 8.0, Fig 1 to 11 and must be suitable for the weight and nature of the parts to be packed. Planed square timber must be bolted with longitudinal skid and covered with diagonal joists. If applicable, construction of the cover and sides is to include diagonal bracing. Covers consisting of several layers of plywood are to be sealed with durable elastic putty or additional water-resistant sheets to be fixed.

#### **8.4.4 Case with Barrier Material – Polyethylene Foil – Packing Category V**

##### **8.4.4.1 Type of Equipment**

Sensitive equipment, simple electrical equipment, insulation materials, fire-resistant materials, with non-corrosion- guarantee for a period up to twelve (12) months.

##### **8.4.4.2 Type of Construction**


Preservation by welding in polyethylene-foil with addition of desiccants and if necessary, application of non-corrosive contact agents, otherwise, type of construction as indicated in article 8.4.2.2.

Additional marking:

- Case with desiccants.

#### **8.4.5 Case with Barrier Material – Aluminium Compound Foil – Packing Category VI**

##### **8.4.5.1 Type of Equipment**

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Electrical equipment such as, switchboards, electric motors, sensitive equipment, with non-corrosion guarantee, for a period up to twelve (12) months.

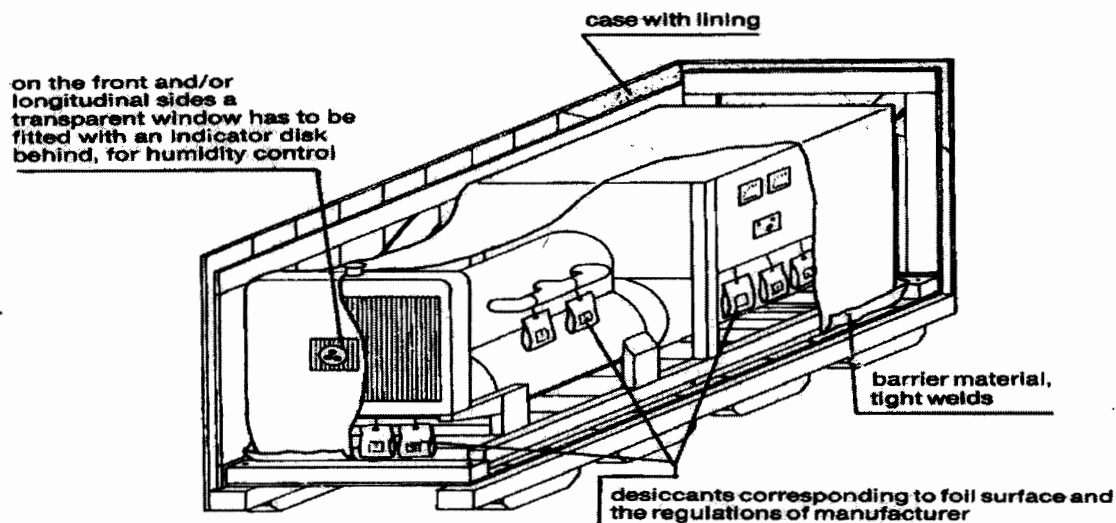
#### 8.4.5.2 Type of Construction

Type of construction as indicated in article 8.4.2.2. Preservation by sealing an aluminium compound foil, with the addition of desiccants. Humidity indicators, if required and installed in the barrier wrapping, shall allow easy control from the outside.

Additional marking:

- Case with desiccants.

#### Packing Category V/VI



#### 8.4.6 Double Case – Packing Category VII

##### 8.4.6.1 Type of Equipment

GOODS which are of high sensitivity to shock, impact and vibration, for instance, special electrical equipment like computers, switchboards, laboratory instruments

##### 8.4.6.2 Type of Construction

Case construction as indicated in article 8.4.2.2, with additional floating inner packing (case-in-case principle), padding corresponding to weight and sensitiveness. Preservation by sealing in aluminium compound foil with the addition of desiccants. The inner case has to be made of plywood or equivalent material with a thickness of 8-12 mm, depending on the weight of the GOODS to be packed. The inner buckles and/or frame borders have to be dimensioned so that the full stability of the inside case will be reached and no twisting is possible. The inner sides of the inside case will be lined with bituminous kraft paper on all sides (except bottom).

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#### **8.4.7 Cable Drum – Packing Category VIII**

##### **8.4.7.1 Type of Equipment**

All type of cables, wires, ropes, hoses.

##### **8.4.7.2 Type of Construction**

For all type of cables refer clause no. 11.1. For other items (wires, ropes, hoses) new or practically new drums are to be used. Planking of the e drums by use of boards, thickness minimum 20 mm, with additional double steel strapping, nailed, and carefully preserved/protected cable ends prior to packing.

#### **8.4.8 Hazardous Materials – Packing Category IX**

##### **8.4.8.1 Type of Equipment**

Hazardous materials according to the law are explosives, compressed gases, liquefied gases dissolved under pressure or deeply refrigerated, flammable liquids, flammable solids: substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases, oxidizing substances, organic peroxides, poisonous (toxic) and infectious substances; radioactive materials, corrosives, miscellaneous dangerous goods.

##### **8.4.8.2 Type of Construction**

Hazardous materials shall always be packed and documented separately from any other material. Selection of packaging materials, execution of packing and marking as well as documentation shall always be in compliance with the applicable laws and regulations. Any certificates required for transportation or for authorities to be supplied before shipment of the GOODS.

#### **8.4.9 Wooden Floor as a Transport Support – Packing Category X**

##### **8.4.9.1 Type of Equipment**

Any materials to be stuffed in containers or on flat racks and that are not stowed on standard pallets or otherwise suitably packed

##### **8.4.9.2 Type of Construction**


- Longitudinal internal square timbers bolted to the front wall runners, longitudinal skid.
- Maximum distance between longitudinal runners 90 cm (middle to middle of the runner).
- Full boarding of the floor.
- Attaching of lifting lugs and/or iron ropes for lifting/pulling the units off the transport equipment.
- If applicable, preservation of the equipment by sealing in polyethylene-foil or aluminium compound foil and the addition of desiccants.

#### **8.5 Air Transport Packing**

##### **8.5.1 General**

Certain types of material may have to be shipped by air from their country of origin. This means of transport will be exceptional, and will be used only:

- For GOODS, which are highly sensitive to shock or vibrations, such as computers, electronic instruments, or those of small dimensions and weight.
- For GOODS urgently required at the module yard(s) and/or jobsite.

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### 8.5.2 Type of Packing

Depending on the goods to be packed, VENDOR may use one of the following types:

- A triple-corrugated cardboard container made with waterproofed glue and a barrier layer of polyethylene on the outsides to keep out humidity.
- Wooden/cardboard packing cases: the wood being used for the framework and base of the cases, waterproofed triple-corrugated cardboard being used for the sides and top. These cases are of the "Bell" type, and used for material of small or medium dimensions.
- For larger dimensions, plywood cases are acceptable. The timber characteristics, cross-sections and thickness will be systematically determined by the nature of the loads to be packed.

### 8.5.3 Dimensions

In order to optimize the existing transport facilities (passenger or cargo aircraft), the dimensions of:

- Triple-corrugated containers.
  - Wooden/cardboard packing cases.
  - Plywood cases.
- Are to be adapted to pallets used for air transportation.

## 9.0 Detailed specification for Wooden Crates/Boxes/Cases and other packing materials

### 9.1 Technical specification for wood

The wood shall be Fir, Chir, Silver Oak (Gravillea Robusta), chemically treated mango and Pinewood with moisture content not exceeding 50%. The wood shall have flexural and compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, cracks, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects or fungus, etc. Surface cracks with maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

### 9.2 Chemical Treatment of Wood:


The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planning, joint grooving, etc.

### 9.3 TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES:

#### 9.3.1 PACKING OF EQUIPMENTS

Various mechanical, electrical and C&I equipment e.g. Pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers, etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases/crates shall be as per details given below and also given in figure 1 to 11.

##### 9.3.1.1 Bottom Frame

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The construction of bottom frame shall be as per Fig-2. The No. of slides/runners for bottom frames shall be selected depending upon the weight and overall dimensions of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt and nuts etc. to bottom frame of the wooden packing cases/crates. The equipment not provided with base frame/plate like cylindrical vessels, etc to be secured to the bottom frame of the wooden cases with "C" clamps fabricated from steel channels/ angle iron.

#### 9.3.1.2 TOP FRAME

The construction of top frame shall be as per fig-3.

#### 9.3.1.3 END PANELS

The dimension of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed. Diagonal braces shall be used for packing cases having height exceeding 500mm. Details of bracings shall be as per fig 5 to 9.

#### 9.3.1.4 Sling Plate


To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig-11.

#### 9.3.1.5 Angle Iron Cleats

Angle iron cleats shall be used for strengthening the joints as indicated in fig-10

#### 9.3.1.6 Other Requirements

- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc shall be of single length i.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length up to 2400mm, proper jointing is permitted for planks for sheathing and diagonal bracings.
- Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polythene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.
- The inner surface of 4 sides of shooks shall be nailed with bituminized water proof craft paper. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- All the inner sides of the box shall be nailed with bitumen coated HESSIAN POLYTHYLENE KRAFT PAPER. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- For delicate equipment like control panels and switchgears, lighting panels and lighting transformers, suitable cushioning material like rubberised coir (min. 50 mm thick and 100 mm wide) shall be provided on their bottom support and the gap between the panel and casing

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shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig15). For other equipment suitable support from sides of the casing shall be provided.

- Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose and shall be separately packed and shipped as per packing instructions in clause 10.4.
- Packing case for control panels and switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4mm.
- Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further heavier boxes shall be strapped with C clamps (ref fig-4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.
- Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be indicating type confirming to IS-304 (1979) packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into directly contact with equipment/material inside the package. The quantity of silica gel shall be adequate for storage period of one year, however it shall not be less than 4 gm. per ltr. Volume of case subject to minimum 400 gm. Per case.





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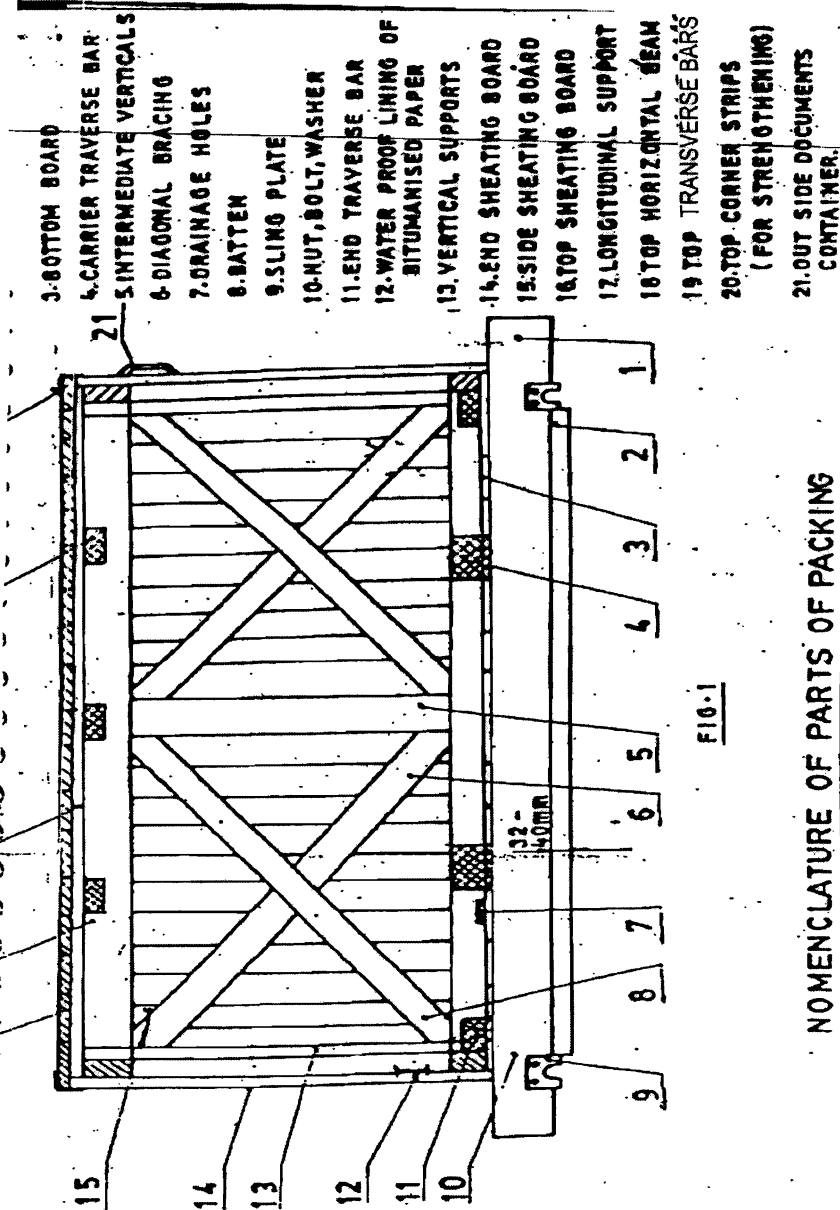


FIG-1

## NOMENCLATURE OF PARTS OF PACKING

### CASES

FIG-1

028

EC-009



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## BOTTOM FRAME ARRANGEMENTS

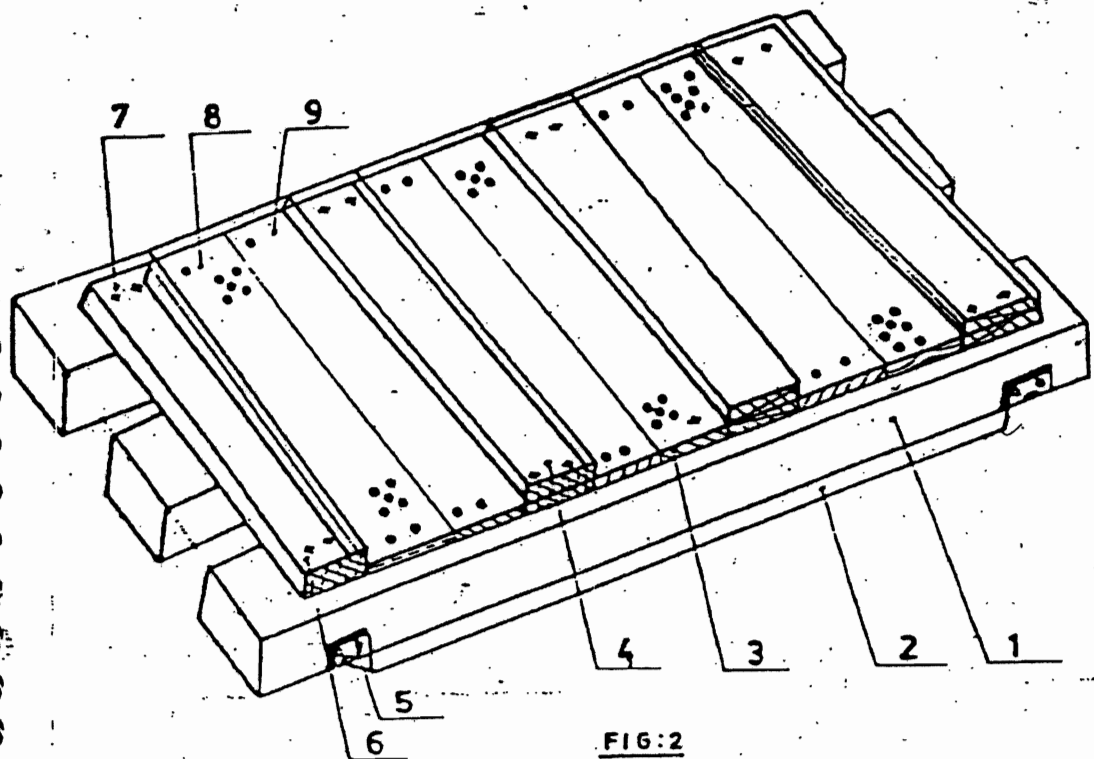



FIG:2

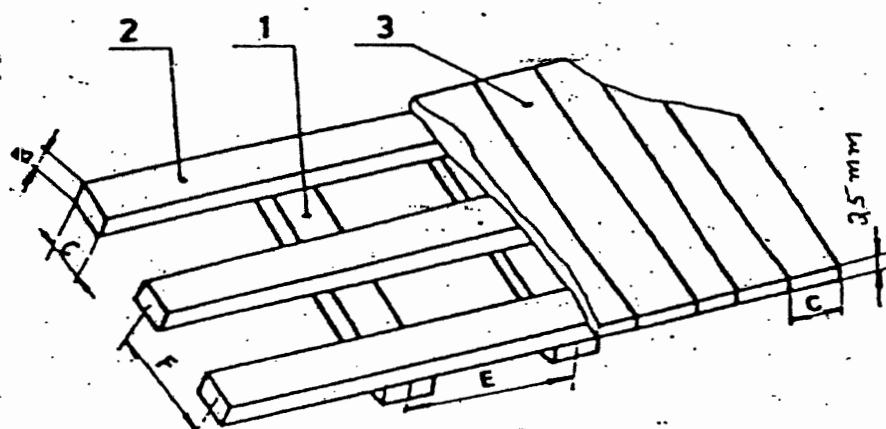
Nos. of slides: Minimum 2 Nos.  
For length more than 1800 mm or  
load more than 1000kg, nos. of  
slides shall be minimum 3 Nos.  
For dimensions of slides, refer Table 1  
Cross section of end traverse bar; 100x100 mm.  
(minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TRAVERSE BAR
5. SLING PLATE
6. TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS

027

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### TOP FRAME ARRANGEMENT

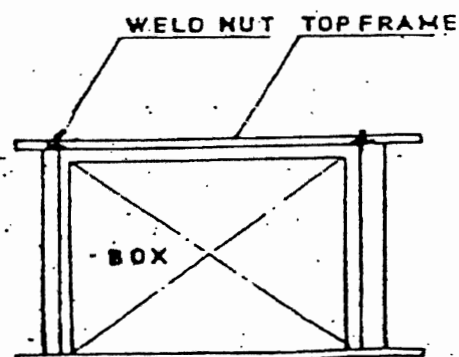
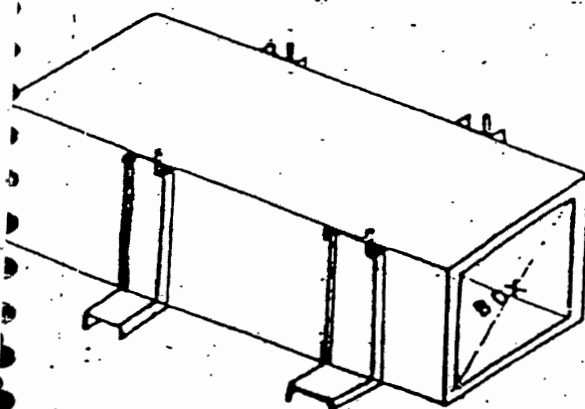


**FIG-3**

F : 700 to 1000 mm  
 E : 500 to 900 mm  
 30x100 mm.

- 1 - Traverse Bars
- 2 - Horizontal Soans
- 3 - Top Board

### ARRANGEMENT OF C-CLAMPS AROUND CASES



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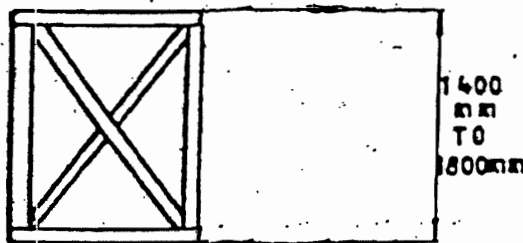
**ARRANGEMENT OF DIAGONAL BRACING AND  
HORIZONTAL SUPPORT**

FIG: 6

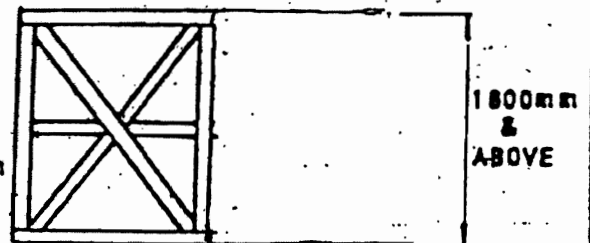


FIG: 8

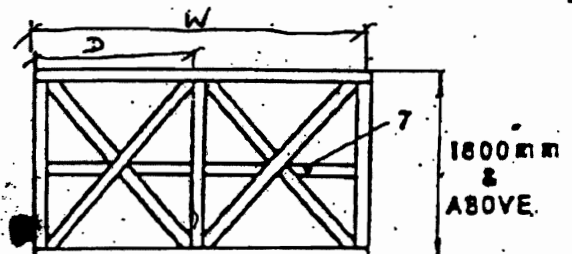


FIG: 7

7- Middle Horizontal Support

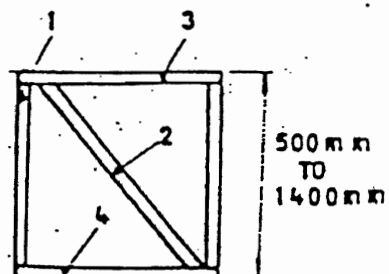


FIG: 5

1- Vertical Support

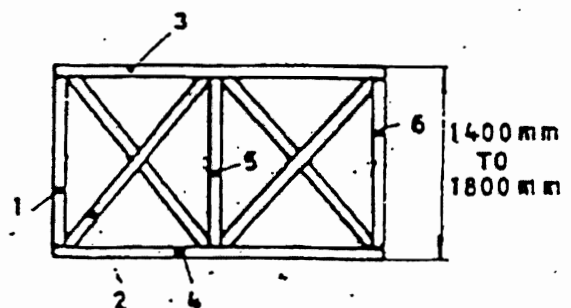


FIG: 7

1, 5, 6 - Vertical Support

029

**TITLE**

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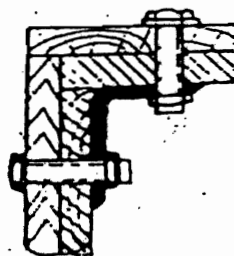
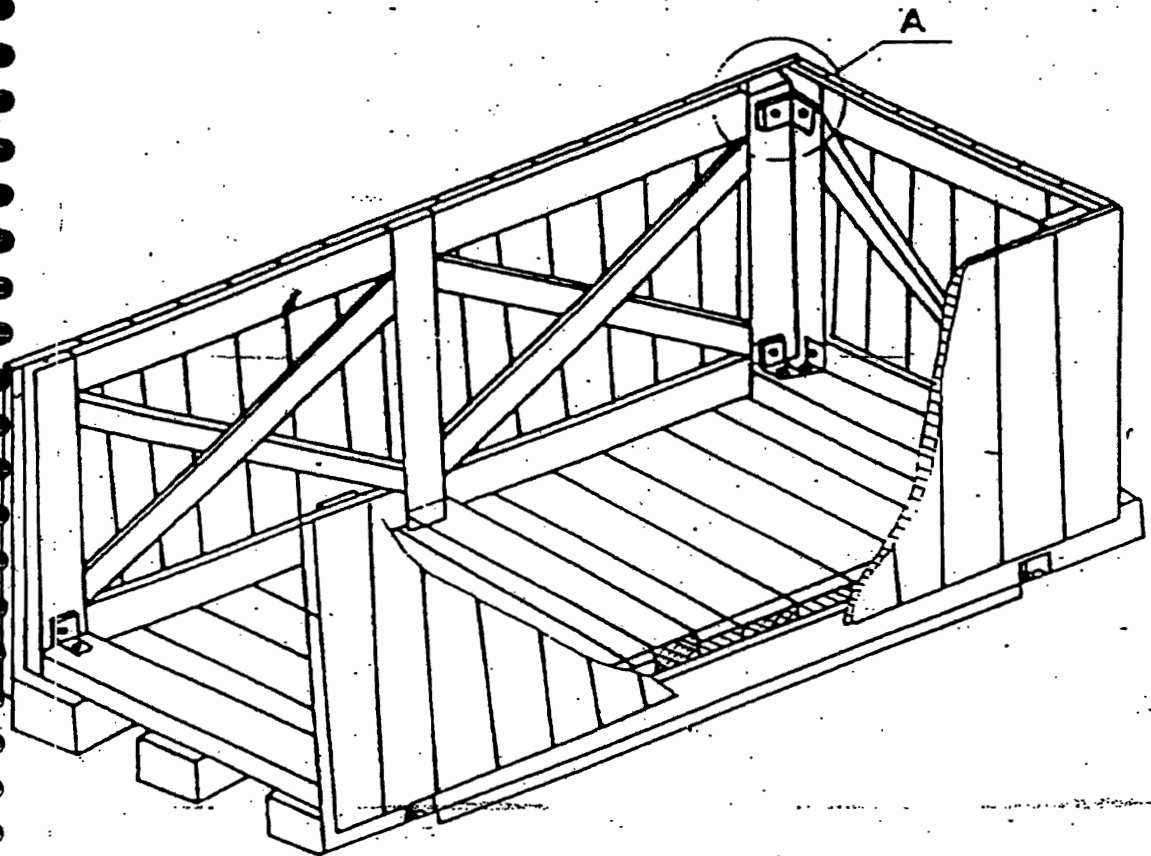
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## ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER  
MUST CONFORM  
TO BOLT DIA

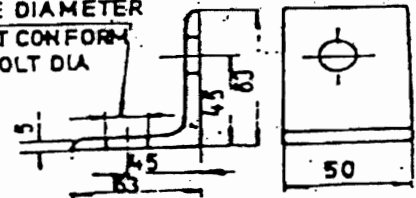

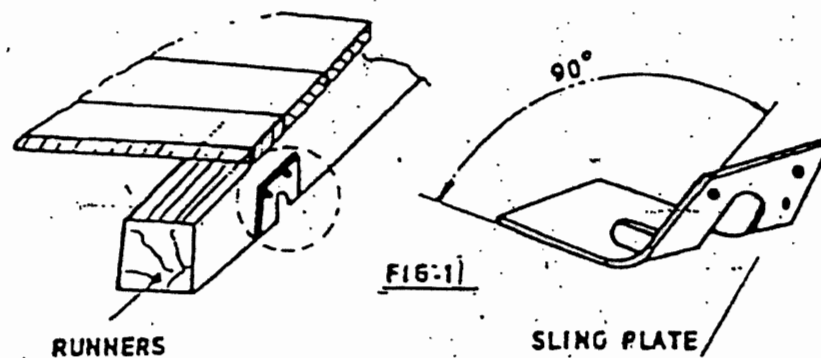



FIG:10

030

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## ARRANGEMENT OF SLING & PLATE ON CASES



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**TABLE-1**


LOADS	LENGTHS OF SLIDES						
	600	800	1000	1200	1300	1500	2000
	Cross section b x c				<div style="border: 1px solid black; display: inline-block; width: 80px; height: 15px; vertical-align: middle;"></div> c b		
500	50 X 100	50 X 100	50 X 100	50 X 100	75 X 100	75 X 100	100 X 100
800	50 X 100	50 X 100	75 X 100	75 X 100	75 X 100	75 X 100	100 X 100
1000	75 X 100	75 X 100	75 X 100	100 X 100	100 X 100	100 X 110	100 X 150
1500	75 X 100	75 X 100	100 X 100	100 X 100	100 X 100	100 X 150	100 X 150
2000	75 X 100	100 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150
2500	75 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150	150 X 150
3000	100 X 100	100 X 150	150 X 150	150 X 150	150 X 150	150 X 150	150 X 150

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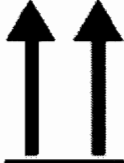




**Table-2**

End and side panels	Width of the panel "W"	Distance between longitudinal support (Dimension "D")						
		600	800	1000	1200	1400	1600	1800
		Cross section b x c				Item 1 to 7		
Fig- 5 to Fig-9	600 to 1200	30	30	30	30	30	30	30
		X	X	X	X	X	X	X
	1201 to 1600	100	100	100	130	130	130	130
		30	30	30	30	30	30	30
	1601 to 2000	X	X	X	X	X	X	X
		130	130	130	130	130	130	130
	2001 to 3000	30	30	30	30	30	30	40
		X	X	X	X	X	X	X
	3001 to 4000	130	130	130	130	130	130	150
		40	40	40	40	40	40	40
		X	X	X	X	X	X	X
		150	150	150	150	150	150	150




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#### INDICATION MARKS ON CASES/BOXES/CRATES

Designation	Symbol	Explanation
Fragile, Handle with care		The symbol should be applied to easily broken cargoes. Cargoes marked with this symbol should be handled carefully and should never be tipped over or slung.
Use no hooks		Any other kind of point load should also be avoided with cargoes marked with this symbol. The symbol does not automatically prohibit the use of the plate hooks used for handling bagged cargo.
Top		The package must always be transported, handled and stored in such a way that the arrows always point upwards. Rolling, swinging, severe tipping or tumbling or other such handling must be avoided.
Keep away from heat (solar radiation)		Compliance with the symbol is best achieved if the cargo is kept under the coolest possible conditions. In any event, it must be kept away from additional sources of heat. It may be appropriate to enquire whether prevailing or anticipated temperatures may be harmful.
Protect from heat and radioactive sources		Stowage as for the preceding symbol. The cargo must additionally be protected from radioactivity.
Sling here		The symbol indicates merely where the cargo should be slung, but not the method of lifting. If the symbols are applied equidistant from the middle or center of gravity, the package will hang level if the slings are of identical length. If this is not the case, the slinging equipment must be shortened on one side.
Keep dry		Cargo bearing this symbol must be protected from excessive humidity and must accordingly be stored under cover. If particularly large or bulky packages cannot be stored in warehouses or sheds, they must be carefully covered with tarpaulins.


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Center of gravity		This symbol is intended to provide a clear indication of the position of the center of gravity. To be meaningful, this symbol should only be used where the center of gravity is not central. The meaning is unambiguous if the symbol is applied onto two upright surfaces at right angles to each other.
No hand truck here		The absence of this symbol on packages amounts to permission to use a hand truck on them.
Stacking limitation		The maximum stacking load must be stated as "... kg max.". Since such marking is sensible only on packages with little loading capacity, cargo bearing this symbol should be stowed in the uppermost layer.
Clamp here		Stating that the package may be clamped at the indicated point is logically equivalent to a prohibition of clamping anywhere else.
Temperature limitations		According to regulations, the symbol should either be provided with the suffix "...°C" for a specific temperature or, in the case of a temperature range, with an upper ("...°C max.") and lower ("...°C min.") temperature limit. The corresponding temperatures or temperature limits should also be noted on the consignment note.
Do not use forklift truck here		This symbol should only be applied to the sides where the forklift truck cannot be used. Absence of the symbol on other sides of the package amounts to permission to use forklift trucks on these sides.
Electrostatic sensitive device		Contact with packages bearing this symbol should be avoided at low levels of relative humidity, especially if insulating footwear is being worn or the ground/floor is nonconductive. Low levels of relative humidity must in particular be expected on hot, dry summer days and very cold winter days.

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Do not destroy barrier		A barrier layer which is (virtually) impermeable to water vapor and contains desiccants for corrosion protection is located beneath the outer packaging. This protection will be ineffective if the barrier layer is damaged. Since the symbol has not yet been approved by the ISO, puncturing of the outer shell must in particular be avoided for any packages bearing the words "Packed with desiccants".
Tear off here		This symbol is intended only for the receiver.

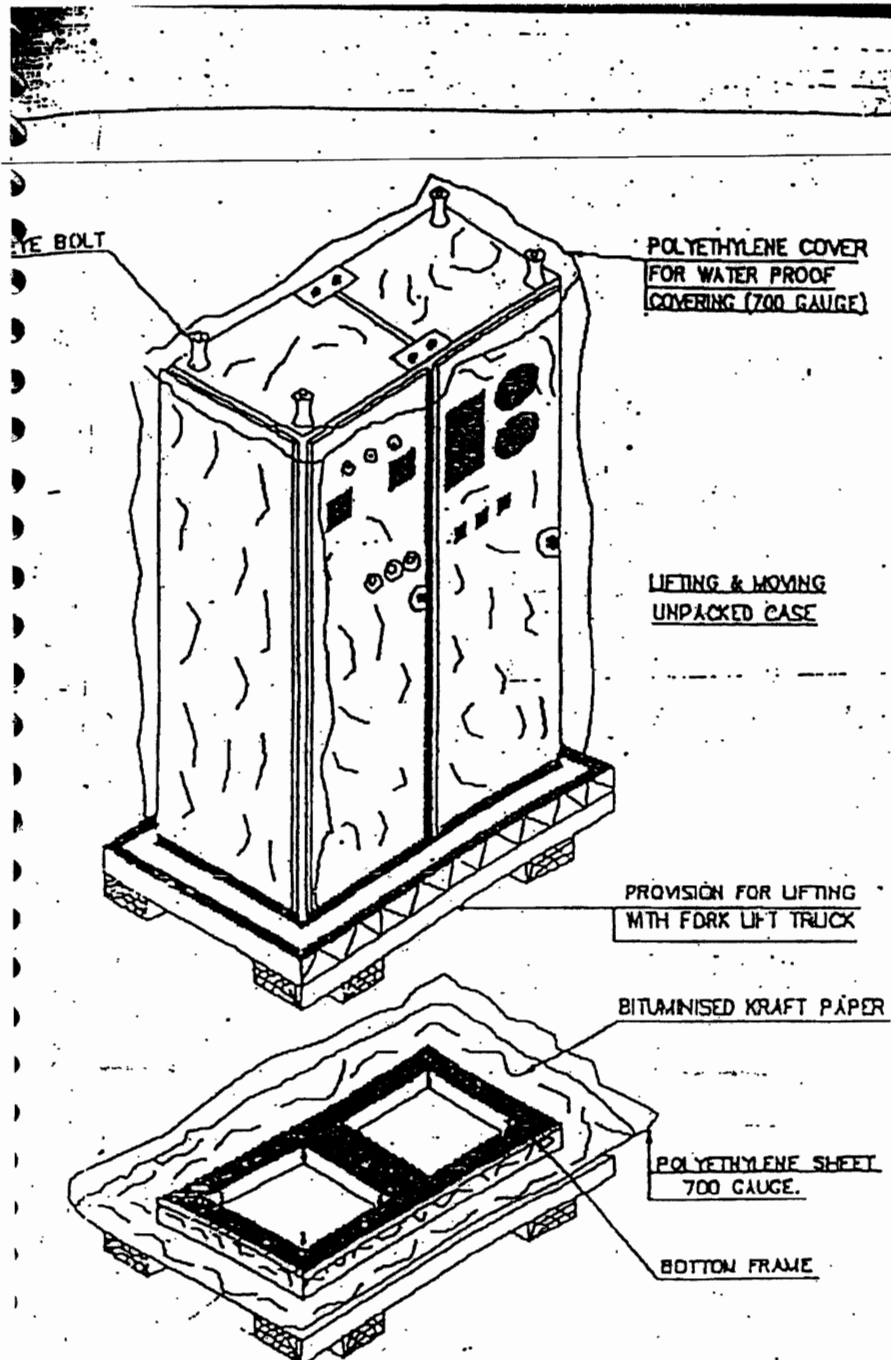
**FIG-12**

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BHEL-PEM-DELHI-INDIA	
CONSIGNEE	
MATERIAL	
CUSTOMER REF.	MO. NO.
DESPATCH ADVICE NOTE NO.	CASE NO.
DIMENSIONS(MM) LXBXH	NET WT -KGS
	GROSS WT -KGS
SPECIAL INSTRUCTIONS	HANDLE WITH CARE -- KEEP DRY DO NOT DROP -- DO NOT TILT

FIG-13: MARKING PLATE

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**FIGURE-14**



# TITLE

## TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS

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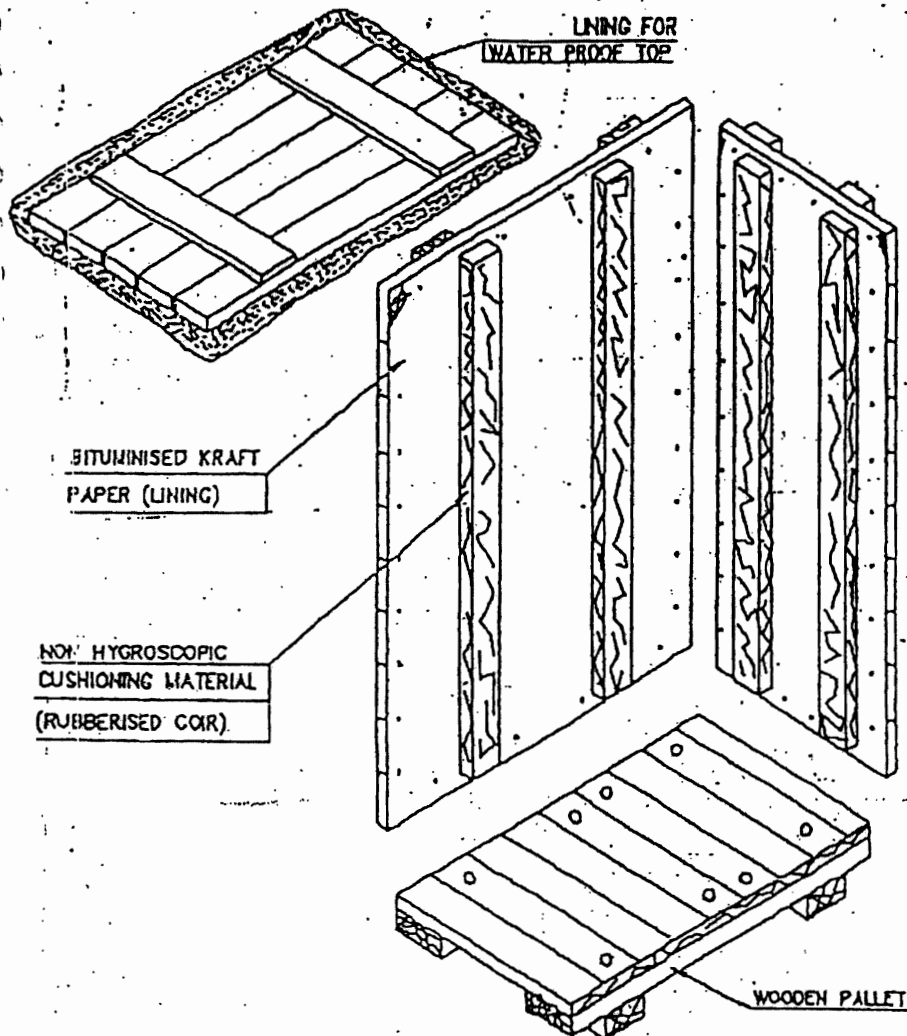

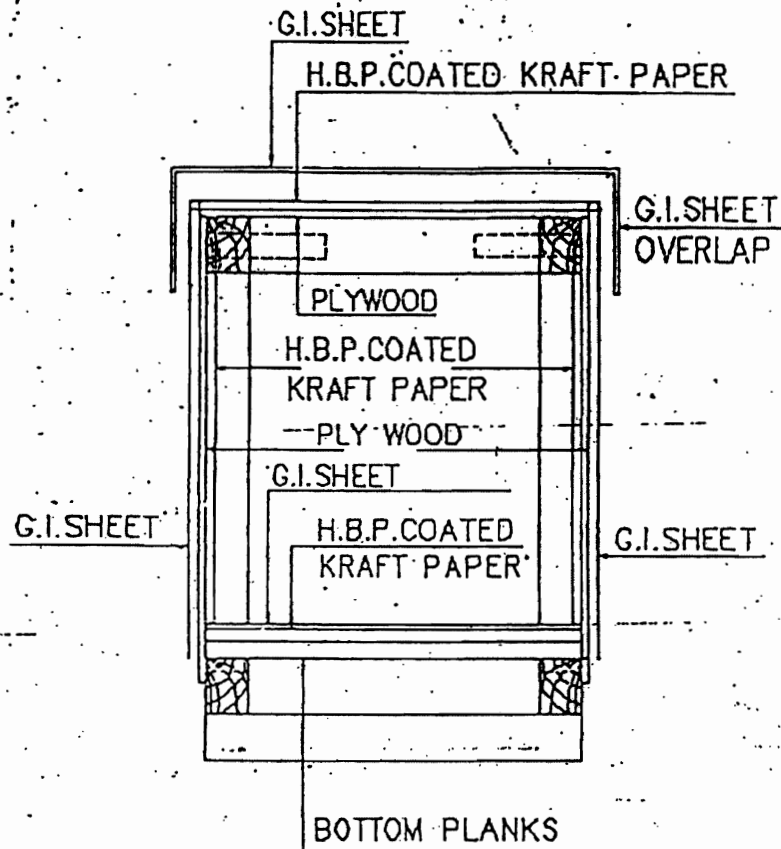



FIGURE-15

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**FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET  
SHOWING LAYERS OF PACKING MATERIALS.**

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## 10.0 TYPICAL PACKING DETAILS/PROCEDURE FOR MECHANICAL ITEMS

### 10.1 INSULATION MATERIAL (MINERAL WOOL MATTRESSES)

This specification covers the requirements of seaworthy packing and marking for bonded mineral (rock) wool mattresses having metallic hexagonal wire netting as facing on one or both sides.

#### 10.1.1 TYPE OF CONSTRUCTION

Mattress shall be packed in Polythene (of 0.2 mm thickness) all around and sealed to prevent moisture absorption during transit and storage. Further it shall be wrapped with Bitumen coated Polythene bonded/lined Hessian and stitched and then packed in 5 ply DFC carton box.

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS:304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into direct contact with the material inside the package. The quantity of silica gel shall be enough for storage period of one year. However, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

Each mattress as well as the packages shall be serial numbered. Also, printed sheets indicating the nominal thickness, density and wire netting details (i.e. material and size) shall be placed below the wire netting.

Following details shall be legibly written on the packages. The details shall also be typed on a sheet of paper & kept in a sealed Polythene cover, inside the packages

- a) Project Name
- b) Purchase Order No.
- c) Sl. No. of package
- d) Size of mattress (Thickness x Length x Width)
- e) Density
- f) Wire netting material and size
- g) Weight of the package


### 10.2 INSULATION MATERIAL (ALUMINIUM COIL)

Heavy Gauge Aluminium Coil Packaging are done by Eye-to-Sky packaging or by Eye to eye packaging as per the proven practice being followed by manufacturer of Aluminium sheets.

#### 10.2.1 Type of construction for Eye to Sky packaging

- a. Strapping of coil with polyester strap around circumference at one place.
- b. Putting paper I. D. Edge protector.
- c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
- d. Wrapping the coil with HDPE film.
- e. Covering the coil including its build up & bore with masonite / particle board.
- f. Putting metallic I. D on coil.
- g. Putting O.D edge protector (paper) on coil.



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- h. Putting circumferential polyester strap (3 nos.) & eye polyester strap ( 4 nos.).
- i. After placing the coil on coil tilter ply wood (10mm thick) of suitable size along with wooden pallet is to be put at the bottom side of the coil.
- j. Coil is to be tilted to eye-to-sky position.
- k. Final strapping with metallic strap to unit coil and skid at 2 places with top cover of plywood.
- l. Fixing the coil with wooden blocks at 4 corners.
- m. Labeling 2 nos.(one metallic & one adhesivetype) For specification, net wt. & gross wt.

#### **10.2.2 Type of construction for Eye to Eye packaging**


- a. Strapping of coil with polyester strap around circumference at one place.
  - b. Putting paper I. D. Edge protector.
  - c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
  - d. Wrapping the coil with HDPE film.
  - e. Covering the coil including its build up & bore with masonite / particle board.
  - f. Putting metallic I. D on coil.
  - g. Putting O.D edge protector (paper) on coil.
  - h. Putting circumferential polyester strap (3 nos.) & eye polyester strap ( 4 nos.).
  - i. Placing of coil on wooden skid Coil is to be tilted to eye-to-sky position.
  - j. Final strapping of coil and skid at 2 places with steel strap. Fixing the coil with wooden blocks at 4 corners.
- Labeling 2 nos.(one metallic & one adhesive type) For specification net wt. & gross wt.

#### **10.3 Packing Procedure for Online Tube Cleaning System and accessories**


This procedure is applicable for the shipment of Onload Tube Cleaning System and accessories by sea.

##### **10.3.1 Packing details:**

- The Packing case shall be made of treated rubber wood. The design of the case shall be as per Annexure IIIA & IIIB.
- The Equipments shall be placed on the wooden base of the Packing case and fastened if required to arrest the movement of the same.
- Equipment shall be covered by Polythene sheet and inside wall surfaces of the wooden cases also shall be covered by polythene sheet.
- All Nozzles shall be closed with plywood dummies.
- All electrical components assembled or loose shall be covered with polythene sheets along with silica gel pack.
- Silica gel desiccants shall be kept inside each case in sufficient quantities in order to absorb the moisture.

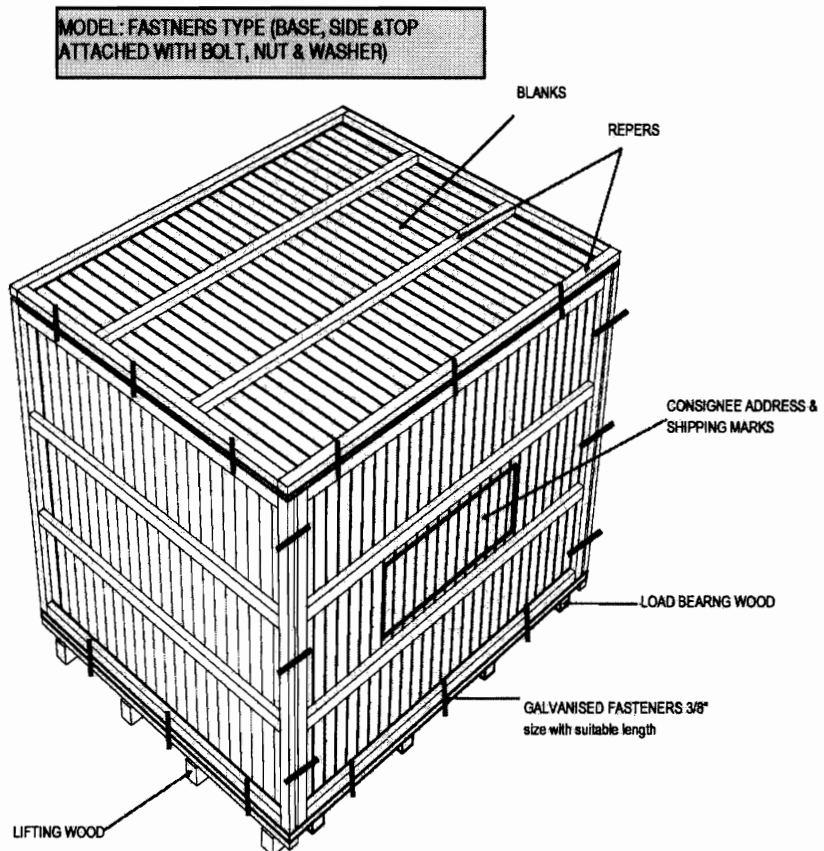
	<b>TITLE</b>  <b>TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS</b>	SPECIFICATION NO. <b>PE-TS-888-100-A001</b>	
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- Thermocol packing shall be made for glass items like Ball vessel sight glass, Vpiece
- sight glass & pressure gauge.
- Silica gel desiccants shall be kept inside of each case to absorb the moisture.
- A Packing list covered in a polythene envelope shall be fixed inside and outside of each packing case.
- Shipping marks and consignee address shall be painted on the outer surface of the case.
- All handling instruction required for the case like top, sling, rain, handle with care etc, shall be marked on the case as per the symbol attached.
- Machined surface will be applied with Anti rust oil and covered by polyurethane sheet to protect from external oxidation.
- All valves will be closed with dummies to protect the internals and placed in the wooden case which will covered by polyurethane sheet.


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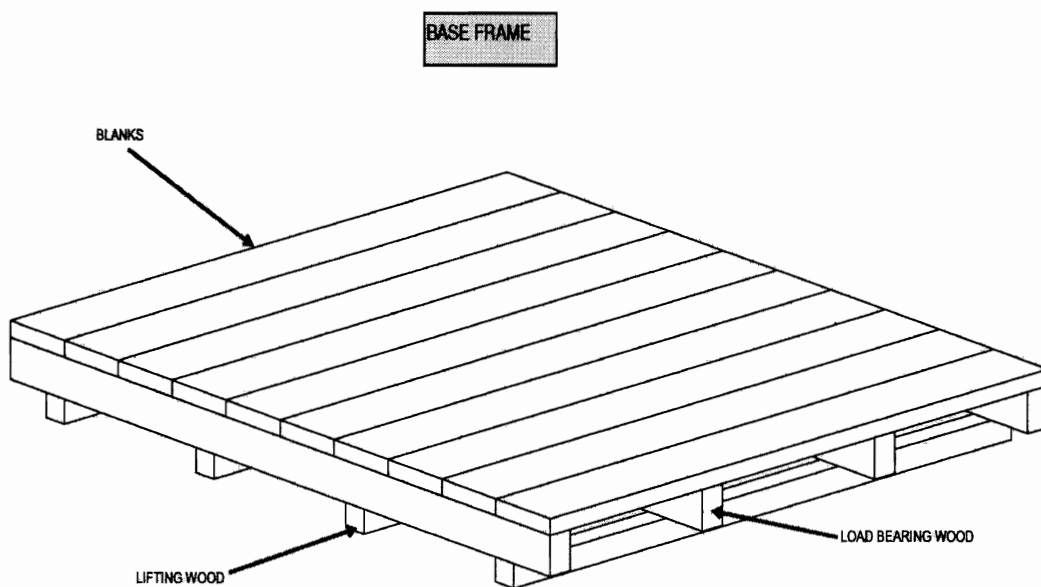
This Type of case to be used for following items:

1. BALL SEPERATOR
2. BALL COLECTOR SKID




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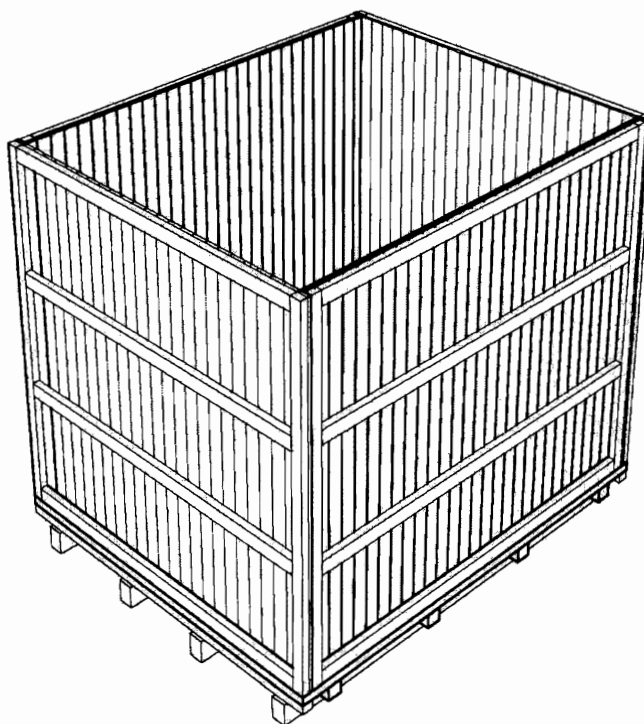
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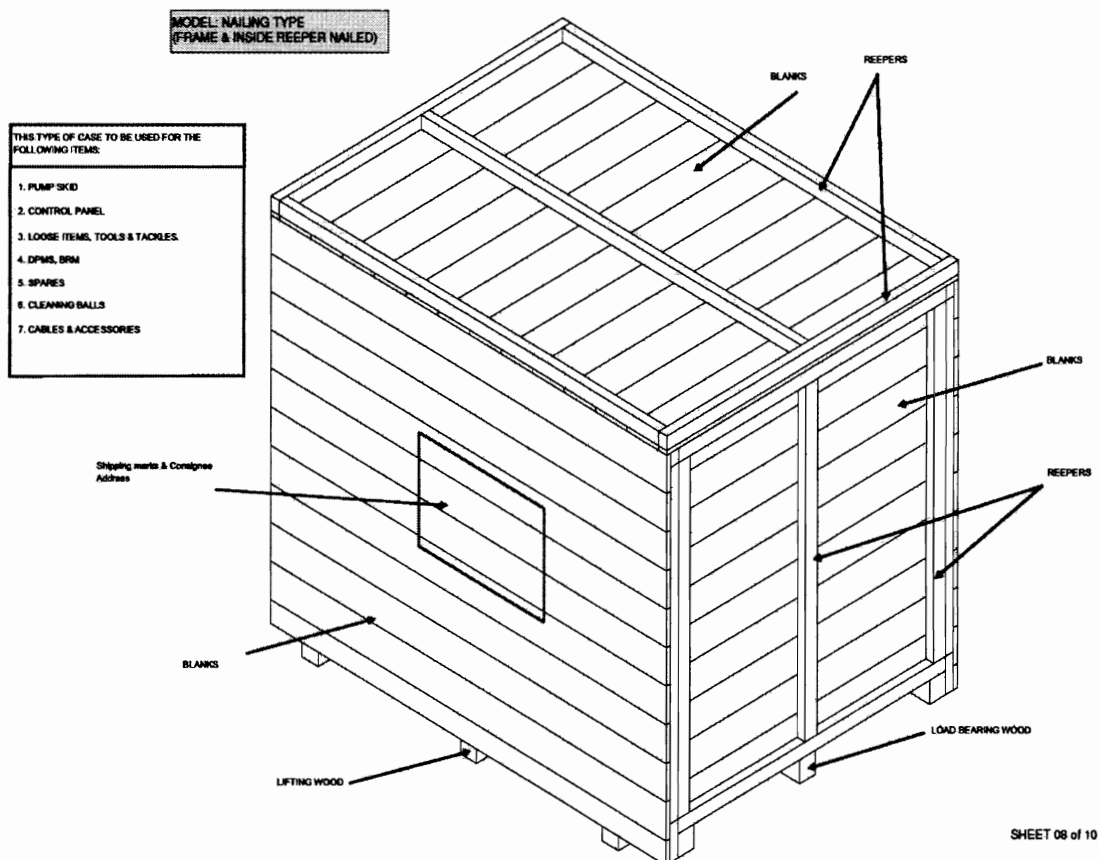
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MODEL: FASTNERS TYPE - WITHOUT TOP




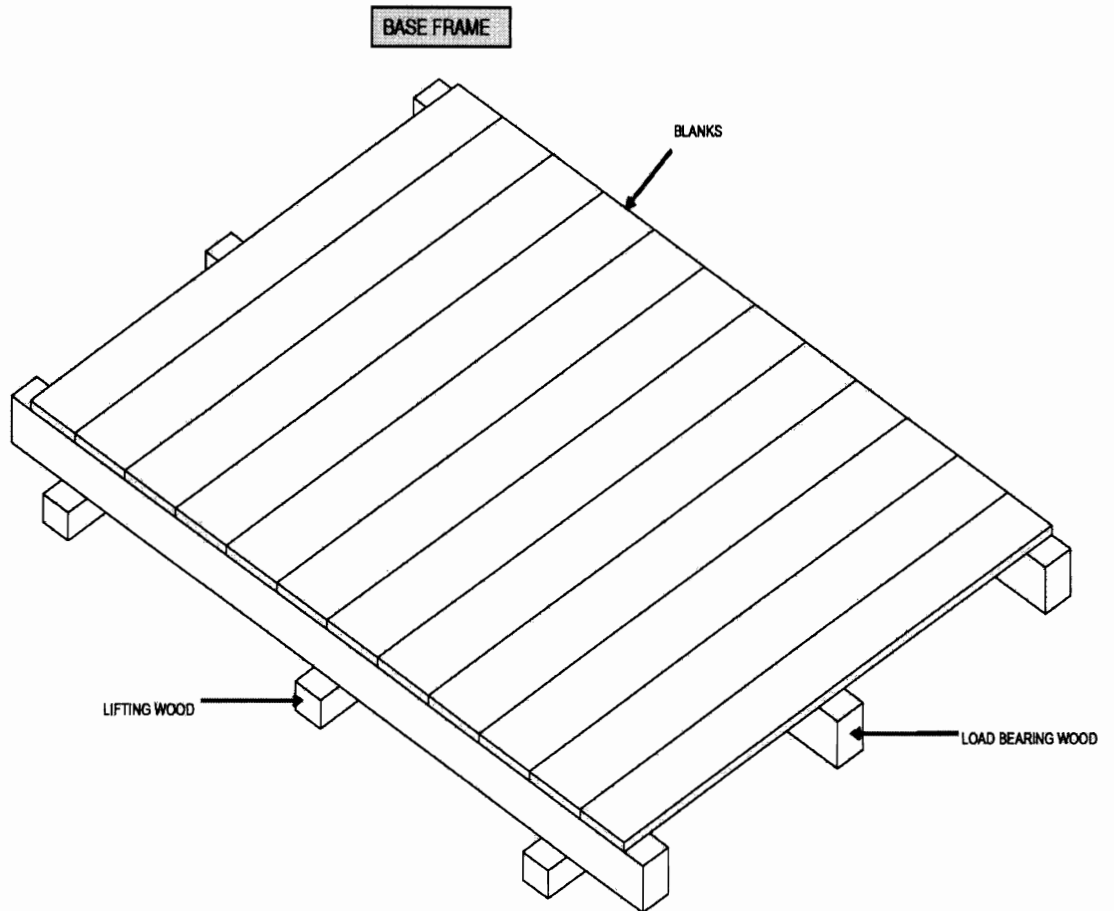
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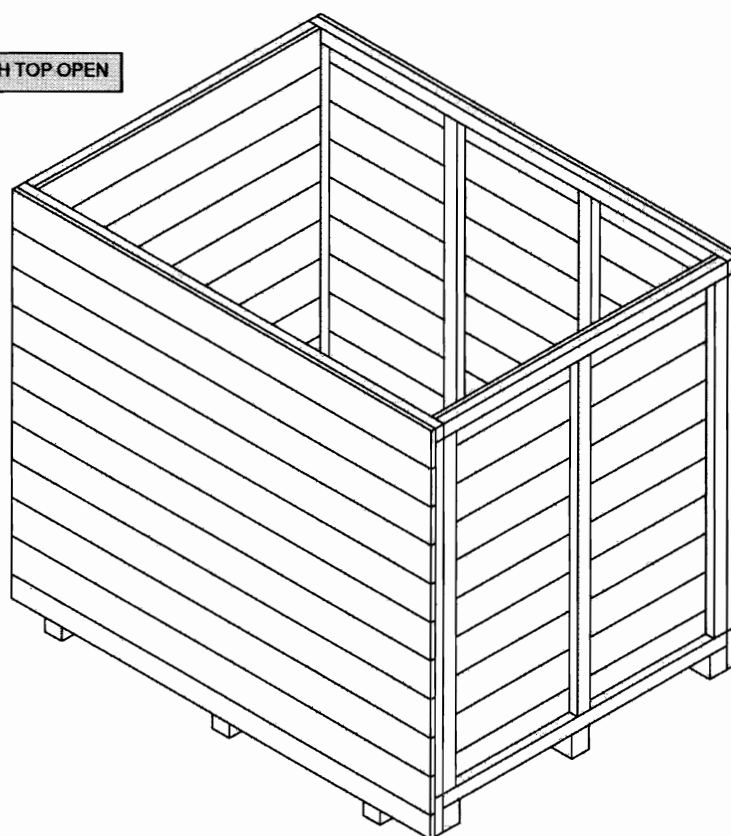
	<b>TITLE</b>  <b>TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS</b>	SPECIFICATION NO. PE-TS-888-100-A001	
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NAILING TYPE MODEL WITH TOP OPEN



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#### 10.4 PACKING OF LOOSE ITEMS

Loose mechanical, electrical and C&I items e.g. valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/ thermocol sheets/air bubble sheets depending upon the items and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect, Special attention shall be paid to relays, instruments etc for arresting the movements of their operating mechanism during transportation.

The construction of wooden packing cases shall be as per clause 9.3.1 retaining its all features concerning strength of the box. The construction of wooden packing case for electrical and C&I items shall be as per fig-16.

Inner surface of 6 sides of the box shall be lined with bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the boxes.


#### 11.0 PACKING OF ELECTRICAL ITEMS

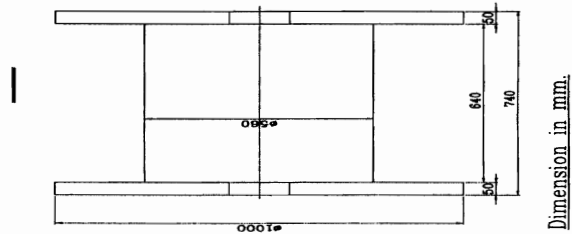
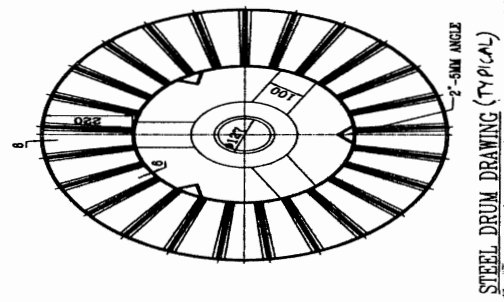
##### 11.1 CABLES


**11.1.1 Type of Equipment**  
All type of cables..

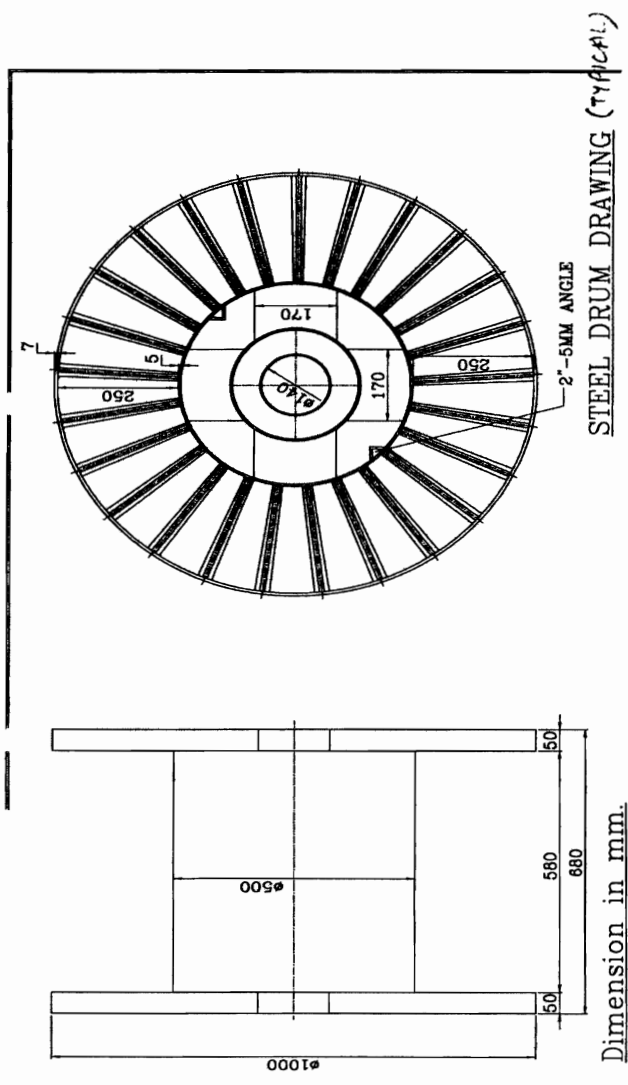
##### 11.1.2 Type of Construction

New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. Cable drum can be put in wooden crates for ease in transportation and handling. (Wooden cable drum is also acceptable, however vendor to furnish constructional details for approval).

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## 11.2 PACKING OF CABLE TRAYS & ACCESSORIES AND CABLE TRAY SUPPORT MATERIAL

11.2.1 Cable trays can be packed in wooden boxes as per fig 1 to 11 or in steel boxes. Details of steel box construction is as indicated below.

- 1) All Dimensions are in "mm" unless otherwise stated.
- 2) Packing Box shall be fabricated using 50x50x6mm MS Angle, 50x3mm Flat, 2.5 mm thick C Channel, 1mm & 1.6mm Thick sheet.
- 3) Finish of Packing Box Shall be Galvanized.
- 4) Angle & Channel Section forming part of the Main frame shall be welded thoroughly with each other to give a rigid structure.
- 5) Sheet Section and Flat section shall be bolted/ Riveted/ Welded suitably to the Main frame stated in '4' above.

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- 6) Welding Portion on galvanized surfaces shall be painted with Zinc Rich Paint.
- 7) Dispatch details such as consignor/consignee address, contract and case details, 'country of origin, port of delivery, stacking instructions shall be written on one of the side of boxes. An anodized aluminium plate as per details and specifications given in page 3 of 5 shall be provided on the boxes
- 8) One copy of packing slip wrapped in polythylene bag covered with suitable aluminium .packing slip holder to be nailed on the external surface of the box. One more copy 9f the packing Slip wrapped in polythylene bag to be kept inside the box at the prominent place.
- 9) **INDICATION MARKS ON THE BOXES:** Markings shall be provided on the boxes indicating position of Boxes for handling, storage and nature of consignment. For guidelines referred page 4 of 5. The ink issued for this purpose as well as for marking dispatch instruction shall be indelible/non-washable marking ink.
- 10) Each item as mentioned in BOQ shall be packed & supplied as a set comprising of required numbers of associated fasteners & hardware etc

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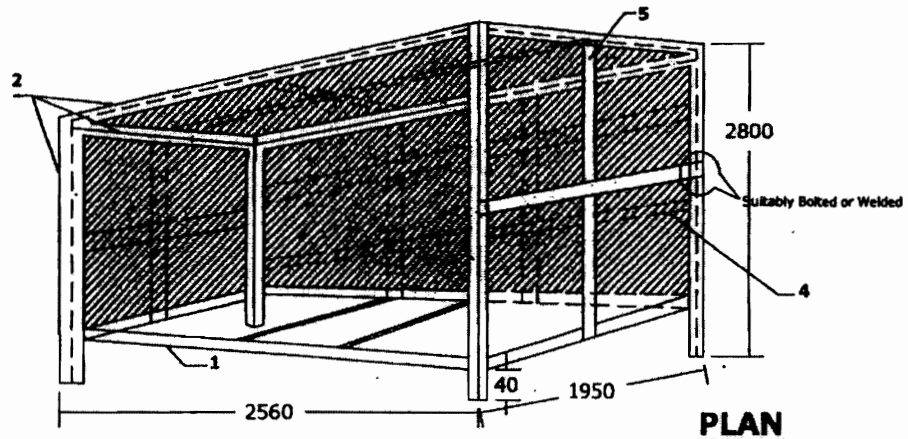
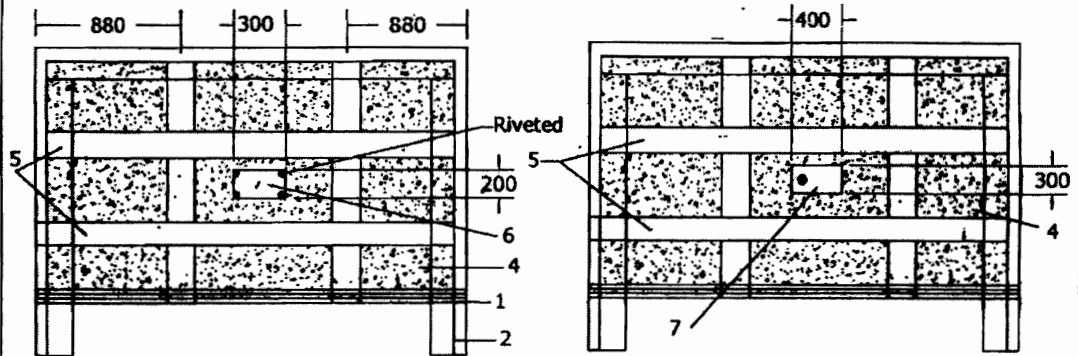
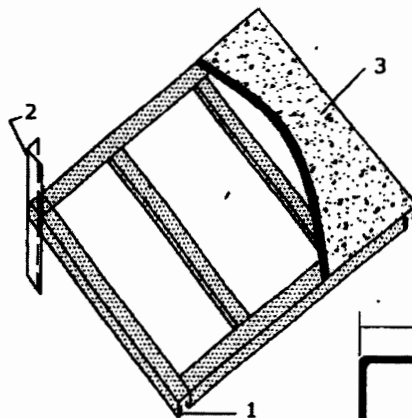
SPECIFICATION NO. PE-TS-888-100-A001

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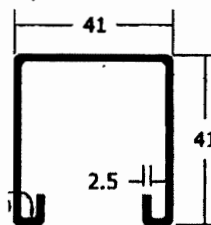
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**STEEL PACKING (TYPICAL DETAILS)****PLAN****FRONT SIDE OF BOX****BACK SIDE OF BOX****BOTTOM FRAME ARRANGEMENT****Note:**

1. "C" Channel to be used on Bottom Frame.
2. 50x50x6 Angle to be used Vertically on four sides of the Box and Horizontally on four sides on the top Frame.
3. 1.6mm thick sheet (plain) on Bottom Plate.
4. 1.0mm thick sheet to cover top & four sides of BOX.
5. 50x3 Flat as additional cross members to be used Horizontally & Vertically on top & Four Sides of Box.
6. Anodised Aluminium Plate for Marking.
7. Hinged Inspection Window.

**DETAILS OF "C" CHANNEL**

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### 11.3 PACKING FOR STATION LIGHTING SYSTEM

Aspects of packing specific to equipments / items of station lighting system are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

#### 11.3.1 For LIGHTING TRANSFORMER, DISTRIBUTION BOARDS, LIGHTING PANELS,

- Construction of packing case for LIGHTING DISTRIBUTION BOARDS, LIGHTING PANELS, TRANSFORMER . shall be EITHER as per FIGURE 1,2,3,5,6,7,8,9,10,11 OR FIGURE 14,15,16.
- Each Panel/Transformer shall be individually covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian polythene craft paper. Wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm.

For the top frame it shall be project on all sides by 100mm and shall be nailed on sides .

- The gap between the panels and packing case shall be filled with rubberized coir of thickness 50mm minimum and width 100mm. The distance between two consecutive supports of rubberized coir shall be less than 500mm.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.
- Packing case shall be finally covered with GI sheet of thickness 0.4mm minimum.

#### 11.3.2 For LUMINARIES, RECEPTACLES. EMERGENCY LIGHT, 240/24V TRANSFORMER, CEILING FAN, SWITCH BOARDS, FLEXIBLE CONDUIT, WIRES, EARTH WIRE. JUNCTION BOXES, ERECTION COMMISSIONING SPARES, RECOMMENDED SPARES , ERECTION MATERIAL AND CONSUMABLES

- Construction of packing case for THE ABOVE MATERIAL shall be as per FIGURE 1to11.
- Items placed inside the case shall be covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian craft paper. wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm. For the top frame it shall be project on all sides by 100mm and shall be nailed on sides.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.

#### 11.3.3 For CONDUIT PIPE


As per international practice pipes are shipped in open bundles with metal strapping. Packing as per attached figure A shall be provided which is described as following:

- Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- Then bundle will be wrapped with bitumen coated hessian craft paper.
- Bundle shall be strapped with steel straps.
- An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

#### 11.3.4 For POLES


Poles will be wrapped with 2 layers of minimum 175 microns thick polythene sheet and then with bitumen coated hessian craft paper, packed as per Figure – C i.e. bundling.

#### 11.3.5 For STRUCTURAL STEEL

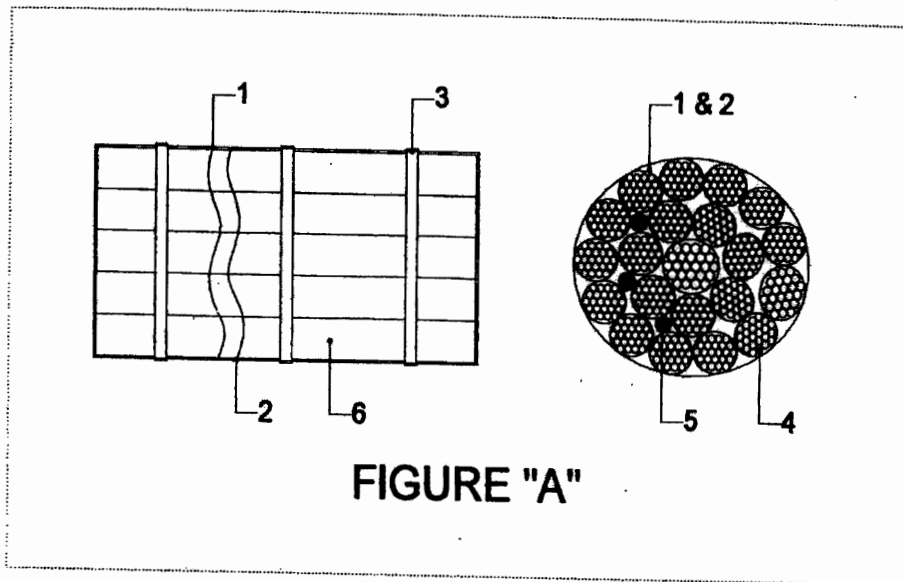
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Structural steel will be different sizes and shapes. Hence it will be packed as per Figure No. B and described as following :

- a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- b) Then bundle will be wrapped with bitumen coated hessian craft paper.
- c) Bundle shall be strapped with steel straps.
- d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

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### **PACKING PROCEDURE FOR CONDUIT PIPE**



- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) CONDUIT PIPES.
- 5) SILICA GEL POUCHES.
- 6) BUNDLES OF CONDUIT PIPES.



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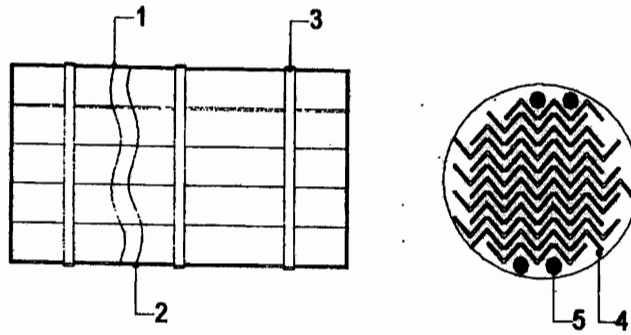
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**PACKING PROCEDURE FOR STRUCTURAL STEEL****FIGURE "B"**

- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) STRUCTURAL STEEL.
- 5) SILICA GEL POUCHES.



# TITLE

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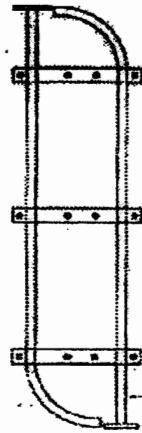
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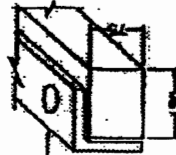
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## packing procedure for poles



POLES WRAPPED WITH POLYTHENE SHEET &  
EXTRUDABLE COATED HESSIAN CLOTH



TOP WOODEN BATTEN TO BE  
FIXED WITH L50x80x6 MM ON TOP  
OF IT FOR TIEING THE ROD  
25 MM DIA



BOTTOM WOODEN BATTEN TO BE  
FIXED ON L50x80x6 MM ANGLE

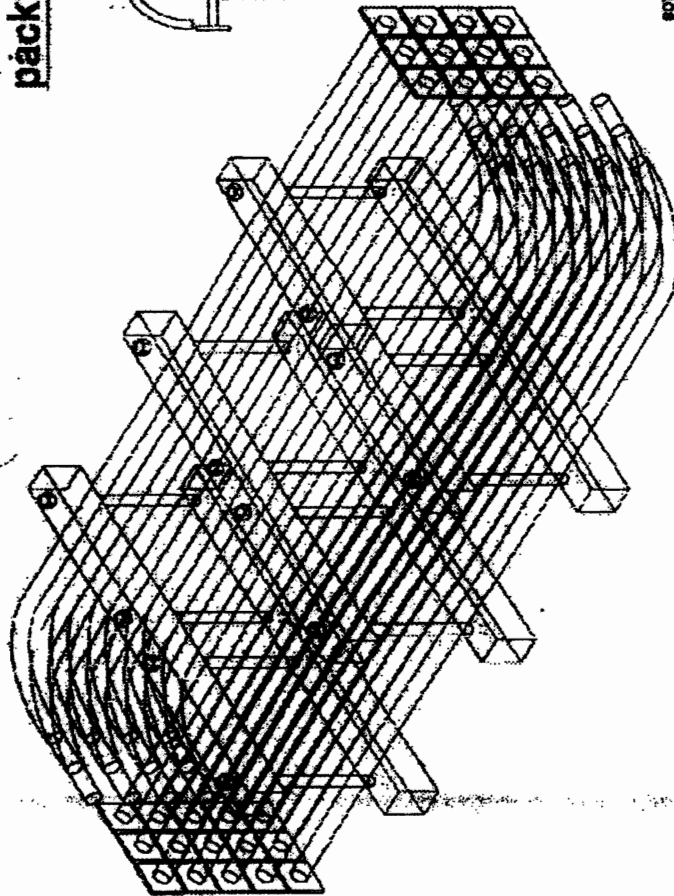



FIGURE "C"

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#### **11.4 PACKING FOR DC BATTERY**

The packing procedure for seaworthy packing of DC Battery is defined below, which is capable of withstanding impacts, compression, vibration, toppling, sea water spray, prevention against rust, temperature and extreme atmospheric conditions. Aspects of packing specific to equipments / items of DC Battery are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

The packing procedure consists of various stages namely primary packing, cushioning, securing, desiccant, outside packing box, Runners/ sliders/ transverse bars of plywood, etc., provided for each movement.


- a) The packing boxes shall be made up of plywood boxes (thickness 9mm min.) with blocks at the bottom of the box for provision for handling the boxes using the forklift. The packing boxes sizes are generally standardized to half-euro size (capable of handling equipment's weight).
- b) Rubberized coir of 25mm thickness shall be provided as cushioning material at the bottom and thermocole of 20mm shall be provided inside on all four sides. Other than this polyethylene film wrap or cover also will be provided. Left out spaces to be filled with rubberized coir/ thermocol to get cushioning effect.
- c) Silica gel in dust free air permeable cotton/paper bag shall be placed in the packing boxes for storage period of 1 year as per IS 304 (1979)
- d) While packing the cells, transit caps (polypropylene) of red and blue shall be used for big size cells for ensuring that cells does not get damaged during the transport due to vibrations etc.
- e) The battery accessories shall be packed with suitable precautions as follows:
  - i) Copper connectors shall be packed after making bunches with lead wire seals to avoid misplacement.
  - ii) Hardware items shall be packed in polyethylene bags (Thickness  $\geq 0.175\text{mm}$ ) with item slip
  - iii) Battery rack shall be packed in dismantled condition, wrapped with polyethylene sheet
  - iv) For Ni-Cd type battery, electrolyte in solid form for dry cells shall be packed in cans with KOH, LiOH being packed separately.
  - f) Galvanized Steel straps are provided for binding the packing box sides.
  - g) The handling instructions shall be marked in indelible/ non-washable ink, indicating the upright position.

#### **11.5 PACKING OF SERVICE TRANSFORMERS(OIL FILLED) & ACCESSORIES**

This instruction is applicable for packing of transformers (oil filled), its accessories and components so as to ensure safe delivery to end user. Aspects of packing specific to equipments / items of transformers(oil filled) are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

##### **11.5.01 PACKING DETAILS :**

- a) Items shall be packed in case / crates as per the shipping list.
- b) All fragile items and small items shall be packed in cases and to be marked as "Fragile, handle with care Fragile items".
- c) Fragile accessories are to be first packed in their original boxes (VENDOR's packing). Very

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- d small / delicate items such as glass thermometer, door keys shall be packed in separate box.
- d In case original box is found damaged, suitable alternate box or packing method using felt or foam sheet and polythene wrap to be used.
- e These boxes are then placed in identified wooden boxes. Inside of such boxes are lined with a layer of polythene sheet, packing wool / grass and another layer of polythene sheet before placing the boxes. All boxes are then wrapped with this polythene sheet before closing the box. Fragile items shall not be placed loose, one above the other inside the case.
- f All wiring cables, connection flats of non-ferrous materials, CTs, valves bellows shall also be packed.
- g Items like CTs, Oil communicating bushings, insulators, wired equipments and housings such as RTCC Panel, M. Box, Drive Mechanism, thermometers, gauges shall be wrapped in polythene from all around.
- h Buchholz relay and OSR relay openings will be blanked using covers, before putting them in the box
- i Items shall be carefully lowered and arranged inside the crate / case and each item shall be locked from all sides in such a way to avoid its movement in any way. Wooden stoppers and separators shall be provided for this and nailed to the crate / case wood.
- j Wooden planks and batons in contact with fragile items shall be provided with kit foam at the locations of contact.
- k Oil communication bushings shall be packed in separate case on V or U shape wooden felted supports, as in case of condenser bushings.
- l While placing and arranging the items inside the crates / cases, these shall be verified for correctness and then the packing note shall be signed. The cover top of the crate / case shall then be closed.
- m The main equipment like transformer tank shall be packed suitably to prevent any damage during transit / storage. Support structures like frame, header supports etc. shall be crated. Conservator headers shall also be crated. Radiators pipe work and other instruments & components shall be packed in cases. All the cases shall be lined with polythene from inside.

#### **11.6 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCH GEARS**

For Control and switch gear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below.

Thickness of planks for all sides, binding and jointing battens shall be at least 25 mm. Width of the plank shall be at least 125mm and that of binding and jointing planks shall be at least 100mm.

Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudinal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per cl 9.3.1.3 and all other requirements shall be as per clauses 9.3.1.4 to 9.3.1.6.

#### **12.0 Containerization**

As required by BHEL, the VENDOR shall stuff the GOODS into 20 or 40 foot containers (dry, open top, flat racks, etc.).

The maximum inside dimensions of containers are to be considered:

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- 40 foot containers: 11.80 m x 2.20 m x 2.05 m
- 20 foot containers: 5.80 m x 2.20 m x 2.05m
- 

The present definition of containerization is valid for sea containers only. Vendor to check the size of containers before start of packing of equipment.

#### **12.1 Protection of Cases/Crates**

Since shipping containers are in general not water tight, packing in contact with the floor of the container shall be raised in order to prevent it from being damaged by the accumulation of water.

#### **12.2 Mechanical Constraints**

The mechanical constraints for "general use" closed containers are of a different nature (height of "stacking" being limited inside the containers), the packing for the GOODS may be of a lighter structure. However, it is necessary that the packing be appropriate so as to protect the GOODS on site during the storage period, as required after discharging of the GOOD'S from the containers.

**Note:**

*It is the responsibility of the VENDOR to ensure that the cases/crates are stowed, secured and fastened inside the container. The VENDOR will take all necessary precautions to conform to the maximum weight allowed and the centre of gravity of the container. The securing and fastening of the cases/ crates can be carried out by nailing timbers on the bottom or on the vertical sides of the container.*

#### **13.0 Other Services to be provided by Vendor**

In addition to the packing and shipping documents, VENDOR must also carry out the following services, which shall be included in his quotation:

Carriage of VENDOR's sub-contracted equipment and material, which must be re-grouped in VENDOR's or PACKER's workshops, whilst waiting for packaging.

BHEL reserves the right to postpone the shipping of the GOODS. In this event, any storage and insurance costs during the first ninety (90) days shall be borne by the VENDOR.

Loading, including lifting, securing, lashing, and stowing, of all cases, crates, or packages onto means of transportation such as, but not limited to, trailers, containers, etc.

#### **14.0 Responsibilities and Guarantees**


VENDOR is responsible for the choice of category for packing according to the transport facilities used, and on the basis of the present document. In case of doubt or disagreement regarding the choice, VENDOR must inform BHEL prior to packing and await BHEL's approval. All phases of packaging, marking, loading, etc. will be subject to BHEL inspection.

BHEL reserves the right to reject the packing when the packing does not conform to these instructions and/or when the packing does not ensure perfect protection of the GOODS. VENDOR is responsible for the weights and dimensions declared, and the marking of the packages.

The documents must be in strict conformity with the packing contents.

The packing specified in these "Packing, Marking and Shipping Instructions" is guaranteed for a twelve (12) months storage period after delivery on site.

VENDOR is responsible for providing storage recommendation adapted to the GOODS. According to this guarantee, VENDOR is held responsible in the event of goods becoming

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useless, damaged or broken, as a result of poor packing and/or stowing, or due to corrosion, subsequent to insufficient or inadequate protection. All direct or indirect costs resulting thereof, will be back-charged to VENDOR.

<p style="text-align: center;">Bharat Heavy Electricals Limited International Operations - Projects Division Integrated Office Complex, Lodhi Road New Delhi -110003</p>			
400 MW MARIB GAS TURBUINE POWER STATION PHASE-II			
Following dispatch instructions for effecting supplies under the above contract are being issued for compliance by all the units involved in this project.			
Sr. No.	Item No.	Details	Action By
01	01	<u><b>Purchaser's Name and Address:</b></u> Public Electricity Corporation Airport St P.O. Box 178 Sana'a Republic of Yemen Attention: Eng. Abdul Mumen M. Mutaheer Managing Director Tel : (967 1) 328 141-142 Fax : (967 1) 328 150 E-mail : YPECNT@Y.net.ye	For information
02	01	<u><b>Delivery Terms:</b></u> DAP ( Marib Site YEMEN) Public Electricity Corporation Airport St P.O. Box 178 Sana'a Republic of Yemen	Units to ensure proper marking on the boxes so as to Identify the final destination clearly.
03	01	<u><b>Seller's Name and Address:</b></u> Bharat Heavy Electricals Limited International Operations Division Lodhi Road Integrated Office Complex New Delhi –110003, INDIA	For information
04	01	<u><b>Payment Terms for Equipment Supply.</b></u> Contract Terms: Advance - 10% of the Contract price. Supply– 80% on submission of shipping documents 5% on the receipt of Taking over and Acceptance Certificate and 5% on the receipt of Final Acceptance Certificate	All Units
05	01	<u><b>Shipping Marks :</b></u> As Per LC ( Copy Enclosed)	All Units
06	01	<u><b>Consignee:</b></u> As per LC ( Copy Enclosed)	All Units
07	01	<u><b>Notifying Party :</b></u> As Per LC ( Copy Enclosed)	All Units

08	<b>Packing Instructions &amp; Inspection Prior to Dispatch by Supplying Units/Sub-Vendors:</b>		All Units & Suppliers
	01	Packing (tare) shall be part of the Equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of Equipment during transportation. In case of Equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.	All Units/Suppliers
	02	<b><u>Special instructions from PEC Yemen :</u></b>	
	02.1	All equipment and instruments should be fully packed and protected from damage during transportation and field storage. All machine surfaces should be protected with planks or similar materials and reinforced with metal strips or plates from the outside.	All Units/Suppliers
	02.2	All electrical / electronics equipment such as motor, switch, control device, instrument and component should be sealed with polyethylene insulation and a corresponding drying agent should be provided.	All Units/Suppliers
	02.3	For all piping ends as well as pipes and tanks, the openings should be protected from damage and sealed to avoid getting affected by particulates, moisture and air. These Protection measures should be kept intact before the start of installation or moving for periodic inspection. The cost spent for the moving, modification and replacement of the packing and protection device would be paid by the BHEL.	All Units/Suppliers
	02.4	A waterproofed packing list should be provided in each planks or packing case. The name of articles in the packing case should be marked clearly on the packing list so as to be identified easily.	All Units/Suppliers
	02.5	The articles in the case should be supported by wooden bars in order to be fixed safely and it should not be wedged individually with wooden pad. The marks outside the case should be printed with climate proof materials or paints so as to be protected from being removed during transportation.	All Units/Suppliers
	02.6	All materials and equipment should be packaged according to the typical environmental conditions during storage. In case of severe conditions, these materials and equipment should be packaged carefully by taking a full and appropriate preventive measure to protect from any damage or wear. The marks should be painted or printed clearly and durably with characters of 40 mm height at minimum on both ends of the packing case. The labels should be well protected to prevent loss / tempering.	All Units/Suppliers
	02.7	A mark indicating the correct lifting position should be shown by an arrow on the packing case.	All Units/Suppliers
	02.8	<b><u>Preparation for Shipment of Operational Spare Parts</u></b>	
	02.8.1	Shipping preparations shall be of export quality and crating shall adequately protect the items against injurious corrosion, dampness, breakage, or vibration that might be encountered in their transportation and handling. <b>BHEL to submit a detailed packing and crating procedure to PEC on a parent equipment basis at least sixty calendar days prior to shipment.</b>	All Units
	02.8.2	Operational spare parts shall be crated on a parent equipment on exclusive basis and there shall be no common crating of unrelated spare parts. For items too small to be individually crated, they have to be crated on the same kind of equipment basis under condition that they are classified and packed in a vinyl bag or small box on a parent equipment basis.	All Units



	02.8.3	To the extent that BHEL intends to utilize containers in the shipment of operational parts, BHEL shall utilize good quality shipper owned or nonreturnable containers which should be conveyed to Owner before its receipt at the Site.	All Units/ROD
	02.8.4	All shipments of operational spare parts shall be consolidated prior to shipment and shall be transported to the Site in accordance with the contractual shipping schedule. BHEL shall not make partial or multiple shipments of operational spare parts for the same parent equipment item without prior approval of Owner.	All Units
	02.8.5	BHEL shall submit schedules identifying completion of fabrication, ship date and site delivery dates for the operational spare parts on a parent equipment basis.	All Units
	02.8.6	<b>To the greatest extent practicable , BHEL shall individually tag each Operational Spare Part.</b> The tagging data shall include the Contract number, Item number and the part identification number. Where such individual tagging is impracticable due to the size or quantity of certain operational spare parts the tagging data shall be fixed to the permanent packing of these operational spare parts.	All Units/Suppliers
	02.8.7	BHEL shall prepare packing lists in strict accordance with the tagging requirements and shall reference the Exhibit C, Section 3. Item numbers of the individual operational spare parts including required quantities. Contractor shall include on the packing list the net weight of operational spare parts exceeding 300 Kg. Packing lists shall also provide a certification verifying that the packing list quantities constitute "Partial" or "Complete" shipment of all required quantities of operational spare parts.	All Units/Suppliers
	02.8.8	<b>All packages to be wrapped in <u>Sealed transparent polythene</u> inside the crates for effective weather proofing</b>	All Units/Suppliers
	03	Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: Destination Package number: BHEL/YMN/XXX/YYY/ZZZZ where XXX stands for Unit abbreviation e.g. HWR , HYD ,EDN, PEM, RPT etc YYY stands for Vendor abbreviation Following series of ZZZZ should be used by Different Units HWR (10000) ,HYD (20000),PSNR (30000),PEM (40000),BPL(50000),RUD(60000), TBG(70000),TRY(80000),EDN(90000) i.e. first package dispatched from HWR should be numbered : BHEL/YMN/HWR//10001 . Gross and Net weight Dimensions Lifting places Handling marks and the following delivery marking: CONTRACT Nr. 12/2008 PURCHASER: PEC YEMEN	All Units/Suppliers
	04	<b><u>Completeness of Contents of each packing case:</u></b>	
	04.1	Concerned CQA/Unit QC/Third Party Inspection Agency shall verify the completeness of contents of each package w.r.t packing list both in terms of quality and quantity before authorising dispatch of the consignment.	All Units/Suppliers
	04.2	Packing commensurate with <b>international standards</b> and accepted norms will be ensured by CQA/ Unit QC/Third Party Inspection Agency. Packing has to be sea-worthy and secure. As far as possible, the packing has to be rectangular in shape for optimum space utilization in the ship and economize on shipping costs. <b>Projections on packages are prohibited.</b>	CQA/All Units

04.3	The packing list has to be checked and certified by the Inspection agency (ies) with due signatures. All packages shall be enclosed in suitable GI sheets on all sides.	CQA/All Units
04.4	No loose items / Gunny bag packing are allowed for shipment. Proper pallets and crates are to be used for packing of Oil drums and Structures.	CQA/All Units
05	<b><u>Routing of Packing Lists:</u></b> Packing list is an extremely important document, which forms a part of export documentation in connection with the processing of customs formalities. Packing List has to be generated by units/Unit vendors and sent to IO and ROD, Mumbai (both at the same time), two weeks in advance, for processing and obtaining shipping bills' clearances and avoiding octroi payment through 'N' form at Mumbai.	All Units/ suppliers
06.1	<b><u>Advance intimation to ROD, Mumbai &amp; IO</u></b> All supplying units/vendors will give at least 15 days advance intimation to ROD, Mumbai & IO along with package details before actual dispatches to arrange for storage/shipping arrangements by ROD Mumbai and customs invoicing by IO. <u>Information must be sent to consolidate the details and arrange for shipments in time.</u>	All Units
06.2	<b><u>Telephonic Intimation to ROD Mumbai of Movement of Vehicles:</u></b> Vehicle drivers to be instructed by the units to contact ROD regarding movement of vehicles on daily basis for heavy lifts, especially 2 days before arrival at Mumbai so that suitable directives can be given to the driver of the vehicle for further transportation of the goods either to docks or godown.	All Units
07	<b><u>Excise Attestation at Works:</u></b> To avoid opening of big cases for examination by customs at port of shipment, the supplying unit may arrange to get the packing cases sealed by local excise authorities/ self certification and to get the relevant invoices and packing lists endorsed from Superintendent, Central Excise. For this purpose, Units should send the packing lists to IO at least 2 weeks in advance to enable prepare Shipping Invoices for furnishing to the units for requisite attestation and sending the same to ROD Mumbai through fastest means for a smoother and faster customs clearance. Also Units to provide "specification of packing with the indication of the number of cargo packages, type of packing and weight of packing in English" along with the packing list.	All Units/ suppliers
08	<b><u>Provision of inspection windows on Packages:</u></b> Unit/Vendors should provide inspection window of size 6" x 4" (glass perplex) for customs examination for all packages (above 1.5 x 1.5 x 1.5 cu m) involving panels of any kind. Care would be taken to ensure that all packages are properly sealed to avoid ingress of moisture, rodents etc. Packing slip folders shall be attached in each box.	All Units/ Suppliers
09	<b><u>Transportation Drawings for Heavy Weight/ODC consignment: For any package/item weighing above 20000 kgs and/or size greater than 2.5 X 2.5 X 4 m :</u></b> Detailed engineering documents (at least 4 sets) for all items of the above category shall be furnished by respective units to issue shipment enquiries in a proper manner. This would include <b>Gas Turbine ,Transformers, Lube Oil tanks,Storage Tanks (Oil and Water) and Generator</b> . The drawing has to include center of gravity of the item clearly (Units to identify such items and notify IO as soon as the engineering documents are released).	All units

	10	<u>Lifting Beams:</u> <b>All heavy lifts for which safe handling is essential at the port of dispatch shall be accompanied by lifting beam on non-returnable basis</b>	All Units
09	01	<u>Marking for Safe Handling:</u> To ensure safe handling, packing case shall be marked to show the following: <ul style="list-style-type: none"> <li>• Upright position.</li> <li>• Sling position and Centre of Gravity position.</li> <li>• Storage category.</li> <li>• Fragile components (to be marked properly with a clear warning for safe handling).</li> </ul>	All Unit
10	01	<u>Marine Insurance Policy:</u> Insurance Policy for 110 percent value of the contract covering all risks including war and SRCC from Port of shipment in India/Third country direct dispatches, to site shall be taken by IO Insurance Policy and it shall indicate PEC as co-insured.	IO Projects
11	<b>Shipping Documentation including those covered by customs requirements:</b>		
	01	Customs Invoices: Values to be allocated by IO (Alternatively, Excise attested invoices where the package is sealed and dispatched by the units)	ROD/ IO Projects/ All Unit
	02	Packing List	All Units /Sub-vendors of units
	03	ARE1 forms/Excise Invoice corresponding to Unit invoice values and Delivery challans.	All Units /Sub-vendors of units
	04	Chartered Engineer's Certificate, applicable to be arranged by Units. Care should be taken to ensure that usage of the materials shown in C.E. certificate out of DEPB goods is not disproportionate.	All Unit/ROD
	05	Catalogues/literature/write-up in case of customs endorsement for discharging exports obligation in case of DEEC imports to be made available to ROD before arrival of goods in the city of port of dispatch.	All Unit
	06	Unit's sub-vendors, whose responsibility of supply is upto FOB, can make their own arrangements of Customs House Agents as well as Octroi clearance, apart from physical examination of the cargo at the port of dispatch and make arrangements of loading on BHEL's nominated vessel. BHEL, in such a case, through ROD would arrange to furnish a copy of the shipping invoice to CHA of sub-vendors. All units to keep ROD Mumbai informed in this regard about the arrangements made with sub-vendors.	All Units/ Suppliers/ROD
	07	To avoid any problem with Octroi post at Mumbai & Customs, the values appearing in Unit invoice sent with the cargo shall be preferably within $\pm 10\%$ of IO-Projects shipping invoice value.	All Units/Rod
	08	<b>Octroi Clearance:</b> Drivers/Escorts carrying the export cargo for this project on behalf of the units to be advised to contact the agents at Octroi Naka:(To be intimated by RODMumbai) Copies of the dispatch documents must be sent to ROD Mumbai by i) Fax ii) e-mail through scanning of the documents with copy to IO	All Units/Rod
12		<u>Full Set of Clean Multimodal Transport Document:</u> Complete set of shipping B/L showing freight prepaid as per the rates of regular shipping lines. In case of Air Freight consignment, one original of AWB is required together with three copies of the same.	ROD/ IO Projects

13		<u>Certified Inspection Certificate Approved by Customer:</u> The certificate signed by PEC inspector (if equipment tested in presence of PEC representative) is to be provided to IO . In case the Certificate is signed by BHEL/Third Party Inspection Agency,it is to be provided by Units/ suppliers to IO and IO will get it approved from PEC.	All Units/ Suppliers
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14	<b>Shipping Carrier Specification and related Requirements:</b>		
	01	Certificate of Freight having been pre-paid as per the regular shipping lines is required on MTDs.	ROD/ IO Projects
	02	Subject cargo would be generally shipped under the deck. Specific confirmation/clearance of IO is needed for shipment on deck.	ROD/ IO Projects
	03	Vessel age to be restricted as per insurance policy in force Buyer's Reference (Contract No.) is required on B/Ls.	ROD/ IO Projects
	04	For Third Country Supplies , concerned units will ensure all the above certificates in addition to Certificate of Origin.	All Units/ Suppliers
15	<b>Guidelines for Dispatches from Units/Indian Vendors:</b>		
	01	Vehicle drivers shall carry ARE1 in photocopy (3 originals to be sent to ROD). Each consignment carried by the vehicle shall have a separate ARE1 and it must be ensured that materials under one ARE1 get transported in the same truck/trailer. In order to avoid any problems at port of dispatch from the point of view of i) shipping bill preparation and passing thereof ii) 'N' form at Octroi check post and iii) control and movement of cargo within Mumbai and iv) physical examination of cargo by customs, the materials under the same category e.g. a) DEEC cargo b) Free shipping bill cargo c) DEPB (duty entitlement pass book scheme) and d) duty drawback must be sent in the same truck/trailer. Units to ensure that ROD is communicated very clearly the type of shipping bills to be prepared, well before the materials are dispatched from the works.	All Units
	02	<u>All materials to be dispatched under intimation to:</u> Senior Manager(Exports) Bharat Heavy Electricals Limited Regional Operations Division 14th Floor, World Centre 1, Cuffe Parade Mumbai-400005 Attention: Mr.Sanjeev Shikhare Telephone No.: 22171302 (Mumbai)	All Units/Rod
	03	<u>Clearing Agents:</u> All materials to be dispatched to Mumbai on door delivery basis, freight prepaid to the address of the clearing agents(to be specified by ROD, from time to time)	All Units/Rod
16	01	<u>Customs formalities Period:</u> Packages arriving at the port shall have a minimum time of 3 working days for customs examination and other related formalities in respect of the cargo under shipment. The goods received after arrival of the ship may not be loaded if either sufficient time does not exist or space available in the ship is booked by the carrier for other exporters due to lack of availability of the goods at the port in time for shipment from BHEL. In cases, where the committed cargo to the carrier based upon information received from all the units does not reach in time of scheduled shipment at the port of dispatch, IO-Projects would be within its right to decide the priority of loading as per the project schedule requirements given the condition that adequate space in the ship is not available to accommodate the cargo.	For information
17	01	<u>Triplicate ARE1 forms for Cancellation of Bonds:</u> It is necessary that the units ensure that ARE1 forms are sent in Triplicate to ROD Mumbai. After ROD Mumbai effects the shipment, endorsement of customs on triplicate copy of ARE1 form would be obtained by ROD Mumbai and sent to the concerned unit within 6 to 8 weeks for cancellation of the excise bond.	Units/ ROD Mumbai

18	01	<u>Formalities in Connection with 'N' form:</u> After the shipment is effected, requisite formalities indicating physical export of the goods earlier exempted from payment of Octroi at Mumbai will have to be ensured. Units to ensure this from their sub-vendors because In past , Octroi notices from Mumbai municipal corporation were received and 'N' form facilities were withdrawn at times.	Units
19	01	<u>Shipping Procedures and ROD Responsibilities:</u> Consolidation of Packages and Storage in Warehouse: ROD Mumbai either themselves or through their CHA would ensure following: <ul style="list-style-type: none"> <li>• Proper storage of goods at an elevated level if store is in open to avoid damages to the consignment during rainy season (All the packages to be covered with a proper tarpaulin in open storage).</li> <li>• All Electrical and C&amp;I items to be stored indoors.</li> <li>• Consolidation of the goods as per summary packing lists.</li> <li>• Check marks and numbers on packages. Carry out the corrections, if necessary.</li> <li>• Label the packages linking to the proposed shipping carrier to ensure that package does not get left out.</li> </ul>	ROD



**BELLARY  
1 X 700 MW TPS**

**LIST OF MAKES  
AIR-CONDITIONING SYSTEM**

**SPECIFICATION NO. PE-TS-367-553-A001**

**VOLUME II B**

**SECTION C**

**REV.**

**DATE: 19.03.2012**

**SHEET 1 of 3**

## **ANNEXURE-I**

### **LIST OF MAKES**



## SUB VENDOR LIST & INSPECTION CATEGORISATION COMPRESSED AIR SYSTEM

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Remarks
1	OIL FREE SCREW COMPRESSOR COMPLETE SKID MOUNTED WITH MOTOR, CONTROL PANEL AND ACCESSORIES	I	ATLAS COPCO - BELGIUM Assembly along with Indigenous components and Testing at Atlas Copco Works - Pune	Belgium (Pune)	
		I	KOBELCO - JAPAN Assembly along with Indigenous components and Testing at KPCL Works - Pune	JAPAN (Pune)	
		I	ELGI Air End from Hitachi Japan, Assembly along with Indigenous components and Testing at ELGI Works - Coimbatore	Coimbatore	
		I	Ingersoll Rand Compressor from IR USA, Assembly along with Indigenous components and Testing at IR Works - Ahmedabad	Ahmedabad	
2	REFRIGERATED TYPE ADP	I	DELAIR	CHENNAI	
			SUMMITS	COIMBATORE	
			TRIDENT	COIMBATORE	
			GEM	COIMBATORE	
			ATLAS COPCO Testing at Atlas Copco Works - Pune	Belgium (Pune)	
3	MS/GI Pipes –ERW IS 1239 / IS 3589 (Quantity < 200 meters Assorted sizes)	III	SAIL	Rourkela	Material will be accepted on the basis of Main contractor COC supported by manufacturer TC as per relevant Code. In addition to above main contractor will certify availability of correlated identification marks on pipe wrt Manf TC and will also certify that pipes are free from rust
			Jindal (upto 350NB)	Ghaziabad	
			Surya Roshni (upto 400NB)	Bahadurgarh	
			Tata (upto 150NB) IS 1239 Pipes	Jamshedpur	
			Maharashtra seamless (200 to 500 NB) IS 3589	Raigad	
4	Forged/Formed fittings	III	EBY	TALOJA	
			Siddarth & Gautam	FARIDABAD	
			Pipefit	BARODA	
			MS Fittings	KOLKATA	
			Tube Products	BARODA	
			Bharat Forge	PUNE	
			NL Hazra	KOLKATA	
5	Ball Valve	I	Precision Engg	Nasik	upto 400NB 150 class
			Microfinish Valves Ltd	Hubli	upto 50NB 800 class; 400 NB 300 class
			BDK engg Industries	Hubli	upto 50NB 800 class ; 400NB 150 class
			Flow chem. Industries	Ahemdabad	upto 50 NB 800 Class: 350NB 150 class
			Audco	Chennai	
			Akay India	Hubli	upto 50NB 800 class




SL No	Item	QP / Insp.Cat	Proposed Subvender	Place of Manufacturer	Remarks
6	CS/FS Gate/Globe/Check valves Upto 600 NB 150 Class, 50 NB 800 Class	III	Fouress	Mumbai/ Aurangabad	
			BDK	Hubli	
			Audco	Chennai	
			Leader	Jullundhar	
			KSB	Coimbatore	
			KBL	Kondhapuri	
7	Butterfly Valve (Upto 500 NB PN 16)	II	KBL	Kondhapuri	
			Fouress	Bangalore	
			Audco	Chennai	
			BDK	Hubli	
			Tyco	Halol	
			Inter Valve	Pune	
8	Air Receiver	I	Integrated Engineers	Mumbai	
			Diamond Fabricators	Pune	
			Parkaire	Delhi	
			Temasme Vesselex	Noida	
			United Engineering Works	Nasik	
9	Safety Relief Valve	III	LEADER	JALANDHAR	
			SPIRAX MARSHALL	PUNE	
			FISCHER SANMAR	CHENNAI	
10	Pr./Vacuum/Dp Gauges	III	Auxitrol	U.K	
			Switzer (for DP gauge)	Chennai	
			Budenburg	U.K	
			A.N.Instruments	Kolkata	
			Bells Control	Kolkata	
			Manometer India	Mumbai	
			H Guru	Muzzafarpur / Risra	
			General Inst.	Mumbai/Goa	
			Gluck India	Mumbai	
11	Pr./Vacuum/DP.switch	II*	Indfos Ind.	Ghazibad	* If the total Quantity is <= 10, then inspection category III. However, manufacturer TC to be submitted
		III	Barton Inst.system	USA	
		I*	Gauges Bourdon	Mumbai	
		II*	Switzer	Chennai	
12	Temperature Gauge	III	Budenburg	U.K	
			A.N.Instruments	Kolkata	
			Bells Control	Kolkata	
			H Guru	Muzzafarpur / Risra	
			General Inst.	Mumbai/Goa	
13	Temperature Transmitter	I	(ABB)	Faridabad/Germany	For Din Rail Type only
		II*	Yokogawa	Japan	* If the total Quantity is <= 10, then inspection category III. However, manufacturer TC to be submitted
		II*	Emerson (Rosemount)	USA	

SL No	Item	QP / Insp.Cat	Proposed Subvender	Place of Manufacturer	Remarks
14	Pr./DP Transmitter	I	(ABB) -2600T series	Faridabad/Italy	
		II*	Honeywell	USA/India	* If the total Quantity is <= 10, then inspection category III. However, manufacturer TC to be submitted
		III	Fuji	Japan	
		III	Emerson (Rosemount)	USA	
		II*	Emerson (Rosemount)	Daman	
		II*	Yokogawa	Japan	Calibration at YIL Bangalore is acceptable
15	HT Motor for Air compressor	I	CGL	Mandideep	Upto 1600 KW, 6.6 KV; Upto 1310 KW, 11 KV
			Marathon Electric	Kolkata	Upto 6.6 KV, 750 KW
			BHEL	Bhopal	
16	Flow Switch	III	Switzer	Chennai	
			Levecon	Kolkata	
			DK Instruments	Kolkata	
			Delta	UK	
			ITT Barton	USA	
17	Temp Sensor	III	Pyro Electric	Mumbai	
			Detriv	Mumbai	
18	Flow Indicator	III	Sigma	Mumbai	
			Eureca	Pune	
19	Auto Drain Trap	III	Main Contractor approved sources		
20	Dew point meter	III	GE Sensing	Ireland	
			Michell Instruments	UK	
			Shaw	UK	
21	Flow Meter / Rota Meter	III	Trac	Hyderabad	
			Eureca	Pune	
22	Level Indicator/ Gauge	III	Sigma	Mumbai	
			Levcon	Kolkata	
			Pune Techtrol	Pune	
			SBEM	Pune	
23	Solenoid Valve	III	HERION	GERMANY/ ITALY	
			ROTEX AUTOMATION LTD.	V V NAGAR/ BARODA	
			ASCO	CHENNAI	
			JEFFERSON	ARGENTINA	
			AVCON	MUMBAI	
24	Cable Glands	III	SUNIL& COMPANY	KOLKATA	
			ARUP ENGG	KOLKATA	
			COMMET	MUMBAI	
			QUALITY PRECISION	KOLKATA	
25	Cable Lugs	III	DOWELLS	MUMBAI	
			CHETNA ENGG	NASIK	
			3D	VALSAD	

SL No	Item	QP / Insp.Cat	Proposed Subvendor	Place of Manufacturer	Remarks
26	Junction Box	III	Main Contractor Approved Sources		
27	PLC	I	ABB	BANGALORE	
			ROCKWELL AUTOMATION (ALLEN BRADLY)	SAHIBABAD	
			Siemens	Mumbai	
			GE FANUC	BANGALORE	
			L&T	Mumbai	
			Group Schneider		


## NOTE :

- 1) INSP CAT I : FOR THOSE ITEMS THE QUALITY PLANS ARE APPROVED AND FINAL ACCEPTANCE WILL BE ON PHYSICAL INSPECTION WITNESS BY BHEL & Customer.
- 2) INSP CAT II : FOR THOSE ITEMS THE QUALITY PLANS ARE APPROVED. HOWEVER NO PHYSICAL INSPECTION WILL BE DONE BY BHEL / Customer. THE FINAL ACCEPTANCE BY BHEL /Customer SHALL BE ON THE BASIS OF REVIEW OF DOCUMENTS AS PER QP.
- 3) INSP CAT III : FOR THOSE ITEMS FINAL ACCEPTANCE BY BHEL / Customer BASED ON BIDDER'S COC.

	<b>TECHNICAL SPECIFICATION</b>  <b>COMPRESSED AIR SYSTEM</b>	<b>SPECIFICATION NO. PE-TS-210-555-A000</b>	
		<b>VOLUME II B</b>	
		<b>SECTION C</b>	
		<b>REV. 0</b>	<b>DATE: September 2003</b>
		<b>SHEET</b>	

## ANNEXURE - II

### CODES & STANDARDS

	<b>TECHNICAL SPECIFICATION</b>  <b>COMPRESSED AIR SYSTEM</b>	<b>SPECIFICATION NO.PES-555-02</b>	
		<b>VOLUME II B</b>	
		<b>SECTION C</b>	
		<b>REV. 0</b>	<b>DATE: September 2003</b>
		<b>SHEET 1 OF 2</b>	

1.

**SCOPE**

This specification covers the design, manufacture, inspection and testing at the manufacturer's and/or his sub-contractor's works and performance testing of the air compressors and associated accessories at site.

2.

**CODES & STANDARD**

The design, manufacture, inspection testing and performance of the air compressors shall comply with all statutory, regulations and safety codes currently applicable in the locality where the equipment will be installed.

Nothing in this specification shall be construed to relieve the vendor of their responsibility. The equipment in general shall conform to the latest edition of the following standards:

2.1.1

IS:6206

Guide for selection, installation and maintenance and maintenance of air operating pressure up to 10 bars.

2.1.2

IS:2825

Code for unfired pressure vessels.

2.1.3

IS:5456

Code for practice for testing of positive displacement type air compressor and exhauster.

2.1.4

BS:1571

Performance test of compressors.

2.1.5

IS:5727

Glossory of term relating to compressors and exhausters.

2.1.6

IS:10431 Pt.1

Measurement of air flow of compressors and exhausters

2.1.7

BS:864

Compression and capillary tube fittings.

2.1.8

PTC 9

Power test copies for positive displacement compressors, vacuum pumps and blowers.

2.1.9

IS:2062

Structural steel (fusion welding quality).

2.1.10

IS:1239

Mild steel tube and fittings.(Part I & II)

2.1.11

BS:4504

Flanges and fittings for pipes, valves and fittings.

2.1.12

IS:1364

Precision and semi precision hexagone bolts, screws, nuts and lock nuts (dia 6 to 39 mm).

2.1.13

TEMA

Thermal equipment manufacturer's associates.

2.1.14

ASME VIII Div. I

Section Code for unfired pressure vessels

2.1.15

IS:2016

Plain washers

2.1.16

IS:1363

Black hexagonal bolts, nuts and locks and nuts (dia 6 to 29 mm)

2.1.17

IS 4503

Shell & Tube Type Heat Exchangers

2.1.18

IS:4009

Green nipples

2.1.19

IS:694

Specifcation for PVC insulated cables for voltages up to 110 V. Part – I

2.1.20

BS: 4368

Compression couplings for tubes steel.

2.1.21

BS: 4579

Compression joints for cables and wires.

2.1.22

ANSI: B 16.5

Steel pipe flanges and flanged fittings.

2.1.23

IS:1875

Carbon steel billets, blooms slabs and bars for forging



# **SECTION-D**

# **STANDARD TECHNICAL**

# **SPECIFICATION**



**TITLE:**

**COMPRESSED AIR SYSTEM**

**STANDARD TECHNICAL SPECIFICATION  
FOR  
COMPRESSED AIR SYSTEM**

**SPECIFICATION NO. PE-TS-888-555-A001**


**VOLUME - IIB**

**SECTION-D**



**BHARAT HEAVY ELECTRICALS LIMITED  
POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NEW DELHI, INDIA**



	<b>TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM</b>	<b>SPECIFICATION NO.PE-SS-EPC-555-A-001</b>	
		<b>VOLUME II B</b>	
		<b>SECTION D</b>	<b>SUB-SECTION A8</b>
		<b>REV. 0</b>	
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	<b>TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM</b>	<b>SPECIFICATION NO. PE-SS-EPC-555-A-001</b>	
		<b>VOLUME II B</b>	
		<b>SECTION D</b>	<b>SUB-SECTION A8</b>
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1.

**GENERAL**

1.1

This specification covers the design, manufacture, testing at Manufacturer’s works, delivery to site, handling at site, installation, commissioning and carrying out acceptance tests and final painting at site of various equipment of the compressed air system, as specified hereinafter.

2.

**SYSTEM DESCRIPTION**

2.1

The compressed air system shall consist of instrument air compressors & air drying plant (ADP), plant air compressors, air receivers, control panels interconnecting compressed air piping, cooling water piping, instrumentation and control.

2.2

The compressors shall be arranged such that all the plant air compressors shall supply air to the upstream (header of instrumentation air of each ADP through an isolation and a non-return valve so that in the event of failure of instrument air compressor, the instrument are in ensured at all time continuously.

3.

**DESIGN CRITERIA**

3.1

The instrument air compressor will be designed to meet the instrument air requirements of all the equipments /plants/systems as specified elsewhere in the specification (excluding the compressed air requirement of Ash Handling Plant).

3.2

The Plant/Service air compressor will be designed to meet the plant/service air requirements of all the equipments / plants / systems as specified elsewhere in the specification (excluding the plant air requirement of Ash Handling Plant) or capacity be identical as that of the instrument air compressors whichever is higher.

3.3

Design margin of 25% is to be considered for IA & PA/SA requirement for sizing of the Instrument Air Compressor & Plant/Service Air Compressor.

3.4

Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.

3.5

The compressors' capacity will be designed for 45<sup>0</sup> C DBT and 75% RH

3.6

For Instrument Air, Delivery pressure will be 7.5 Kg/cm<sup>2</sup> (g) at ADP outlet.

3.7

For Plant / Service Air, Delivery pressure will be 8.0 Kg/cm<sup>2</sup> (g) at Compressor outlet.

3.8

Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.

3.9

The continuous motor rating (at 50<sup>0</sup> C ambient) will be at least ten percent (10%) above the maximum load demand of the driven equipment under the entire operating range. When the driver is not directly coupled to the compressor, due consideration will be made for losses in power transmission, in addition to the above margin.

3.10


Velocity of air in the air piping shall be limited from 6 to 9 m/sec.

3.11

Velocity of water flow shall be limited to 2.5 m/sec and for gravity flow the same shall be limited to 1.5 m/sec.

3.12

For calculating friction loss in piping system: WILLIAM & HAZEN formula shall be used with C value as 100.

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3.13

Noise level of compressors not to exceed 85 dBA to a reference of 0.0002 microbar when measured at a distance of 1.5 m above the floor in elevation and at a distance of 1 m horizontally from the nearest surface of compressor.

3.14

Compressors to be designed for Continuous, Load-Unload and On-Off mode operation.

3.15

Satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, noise etc.

4.

**OIL FREE MULTISTAGE SCREW TYPE COMPRESSORS**

4.1

**AIR COMPRESSOR SHALL COMPLY WITH THE FOLLOWING REQUIREMENTS.**

4.1.1

Design / Construction

i)

Compression chamber Wall thickness to withstand maximum design pressure.

ii)

Casing with a large inlet port for fast filling and low air velocity.

iii)

To provide suitable arrangement for cleaning of the cooling water jackets during maintenance of compressor.

iv)

Dynamically balanced, one piece Rotors with asymmetric profile, to keep leakage losses to a minimum and ensure high efficiency.

v)

Rotor shaft mounted, oil lubricated, highly precise timing gear shall be designed to counter act the axial forces incurred in compression.

vi)

Life of Oil lubricated anti-friction type bearing be at least 8000 running hours.

vii)

Shaft Seals of floating restrictive ring type design.

viii)

The shaft seal rings and retainers shall be free for radial self-adjustment on the rotor shafts.

ix)

Minimum design service factor for the integral, oil lubricated type, step-up Gear Box shall be of 1.5.

x)

To provide safety valves on low pressure and high pressure stages.

xi)

A direct driven positive displacement type oil pump connection to the main drive shaft is preferred. Alternatively a separate motor driven oil pump be provided.

xii)

The lubrication system to include oil pump, oil filter, oil cooler and oil tank / sump.

xiii)

Cooling shall be by closed circuit Demineralised water.

xiv)

Compressor shall be directly coupled with constant speed squirrel cage induction motor conforming to the technical specification attached elsewhere.

4.1.2

Material of construction


The materials of various components shall conform to the applicable BIS / BS / ASTM / DIN standard or any other reputed standards.


i)


Compressor chamber: Cast iron coated with corrosion resistant material.


ii)

Rotors: Forged carbon steel coated with corrosion resistant material


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	<ul style="list-style-type: none"> <li>iii) Timing Gear: Low, Alloy Steel.</li> <li>iv) Inlet throttle valve &amp; Housing: Aluminium</li> <li>v) Shaft Seals: High, Alloy Steel.</li> <li>vi) Safety valves: Brass</li> <li>vii) Water separator: Cast Iron</li> <li>viii) Non-return valves: Stainless steel spring loaded type.</li> <li>ix) Blow off valve: Stainless steel.</li> <li>x) Unloading Cylinder header: Aluminium</li> <li>xi) Tube of Blow off cooler / oil cooler: SS 304</li> <li>xii) Outer casing of coolers: Carbon Steel</li> <li>xiii) Gear box: Cast Iron</li> <li>xiv) Gears: Alloy Steel.</li> </ul>		
4.1.3	<p>Accessories</p> <p>However, Material of Construction of components of Screw Compressor of reputed manufacturer shall also be acceptable subject to BHEL/Customer's approval.</p> <p>Each compressor skid to include Suction filter, silencer, intercooler &amp; After cooler with moisture separators, automatic drain traps, instruments, control panel Base plate, coupling guard. Foundation bolt, nuts, anti vibration pads, Eye bolts and operation and maintenance tools.</p>		
4.1.4	<p>Control Philosophy</p> <ul style="list-style-type: none"> <li>i. Each compressor be operatable under continuous, auto, "Load-Unload" or "On-Off" mode (i.e.) "Dual control modes".</li> <li>ii. Any of the compressors shall be selectable at control panel to operate either for Base duty (Auto Load-Unload) or Standby duty (Auto On-Off) operation.</li> <li>iii. In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall: <ul style="list-style-type: none"> <li>a) Operate the load-unload circuit at a predetermined set pressure.</li> <li>b) Throttle the inlet valve.</li> <li>c) Open the blow off valve.</li> </ul> <p>Unloaded compressors to run in idling mode and when system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow-off valve.</p> </li> <li>iv. In "Stand-by" duty the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor shall be started to unloaded condition. After a suitable time delay, the compressor shall be fully loaded.</li> <li>v. When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period, (set by a timer), the compressor may be loaded to; full load in case of drop in system</li> </ul>		

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<p>pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a pre-set time.</p> <ul style="list-style-type: none"> <li>vi. The pressure and duration of time to be set shall be adjustable at site from the panel.</li> <li>vii. Further all interlocks for safe and proper operation of the compressors shall be provided by the Bidder.</li> <li>viii. All pressure and temperature conditions used for tripping the compressor shall be provided with pre-trip annunciation in the control panel.</li> <li>ix. Independent switches shall be used for alarms (annunciations) and tripping or interlock as far as possible.</li> <li>x. An electrically operated automatic valve shall be provided on cooling water supply line of each compressor which will automatically shut off the cooling water supply, in case compressor is not running for more than set time duration. Suitable interlock shall also be provided for opening the valve before starting of the compressor.</li> </ul> <p><b>4.2 Intake Filter and Silencer</b></p> <p>Intake Air Filter and Silencer shall be comply with the following requirements:</p> <p><b>4.2.1 Performance</b></p> <ul style="list-style-type: none"> <li>i. Filtering efficiency minimum 99% down to 10 microns.</li> <li>ii. Maximum pressure drop across filter at design flow rate in new condition be 250 mm of water column.</li> <li>iii. Design Airflow rate corresponding to compressor airflow.</li> </ul> <p><b>4.2.2 Quantity:</b> One per compressor</p> <p><b>4.2.3 Design air data</b></p> <ul style="list-style-type: none"> <li>i. Dust concentration: 30 mg / M<sup>3</sup></li> <li>ii. Particle size in microns: Up to 10 microns</li> </ul> <p><b>4.2.4 Type/Design:</b> Heavy duty type</p> <p><b>4.2.5 Construction</b></p> <ul style="list-style-type: none"> <li>i. To provide densely packed, replaceable type paper as filtering media.</li> <li>ii. Filter to be designed to have sound suppressing characteristics.</li> <li>iii. Preferably Filter and silencer be combined type.</li> <li>iv. Filter to take suction from outside not from compressor room.</li> </ul> <p><b>4.3 Inter Cooler &amp; After Cooler</b></p> <p>Inter cooler and After cooler shall comply with the following requirements:</p> <p><b>4.3.1 Performance</b></p> <ul style="list-style-type: none"> <li>i. Outlet temperature of air from intercooler to suit the equipment offered.</li> <li>ii. Outlet temperature of air After cooler to be limited to 10 Deg.C of inlet cooling water temperature.</li> </ul> <p><b>4.3.2 Type:</b> Shell and tube type</p> <p><b>4.3.3 Construction</b></p> <ul style="list-style-type: none"> <li>i. Design code: TEMA class "C" or equivalent.</li> </ul>			

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	<p>ii. With removable tube bundle type.</p> <p>iii. With internal baffling.</p> <p>iv. Design pressure in airside: 2 Kg / Cm<sup>2</sup> more than air inlet pressure.</p> <p>v. Design pressure in waterside: Not less than shut off head of DM cooling water pump.</p> <p>4.3.4 Material</p> <p>i. Tube : Admiralty brass or Aluminium brass or SS 304.</p> <p>ii. Shell : SA 285 Gr.C or equivalent</p> <p>iii. Tube sheet: SA 285 Gr.C or equivalent</p> <p>iv. Baffle : Carbon steel</p> <p>v. Flanges : Steel IS 2862.</p> <p>4.3.5 Accessories</p> <p>i. To provide necessary vent &amp; drain connections.</p> <p>ii. Moisture separation units with level gauge.</p> <p>iii. Automatic drain trap stations with bypass &amp; isolating valves for moisture separators.</p> <p>iv. Safety valves</p> <p>v. Lifting eye bolts, tools &amp; tackles if any.</p> <p>4.3.6 Additional Data</p> <p>After coolers are not to be fitted with instrument air compressors if bidder offers "Heat of compression" type air drying plants and the same shall be provided at down stream of ADP.</p>		
	<p><b>5. RECIPROCATING OIL FREE COMPRESSOR</b></p> <p><b>5.1 Each of the Compressors shall comprise but not be limited to the following:</b></p> <p>5.1.1 LP and HP cylinders as required to meet the compressor rating, intercoolers, automatic drain trap station, relief valves and other accessories.</p> <p>5.1.2 Drive machinery including drive motor and accessories.</p> <p>5.1.3 Frame lubrication system, complete with protective devices and instruments.</p> <p>5.1.4 After cooler and moisture separator both complete with automatic trap station, relief valves and other accessories and instruments .</p> <p>5.1.5 Air intake filter and silencer unit</p> <p>5.1.6 Set of local instruments as applicable</p> <p>5.1.7 Set of cooling water control valves.</p> <p>5.1.8 Set of foundation bolts, nuts etc. for compressors, motors, after coolers, suction filters etc.</p> <p>5.1.9 Control panel comprising of all relays, contactors, solenoid valves, pressure switches, instruments, pneumatic impulse air tubing annunciation window selector switches etc.</p> <p>5.1.10 Flow indicator of jacket cooling water after the inter and after coolers</p> <p>5.1.11 Relief valves on the instrument and service air headers and also after the interconnection header between SA and IA headers.</p>		


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5.1.12	<p>Instruments like pressure / temperature gauges and switches as required for the following:-</p> <p>i. Pressure switches</p> <p>a) Compressor lube oil pressure low alarm</p> <p>b) Compressor lube oil pressure very low trip</p> <p>c) To load the compressor</p> <p>d) To unload the compressor</p> <p>e) To start the compressor</p> <p>f) To stop the compressor</p> <p>g) Low water pressure alarm on common water inlet heater of the Compressor.</p> <p>h) Very low water pressure trip on common water inlet heater of the Compressor.</p> <p>ii. Temperature switches</p> <p>a) Air after after-cooler high alarm</p> <p>b) Air after after-cooler very high trip</p> <p>c) Compressor cylinder water outlet temperature high alarm</p> <p>d) Compressor cylinder water outlet temperature very high trip.</p> <p>iii. Pressure gauges</p> <p>a) After compressor inter-cooler</p> <p>b) After compressor after-cooler</p> <p>c) At water inlet common header of the compressors</p> <p>iv. Temperature gauges</p> <p>a) After cooler water outlet</p> <p>b) After cooler air outlet</p> <p>c) Inter cooler water inlet</p> <p>d) Inter cooler air outlet</p> <p>e) After air compressor cylinder jacket</p>
5.1.13	Flow indicator of jacket cooling water after the inter and after coolers
5.1.14	Relief valves on the after coolers, intercoolers, instrument and service air headers and also after the inter connection headers between SA & IA headers, moisture separators etc.
5.1.15	Counter flanges, bolts, nuts and gaskets at all equipment/piping terminating points.
5.1.16	Base plate/plates, support plates, anchor bolts and nuts, inserts, lifting lugs, eye bolts, etc. as required.
5.1.17	Set of special tools and tackles including tools boxes.
5.1.18	Cleaning, protection and painting
5.1.19	Initial fill of lubricating oil for compressors and filtering media for all filters.

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<b>5.2</b>	<b>CONSTRUCTION FEATURES</b>
5.2.1	Air Compressors
	<div><div>i.</div><div>Each compressor shall be multi stage, reciprocating, water cooled type. Compressor cylinder shall be closed grained cost Iron conforming to IS:210 FG 260 or equivalent. The cylinder shall be provided with renewable liners or recording allowance as per API-015, 1974. The crankshaft and connecting rods shall be of forged steel conforming to IS:1875 or equivalent and statically and dynamically balanced,. The service air compressors shall be lubricated / non lubricated type (as required in the data sheet A) whereas the instrument air compressors shall essentially be non lubricated type and the air delivered by these instrument air compressors shall be completely free of any oil, grease and other impurities. To ensure, this the piston rings shall be of Teflon and no lubricating oil shall be used in the cylinder. Special care shall be taken to prevent any oil from finding its way into the cylinders from the crank case.</div></div> <div><div>ii.</div><div>The piston rod packing shall also be of oil less self lubricating type. Any oil adhering to the piston rod shall be wiped off by suitable water rings. Suitable collar may also be fixed in the piston rod so that any trickling oil flow can be stopped from movement towards the cylinder.</div></div> <div><div>iii.</div><div>The intake filters with built in silencers shall be of dry reusable type located at the air intake connection to low pressure cylinder to remove any carried solid particles in air.</div></div> <div><div>iv.</div><div>Crank case shall be of rugged construction and shall have openings for access to all crank case machinery. A level indicator shall be provided for all crank case oil sump.</div></div> <div><div>v.</div><div>Each compressor shall be driven preferably by direct coupleled electric motors or otherwise through 'V' belt drives. The drive shall be provided with a safety guard.</div></div> <div><div>vi.</div><div>Flywheels shall be provided, if required, and shall be of adequate size to smoothen the effect of fluctuation of turning moment load during crank revolution.</div></div> <div><div>vii.</div><div>Compressor valves shall have large effective areas permitting low velocities. In case of on lubricating type compressors, valves disc. Shall be either of stainless steel to AISI 316 or 15% chrome steel heat treated, tempered and ground. The valve seats and guards shall be case hardens and valve spring shall be of stainless steel. Self lubricating valve guides and wear strips shall be used for noiseless operation and long life. The tenderer shall offer his standard materials of construction for the valve for lubricated type of compressor.</div></div> <div><div>viii.</div><div>To shut off cooling water flow through intercooler, compressor jacket and after coolers, operate lockable type gate valve (lockable in open position) shall be provided. These valves are to be shut off manually when required.</div></div> <div><div>ix.</div><div>The crankshaft bearings shall be of antifricition type. A crankshaft driven positive displacement pump shall draw lubricating oil from the crankcase sump though a strained and shall provide for forced lubrication to all the bearings.</div></div> <div><div>x.</div><div>The compressor lube oil pressure shall be built up with in a predetermined time (adjusted by a timer) failing which the compressor shall automatically trip.</div></div> <div><div>xi.</div><div>Provision shall be made for lubricating the parts where ever necessary to ensure smooth operation and freedom from undue wear.</div></div> <div><div>xii.</div><div>Gear boxes and oil bath shall be provided with filling and drain plug of adequate size and shall also be provided with visual level indicators. Provision shall be made for efficient lubrication of all bearings, including ball and roller bearings by the use of separate grease cups, self sealing nipples of oil baths. Housing of</div></div>



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ball and roller bearings shall be packed at the time of assembly. Necessary provision shall be made for preventing dust ingress into lubricated parts. A drawing showing all lubricant points and recommended lubrications to be used shall be supplied. The first fill of oil lubricant of correct grade shall be provided.

xiii. All lubrication systems fittings on all equipment supplied shall wherever possible be standardised. The grease nipples shall be of button head type or approved equal and shall conform to IS:4009.

xiv. The power ratings of the driver shall be selected such that the minimum margin of 15% is available over the power requirement to deliver rated capacity at rated pressure. When the drive is not directly coupled to the compressor, due account should be made for losses in power transmission in addition to the above margin. In case belt driven compressors, 5% belt loss should be considered over and above 15% spare margin in selecting the driven motor.

5.2.2 Inter Cooler, After Cooler and Moisture Separator

i. The intercooler shall be provided between the low and high pressure stages of the compressor. The after coolers and moisture separator shall be located between the compressor discharge and air receiver. Volume bottles shall be provided at LP cylinder discharge end and HP cylinder suction and discharge ends to take care of the pulsation or air flow. Both intercooler and after cooler shall be water cooled complete with standard accessories, such as safety valves moisture separator and automatic drain trap, bypass arrangement for automatic drain trap. The equipment shall be complete with the instrument mentioned elsewhere in this specification included in the scope of work. The inter cooler and after cooler shall be designed with adequate margin in heat transfer area. For design purpose a cleanliness factor of 0.85 shall be used in both cases.

ii. The after cooler shall be designed such that the temperature of air leaving is not more than 80 deg. C above the cooling water inlet temperature.

iii. Following material of construction shall be used.

a) Shell: ASTM A-285 Gr. C or approved / Equal

b) Tubes: Copper as per BS-378 or admiralty brass to ASTM B-111 type B.

c) Moisture separator: Galvanised, to prevent corrosion Internal.

iv. The lower portion of moisture separator shall be provided with the gauge glass. Pressure drop in intercooler, after-cooler & moisture separator, shall be kept to a minimum. Pressure parts shall be designed as per IS:2825 or as per ASME section VIII Div. 1 Design of coolers shall be as per TEMA class C.


v. Both intercooler and after cooler shall preferably be standardised in regard to tube material, tube outside diameter & tube length.

5.2.3 Oil Separator

i. In case compressed air is to be fed from the lubricated compressors to the pneumatic/control valves, then it would be desirable that the air is made oil free before it is fed to the pneumatic valves bypassing it through and air separator. (Please refer to data sheet A).

ii. The oil separator shall be constructed from carbon steel in accordance with pressure vessel codes like ASME Section VIII Div. I or IS 2525. The design pressure of this same shall be indicated in Data Sheet A. The oil separator shall be able to remove the oil in the condensed form by impingement on a cartridge of synthetic wool to a degree as specified in Data Sheet A.

iii. The design of the oil separator shall be such as to facilitate easy removal of the synthetic wool cartridge for cleaning. A drain valve shall also be provided.

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iv. The frequency at which the oil separator is to be drained and the time after which the synthetic wool should be either washed with a solvent or replaced shall be clearly indicated.

**5.3 Control and Interlock Equipment**

**5.3.1 Compressor Capacity Control**

i. Control system for each compressor shall be to maintain receiver pressure within the specified limits by load unload Control" or on-off control" (i.e. dual control as per data sheet 'A' which are briefly described below:-

ii. The loading/unloading of the compressor is to be actuated through pressure switches located on the outlet header of each compressor. The compressor(s), in this mode of control would run continuously at constant speed but would be loaded and unloaded in steps of 100, 50% and 0% by closing and opening of the respective suction valves. This is to be achieved by means of a selector switch, having two position viz "Auto" and 'Mechanical'.

iii. In the auto position the control will be through electro pneumatic means i.e. pressure switches while in the mechanical position, the control shall be through adjustable spring loaded mechanical governors.

iv. Normally the selector switch for control for all the compressors will be in the 'Auto' position and the mechanical position is only a standby arrangement.

v. Another selector switch is to be provided for selecting the duty of the compressor viz. 'Main' or 'Standby' Duty. Depending upon the position selected in this selector switch, the compressor will run as a main compressor or be a standby.

vi. In the ON-OFF mode of capacity control the compressor will always be loaded except during starting. The compressor is started automatically when the discharge header pressure falls below the set value by the pressure switch. The compressor is stopped when the discharge header pressure reaches upper set limit on another pressure switch. The first start of compressor will however, be manual. In the event of tripping of compressor on fault or manually, the compressor will not start automatically until the fault is reset and started manually.

**5.3.2 COMPRESSOR PROTECTION**

The control panel shall house an audio visual alarm system for each compressor in order to ensure safe operation of the compressors and to bring their abnormal operation to the notice of the operator. The items to be annunciated for IA & SA compressors shall include but not be limited to the following:-

a) Receiver pressure high alarm

b) Receiver pressure very high trip

c) Receiver pressure low alarm

d) Compressor lube oil pressure low alarm

e) Compressor lube oil pressure very low trip

f) Air temperature after aftercooler high alarm


g) Air temperature after after-cooler very high trip


h) Compressor cylinder water outlet temperature high alarm

i) Compressor cylinder water outlet temperature very high trip.


**6. AIR RECEIVERS**

Air receivers shall comply with the following requirements.


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6.1.1	Design	<ul style="list-style-type: none"> <li>i. Design pressure &amp; temperature : 10 Kg/cm<sup>2</sup> &amp; 50 Deg.C.</li> <li>ii. Outdoor located, vertical cylindrical vessel.</li> <li>iii. Design code : ASME Sec. VIII Div 1 or IS:2825 &amp; IS 7938.</li> <li>iv. Welded Construction : Longitudinal seam in adjacent sections shall not be in same line.</li> <li>v. To provide gasketed inspection manhole of minimum 500 diameter.</li> </ul> <p>Opening shall not pierce any seam &amp; shall be as far as possible away from any welded seam.</p>		
6.1.2	Fabrication	<ul style="list-style-type: none"> <li>i. Welding as per relevant codes.</li> <li>ii. Filler material to have composition &amp; structure as that of material welded.</li> <li>iii. Welding electrodes to be approved by Owner.</li> <li>iv. Electrodes to be dried before use.</li> </ul>		
6.1.3	Accessories	<ul style="list-style-type: none"> <li>i. To provide Relief valves to suit compressor capacity and set pressure of the same at least 10% above working pressure.</li> <li>ii. The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure.</li> <li>iii. Drain connection with automatic trap stations.</li> </ul>		
6.1.4	Material	<p>Shell End plates &amp; flanges --- IS:2002 or Equivalent.</p>		
<b>7.</b>	<b>AIR DRYING PLANTS</b>	<p>Air Drying plants shall comply with the following requirements:</p>		
<b>7.1</b>	<b>Performance Requirements</b>			
7.1.1	Normal flow rate:	To match compressor capacity.		
7.1.2		To be designed for continuous duty for dew point of outlet air at minus (-) 40 Deg.C at atmospheric pressure.		
7.1.3		Quality of dry outlet air to conform to Instrument society of American standard S7.3 "Quality Standard for Instrument Air".		
7.1.4		ADP to be placed upstream of the air receiver.		
<b>7.2</b>	<b>Quantity</b>			
7.2.1		One ADP for each Instrument air compressor.		
<b>7.3</b>	<b>Type / Design</b>			
7.3.1		"Heat of Compression type ADP" either "Conventional Type" or "Rotary Drum type".		
7.3.2		Drying by absorption method.		


	<b>TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM</b>	<b>SPECIFICATION NO. PE-SS-EPC-555-A-001</b>	
		<b>VOLUME II B</b>	
		<b>SECTION D</b>	<b>SUB-SECTION A8</b>
		<b>REV. 0</b>	
		<b>SHEET 12 OF 15</b>	

<b>7.4</b>	<b>Construction of Conventional heat of Compression type ADP</b>
7.4.1	Reactivation shall be by “Heat of Compression” method without any air purge loss. Hot unsaturated compressed air shall be used for regeneration of exhausted dessicant in case of “Heat of compression type ADP”.
7.4.2	With two absorber tower per ADP for conventional type (One for drying while the other is under regeneration / standby modes).
7.4.3	Design drying cycle: 8 Hours.
7.4.4	Design regeneration cycle: Less than 8 hours including cooling period.
7.4.5	Indoor located.
7.4.6	With (minimum) 3 steps de-pressurisation.
7.4.7	To provide automatic tower change over control with provision for manual take over.
7.4.8	All pressure vessels to be designed as per IS:2825 or equivalent code.
7.4.9	All vessels to include required manholes / harid holes.
7.4.10	All hot vessels & pipelines to be insulated to restrict the outside temperature within 60 Deg.C with mineral wool (or equivalent), GI wire netting and aluminium cladding / over.
7.4.11	Quantity of dessicant to be calculated taking into account residual moisture content at the end of regeneration cycle. Design calculation with curves shall be submitted for approval of Owner.
7.4.12	Absorption capacity and density to be considered for silica gel shall not be more than 10% and 550 Kg/M <sup>3</sup> respectively. In case of activated alumina the same shall be 8% (max) and 900 Kg/M <sup>3</sup> (max.) respectively.
7.4.13	Minimum 20% of dessicant depth shall be provided as free board in adsorber vessels.
7.4.14	Adsorber vessels to be provided with suitable number of inspection / sight windows of peresplex for observation of adsorbent condition.
7.4.15	Dessicant filling and removal connection shall be provided.
7.4.16	Non-lubricated two way three way / four way valves ball valves with pneumatic actuators be provided.
7.4.17	In case of Heat of compression type adsorbers shall be sized so that even when the compressor is operating at 50% capacity, complete regeneration shall be achieved within the cycle time.
7.4.18	Complete ADP equipments shall be preferably mounted on a skid.
7.4.19	Required sample connections in piping be provided for sampling of air at desired locations.
<b>7.5</b>	<b>Accessories</b>
7.5.1	Prefilters and After filters: 2x100% with automatic drain trap filter arrangement & with ceramic candle type elements.
7.5.2	Electric Heaters: 2x100% with thermostatic control for heater & facility for easy replacement of element.
7.5.3	To provide suitable solenoid valves for depressurisation and re pressurisation of towers.
<b>7.6</b>	<b>Material</b>
7.6.1	Absorber vessels & its internals: MS Vessels as per IS; 2062 & Internals SS 304

	<b>TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM</b>	<b>SPECIFICATION NO.PE-SS-EPC-555-A-001</b>	
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		<b>SHEET 13 OF 15</b>	

7.6.2	Regeneration air cooler shell tube(if applicable): SA-285 Gr.C or equivalent		
7.6.3	Blower casing:	Carbon steel	
7.6.4	Blower blades & shaft:	Stainless steel	
7.6.5	Relief valves:	Brass or SS	
7.6.6	Tube of heat exchangers and Dehumidifier:	Aluminium brass or SS	
7.6.7	Shell & tube sheet for the above:	SA 285 Gr.C.	
7.6.8	Baffle:	Carbon steel	
7.6.9	Dessicant:	Silica gel / Activated Aluminium or as per manufacture’s standard.	
7.7	<b>Control philosophy</b>		
7.7.1	Sequential operation of the adsorber towers be controlled automatically with a provision for manual take over.		
7.7.2	Automatic operation of adsorber tower under drying, operation of the other tower under regeneration, change over of towers, starting and stopping of blowers, slow depressurisation & re pressurisation of towers etc. shall be timer controlled. During the process, in case, operation is taken over manually from the panel through push button or selector switch, the sequential operation shall start with the manual initiation for each of the steps.		
8.	<b>INTER CONNECTING PIPING, FITTING AND VALVES</b>		
	Inter connecting piping, fittings and valves shall confirm to the following requirements.		

	<b>TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM</b>	SPECIFICATION NO. PE-SS-EPC-555-A-001	
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	8.1	All interconnecting compressed air piping shall conform to IS: 1239 ( Heavy Grade ) or IS: 3589 Gr. 410 and galvanised as per IS : 4736.	
	8.2	Fittings for air piping shall be conforming to IS: 1239/IS:1879 and Grade equivalent that of parent pipe Grade.	
	8.3	Compressed air piping from air compressor to after cooler and other lines handling hot air will be suitably insulated so as to restrict surface temperature to 60deg.C. The pipe joints will be screwed coupling type for sizes upto 50 NB and above 50 NB the same will be flanged.	
	8.4	All cooling water piping will be M.S. conforming to IS: 1239 (Part-I) (Heavy Grade).	
	8.5	For Air line Ball Valves with Stainless Steel internals with Teflon seat shall be provided. Ball valves upto 50 NB shall be of Forged Carbon Steel Body with screwed connections. Ball valves above 50 NB shall be of Cast Carbon Steel Body with flanged connections.	
	8.6	The check valves shall conform to IS: 3412.	
	8.7	For water line Gate valves shall be provided. For size 50 NB and smaller carrying water the same shall conform to IS:778 with gun metal body and trim and for above 50 NB with carbon steel body and internals.	
	9.	<b>INSTRUMENTATION (GENERAL)</b>	
	9.1	Detailed specification for the Instrumentation shall be referred in the control and instrumentation section of this volume.	
	9.2	The bidder shall include instruments / controls to facilitate safe, reliable and efficient operation for the system offered. The instrumentation control system offered by the bidder shall be subjected to approval of the Employer during detailed engineering.	
	9.3	All Instrumentation and Control equipments required for Compressed air system such as primary and secondary instruments, control panels / cabinets, cable etc. shall meet the requirements specified in control and instrumentation section of the Volume.	
	9.4	The protection and interlock system shall be subject to the approval of the Employer.	
	9.5	All pressure and temperature conditions used for tripping the compressor shall e provided with pre-trip annunciation in the control panel.	
	9.6	Following general philosophy shall be followed regarding instrumentation.	
	9.6.1	Pressure Indicators / Vacuum gauge:	
		i. At inlet outlet of each compression stage (air line).	
		ii. At inlet and outlet of cooling water header.	
		iii. At inlet and outlet of (air line) each heat exchangers of compressors & air drying plant (in air side).	
		iv. At inlet and outlet of each adsorber vessel.	
		v. At each air receiver and at outlet header of compressor & air drying plant.	
		vi. At inlet of each of the filters of compressors assembly and ADP system.	

	<b>TECHNICAL SPECIFICATION COMPRESSED AIR SYSTEM</b>	<b>SPECIFICATION NO. PE-SS-EPC-555-A-001</b>	
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9.6.2

Pressure Switches (Individual for each function).

i.

At inlet/outlet of each compressor stage of the compressor (for annunciation / interlock).

ii.

At each air receiver for:

a)

High/Low pressure alarm, for start/stop control.

b)

For load/unload control.

c)

At common discharge outlet of compressor & air drying plant (for alarm)

iii.

At discharge of each compressor.

9.6.3

Temperature Indicators

i.

At inlet and outlet of each heat exchangers / coolers of compressor and air-drying plant in the lube oil, air & cooling water circuits.

ii.

At inlet and outlet of electric heaters & exhaust (atmosphere) of regeneration air (for open through type ADP).

iii.

At inlet and outlet of each adsorber vessel.

iv.

At common discharge outlet of compressor & ADP.

9.6.4

Temperature Switches / Temperature Controllers

i.

At inlet and outlet of each heat exchangers / coolers of compressor and air drying plant in the air & cooling water and lube oil circuits for low & high alarms, trip & interlock.

ii.

At outlet of electric heaters & exhaust of regeneration air (open through type ADP) for alarm & interlock.

iii.

At discharge of each compressors (before air receiver).

iv.

At common discharge outlet of air compressors & air-drying plant.

**400MW MARIB GAS TURBINE POWER STATION (PHASE - II)**  
**COMPRESSED AIR SYSTEM**  
**SUGGESTIVE PRICE FORMAT**

Clause No.	DESCRIPTION	Qty.	Unit	Unit Price (Rs)	Total Price (Rs)
1	<b>LUMPSUM PRICES</b> Total lumpsum firm prices for Equipment & Services as Specified, Comprising Design, Engineering, Manufacture, Inspection & Testing at Manufacturer's Works, Painting at Manufacturer's Works, Duly packed (seaworthy packing) for Transportation, Delivery to designated port, preparation and submission of as built drawing for the total scope of Compressed Air System as per Specification No. PE-TS-372-555-A001 R01 including supply of erection materials, consumables as required to complete the compressed air plants/equipments installation, maintenance tools & tackles, consumables and first fill of consumables, all taxes, duties but excluding recommended spares & optional items etc.	1	Lot		
2	Break up prices for items covered in clause 1.0 above. Prices for design, manufacture, inspection & testing at manufacturers works & supply of following items.				
2.1	<b>Air Compressor (oil free Screw / Rotary Tooth type)</b> Each of minimum 10 NM <sup>3</sup> /Min capacity at 8.5 kg/cm <sup>2</sup> (g) consisting Electric motor to drive the compressor with accessories, Suction filter and silencer, Inter Cooler, After Cooler (as applicable) with moisture separators, automatic drain traps, instruments, Control panel etc.	3	Nos		
2.2	<b>Air Dryer</b> Air cooled refrigerant type Air Dryer of capacity 10 NM <sup>3</sup> /Min (min) and to match air compressor outlet flow with all instruments and controls as specified.	3	Nos		
2.3	<b>Air Receivers</b> Air receiver of minimum 6 M <sup>3</sup> capacity with each having Pressure switches, Relief valve, Drain connection with automatic trap stations, instruments and other accessories as specified.	4	Nos		
2.4	Ventilation arrangement for the compressor including ducting, support etc.	1	Lot		
2.5	Inter connecting compressed air piping as specified including fitting & valves etc.	1	Lot		
2.6	All field instruments like Temperature & Pressure gauges, Pressure Transmitter & controls etc	1	Lot		
2.7	Electronic Dew point meter with local display	3	Nos		
2.8	Drain piping up to the nearest drain point.	1	Lot		
2.9	Cable lugs, glands, etc for Compressed Air System equipment as required..	1	Lot		



Clause No.	DESCRIPTION	Qty.	Unit	Unit Price (Rs)	Total Price (Rs)
2.10	Any other item not indicated above, but required to complete Compressed Air package as per system requirements.	1	Lot		
2.11	Total lump sum prices for Maintenance Tool & Tackles (bidder to furnish item wise prices separately along with the price bid).	1	Lot		
2.12	Total lump sum prices for commissioning spares (bidder to furnish lists of spares with item wise prices separately along with the price bid).	1	Lot		
2.13	PG testing / acceptance test at site (including Instruments)	1	Lot		
<b>3.0</b>	<b>SUPERVISION OF ERECTION AND COMMISSIONING</b>				
3.1	No of mandays	60	Nos		
3.2	No of site visits	4	Nos		

#### NOTES

- 1 Bidder must submit prices in the Pro Forma duly filled in signed and stamped on every page without any ambiguity. The price shall be written against each item. Term such as "refer covering letter" etc. are not acceptable. Extra sheet may be attached if the space provided is not sufficient
- 2 Price format shall not be changed by the bidder

**400MW MARIB GAS TURBINE POWER STATION (PHASE - II)**

**COMPRESSED AIRSYSTEM**

**GUARANTEED POWER CONSUMPTION FIGURES**

S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY			
1	2	3A	3B	4	5	6=3Ax4x5
1	Air Compressor (oil free Screw / Rotary Tooth type) Each of minimum 10 NM3/Min capacity at 8.5 kg/cm2 (g)	2	1			
2	Air drying plant unit (Refrigerant type)	2	1			
<b>TOTAL (KW)</b>						<b>230</b>

Note:	<p>Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as 230 KW. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ US\$ 620 per KW of additional power over EPC.</p> <p>Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ US\$ 620 per additional KW shall be levied on vendor.</p>
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**ANNEXURE -1**

**FORMAT FOR NO DEVIATION CERTIFICATE**  
**(To be submitted in the bidder's letter head)**

BHARAT HEAVY ELECTRICALS LIMITED,  
Power Sector – Project Engineering Management,  
PPEI Building, Plot No. 25, sector-16A  
Noida -201301(U.P)

Sub	No Deviation Certificate	
	Design, engineering, manufacturing, supply, erection, commissioning etc of Compressed Air System for 400 MW MARIB GTPS PH-II	
Ref	01	Tendor No.
	02	BHEL 's NIT, vide reference no.
	03	BHEL's clarification / confirmation vide reference email dated
	04	Other reference (if any)/

Dear Sirs,

With reference to above, this is to confirm that as per tender conditions, we have visited site before submission of our offer and noted the job content & site conditions etc. We also confirm that we have not changed / modified the tender documents as appeared in the web site / issued by you and in case of such observance at any stage, it shall be treated as null and void.

We hereby confirm that we have not taken any deviation from tender clauses together with offer references as enumerated in the above referred NIT (besides the confirmations given at Sl. No. 03 under Ref.). We hereby confirm our unqualified acceptance to all terms & conditions, unqualified compliance to technical specification and acceptance to reverse auctioning process.


In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted offer in accordance with tender instructions and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized  
representative of the bidder)

	<b>TITLE:</b> <b>COMPRESSED AIR SYSTEM</b> <b>400 MW MARIB GTPS PH-II</b>	SPEC. NO. <b>PE-TS-372-555-A001</b>	
		VOLUME <b>III</b>	
		SECTION :	
		REV. NO. 00	DATE: 21.01.2013
		SHEET	

### SCHEDULE OF CLARIFICATION/DEVIATION


All clarification/deviation from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION



**BHEL**

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	<b>TITLE:</b> <b>COMPRESSED AIR SYSTEM</b> <b>400 MW MARIB GTPS PH-II</b>	SPEC. NO. <b>PE-TS-372-555-A001</b>	
		VOLUME <b>III</b>	
		SECTION : E	
		REV. NO. 00	DATE: 21.01.2013
		SHEET	

### SCHEDULE OF DRAWINGS/ DOCUMENTS

Following is the schedule of drawings/ documents to be furnished by bidder in the event of award of contract.

S. No.	BHEL Drg/ Doc No	Drawing/ Document Title	Submission Schedule - Week Number from date of LOI
1	PE-V0-372-555-A001	QUALITY PLAN OF AIR COMPRESSOR	8
2	PE-V0-372-555-A002	QUALITY PLAN OF AIR DRYING PLANT	8
3	PE-V0-372-555-A003	QUALITY PLAN OF AIR RECEIVER	8
4	PE-V0-372-555-A004	QUALITY PLAN OF MOTOR	8
5	PE-V0-372-555-A101	TDS OF INSTRUMENT AIR & SERVICE AIR COMPRESSORS	8
6	PE-V0-372-555-A103	TDS OF AIR DRYING PLANT	8
7	PE-V0-372-555-A105	TDS & CHARACTERISTIC CURVES OF MOTOR FOR AIR COMPRESSOR	12
8	PE-V0-372-555-A109	TDS & GA OF VALVES	12
9	PE-V0-372-555-A110	TDS OF PIPES & FITTINGS	10
10	PE-V0-372-555-A111	TDS OF INSTRUMENTS	12
11	PE-V0-372-555-A301	GA DRAWING OF INSTRUMENT & SERVICE AIR COMPRESSOR	12
12	PE-V0-372-555-A302	GA DRAWING OF AIR DRYER	8
13	PE-V0-372-555-A306	GA DRAWING OF MOTOR FOR AIR COMPRESSOR	12
14	PE-V0-372-555-A308	GA DRAWING OF AIR RECEIVER	8
15	PE-V0-372-555-A401	COMPRESSOR HOUSE LAYOUT	14
16	PE-V0-372-555-A501	P & I DIAGRAM OF AIR COMPRESSOR	10
17	PE-V0-372-555-A502	P&I DIAGRAM OF AIR DRYER	8
18	PE-V0-372-555-A505	P&I DIAGRAM OF COMPRESSED AIR SYSTEM WITHIN COMPRESSOR HOUSE	8
19	PE-V0-372-555-A701	OPERATION & CONTROL PHILOSOPHY OF COMPRESSED AIR SYSTEM	10
20	PE-V0-372-555-A702	ELECTRICAL & INTERNAL WIRING DIAGRAM FOR COMPRESSOR PANEL.	4
21	PE-V0-372-555-A901	O&M MANUAL-COMP AIR SYSTEM	16
22	PE-V9-372-555-I902	PLC CONFIGURATION DIAGRAM	16
23	PE-V9-372-555-I903	CONTROL DESK/PANEL LAYOUT/GA DRAWING	16

