

# ESTIMATING AND COSTING AND CONVENTIONAL ELECTRICAL SYMBOLS

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## 1.1 INTRODUCTION

In any engineering work the most important requirement is to make pre-assessment of the cost and quantity of the material to be used. This enables the engineer to present a clear picture of the work before taking it in to hands.

## 1.2 ESTIMATING

Estimating means to determine the quantities of various items required to execute a job and to assess the cost of the execution. The estimator keeping in view the requirements arrived at during initial planning, chalk out a list of items and quantities. The cost is determined by him by consulting the price catalogue and schedule of labour rates.

Estimate is prepared for help in taking a right and definite decision while entering into a contract with any organisation, industry or firm but does not in itself set up tender or contract. In general, it can be enlisted under four headings:

1. Estimation of the quantities of material and the cost involved
2. Cost analysis
3. Maintaining neat and clean proper records
4. Provision of selling aids.

## 1.3 VARIOUS STEPS TO FORM AN ESTIMATE

The various steps to form an estimate are as follows :

- (i) Chalk out a list of items and quantities required.
- (ii) Consult the rate catalogues for pricing the various items.
- (iii) Assess the exact number of workmen required to complete the job and after consulting the schedule of labour rates add the labour cost to the estimate under preparation. It should be noted that number of workmen required is dependent upon the time limit fixed to complete the service.

- (iv) Add supervision charges and executor's profit.
- (v) In case of Govt. organisation, where the work is to be executed by the contractor, the tenders are floated only after correctly specifying the description of each item, to avoid any mis-understanding while execution.

## 1.4 PURPOSE OF ESTIMATING AND COSTING

Before starting a new programme as per good management practices it is very necessary to know the necessary material required and the cost to be incurred on it. Hence it is very necessary to prepare a complete project for the given programme because this project acts as a guide in the successful implementation of required programme. Prepared project report includes full details of the work to be executed such as drawing of the work, complete details of the needed materials with its costing and the sequence of number of operations to be performed.

Estimating is also very essential from the point of view to know the amount of money required and availability of material etc. because if there is shortage of money and non-availability of required material that may cause interruption in work at any stage.

The following datas related to an estimate should be known to an estimator, while he prepares an estimate for the internal wiring :

- (i) Full specifications of the building *i.e.*, its length, breadth, and height with positions of various doors and windows.
- (ii) The type of wiring to be used.
- (iii) Quality of the material required for wiring.
- (iv) Complete schedule of the points to be wired up.
- (v) Plans and sections marked with details, at least with the positions of main switch, gear and distribution board.

## 1.5 QUANTITIES OF A GOOD ESTIMATOR

A good estimator must have the following qualities:

- (i) He should have full practical experience and knowledge about preparing estimates.
- (ii) He should have complete and up-to-date knowledge about the latest designs.
- (iii) He should have a very good imagination and experimenting power.
- (iv) He should be able to maintain the proper record of latest prices of the materials required for any work.
- (v) While estimating any project he should have always keep provision for future extension and diversions.

## 1.6 ESSENTIAL ELEMENTS OF ESTIMATING AND COSTING

Before initiating any electrical project the following facts (data) related to estimate should be known to an estimator while he prepares an estimate for that project:

1. Full knowledge of the purchase system.
2. Specifications of the material.

- 3. Latest and up-to-date market cost of materials.
- 4. Latest price lists and net prices.
- 5. Calculation of material and labour cost.
- 6. Any other cost.

1.7. PRICE LIST

In the market the available price list includes terms and conditions of the suppliers along with the price of the required material. One of the sample of price list is shown in Table 1.1.

Table 1.1. Price List

Name of the Supplier/Firm.....Applicable w.e.f.  
Date.....

S. No.	Name of item with specification	Unit	Cost	Remarks
1.	One way switches bakelite :			
	Tumbler switch 5 amps.	per dozen	120.00	
	Tumbler switch 15 amps.	per dozen	216.00	
	2-way switch 5 amps.	per dozen	96.00	
	One way flush switch 5 amps. rating	per dozen	84.00	
	One way flush switch 15 amps. rating	per dozen	240.00	
2.	Switch and socket combined 15 amps. rating flush type	per dozen	360.00	
	Double pole main switch, iron clad 250 volts grade, 30 amps. rating with both fuses	each	325.00	
	Iron clad distribution borad 4-way, 250 volts grade with neutral link, 30 amps. rating	each	100.00	
3.	Miniature circuit breaker, 250 volts grade, 5, 6 and 10 amps rating	per unit	75.00	
4.	PVC insulated aluminium conductor wire of szie 1/1.40 mm dia. or 1.5 mm <sup>2</sup> single core	per 100 meter	750.00	
6.	Incandescent lamps, 230/250V:			
	15 watt	per dozen	96.00	
	25 watt	—do—	108.00	
	40 watt	—do—	108.00	
	60 watt	—do—	108.00	
	100 watt	—do—	108.00	
7.	200 watt	—do—	192.00	
	Compact Fluorescent Lamps (CFLs)			
	2-pin type with built in starter:			
	9 watt CFL—2 pin	each	80.00	
	11 watt CFL—2 pin	each	90.00	

<i>S. No.</i>	<i>Name of item with specification</i>	<i>Unit</i>	<i>Cost</i>	<i>Remarks</i>
	Direct fit type with built in electronics			
	11 watt CFL-DF	each	75.00	
	15 watt CFL-DF	—do—	80.00	
	20 watt CFL-DF	—do—	120.00	
	25 watt CFL-DF	—do—	140.00	
	25 watt CFL-DF spiral	—do—	175.00	
8.	Lamp holders bakelite pendent type	per dozen	84.00	
	Lamp holders brass pendent type	—do—	96.00	
	Balten lamp holder bakelite type	—do—	96.00	
	Anlge lamp holder brass	—do—	108.00	
9.	Ceiling rose bakelite 2 plate	—do—	90.00	
10.	Ceiling rose bakelite 3 plate	—do—	120.00	
11.	Push button flush type	—do—	120.00	
12.	Fluorescent tube 20 watt complete set	each	200.00	
13.	Fluorescent tube 40 watt complete set	each	225.00	
14.	Ceiling fan, 3 blade, 1400 mm sweep	each	825.00	
15.	Ceiling fan 3-blade 1200 mm sweep	each	925.00	
16.	D.P.I.C, main switch, 15 amp rating, 250 volts grade main switch with both fuses	each	450.00	

### 1.8. NET PRICES

When all of the taxes viz., sales tax, excise duty, central sales tax, VAT and other local taxes are added then it is called the net price of the item. It should be kept in mind that generally above mentioned taxes are not mentioned in the price list.

Table 1.2 shows the procedure for giving the discount and finding the net price of the material after imposing sales tax.

**Table. 1.2**

<i>Name of material</i>	<i>Rate per unit</i>	<i>Net price Rs.</i>
30 amps switch and socket combined, 3 pin-flush type	60/-	60.00
Discount 10%		– 06.00
Sales tax 5%		54.00 + 02.70
Net price		Rs. 51.30

## 1.9. PURCHASE ORGANISATION

The purchase department of a large organisation may be of the following type :

**1.9.1. Purchase System.** It is the full responsibility of the Purchase officer to fully know the system of purchase and made available electrical installation material for the project to be started. Moreover, the purchase officer also ensure that the material purchased is at the lowest market rate. The electrical material means, the wiring material, instruments and looks required for the completion of electrical part of the project. The purchase head also has to ensure that the project work which is under process is not stopped due to shortage of electrical material.

The purchase system can be categories into three main heads *i.e.* its objective, functions and the set-up.

### (a) Objective of Purchase

- (i) To purchase on the lowest market rates as per desired specifications from approved/reliable sources within the time schedule to start the project plans.
- (ii) To serve as information centre an materials knowledge-prices, sources of supply of material, complete specifications and Catalogues etc. for department of the set-up.
- (iii) To get approval of purchase budget requirements (including foreign exchange requirements etc. if any) before start of the project.
- (iv) To seek approval of the senior officer before initiating purchase system.
- (v) Some important material should be kept stored so that it is made available in emergency.
- (vi) To get varified from the officer incharge of the project or by a team of experts the quality and quantity of the material before passing orders for making payments to suppliers.
- (vii) To keep the authority appraised of the likely short falls in purchase performance by appropriate reporting systems with a view to seek concerned authority intervention at the right time.

**(b) Purchasing procedure.** For completion of the electrical project the following purchasing procedure be adopted :

- (i) To get requisition from various sources.
- (ii) To call of quotations from different firms/organisations.
- (iii) To prepare Comparative statements.
- (iv) To make purchase order.

**(i) Requisition.** Before starting the project, the demand of various electrical material and quantity is obtained from different departments. Each item should consist of complete specifications. The final list for purchase is prepared and afterwords sent to the Head of purchase department. The lists should be submitted on the following Requisition form which is available in every deptt. office.

**Table 1.3. Requisition Form**

Requisition No. ....		Date .....	
To Purchase Officer PWD Electrical Department Ambala Cantt.			
Kindly make arrangement for purchase of following items of material for power wiring of Govt. Polytechnic Ambala city Electrical Workshop under construction upto dated.....			
<i>Sr.No.</i>	<i>Complete specification of material</i>	<i>Quantity</i>	<i>Remarks</i>
1.			
2.			
3.			
Stock register serial No. .... Stock already in hand ..... Maximum demand quantity ..... Minimum demand quantity .....			
Signature of Store Incharge		Signature of Requisition Officer Govt. Polytechnic.....	
For use by the purchase department	Purchase order Serial No. ....  Name of the Institution given purchase order Signature of verifying officer ..... Signature of receiving officer .....  <div style="text-align: right; margin-top: 20px;">           .....            Seal of department         </div>		

The requisition of material is always prepared in triplicate. Two copies are sent to Head of purchase deptt. and one copy is retained in the office for record. The office of the purchase deptt. enters the requisition form in their register for further necessary action for purchase of the items as initiated.

(ii) **Call of quotations.** After receiving the requisition from various departments, the quotations for calling rate list of supply of material are invited from reputed registered firms. The quotations are called by following two ways :-

(i) By sending individual Registered letters to the suppliers.

(ii) By advertisements in news papers which is said to **Tender Notice**.

Some urgent purchases are to be made directly by purchase officer after collecting personally the quotations from local firms. These type of quotations collected within short period are called spot tendring.

An ordinary letter which is given to the suppliers for calling of quotations is given below :

From     The Principal  
           Govt. Polytechnic  
           Ambala City (Haryana)  
To,  
           M/s OSAW Pvt. Ltd.  
           Jagadary Road.  
           Ambala cantt. (Haryana)

Memo No.         Q/El./2008,                     dated: 2/5/08

**Subject         Quotation**

Dear Sir,

The institute is to purchase the following items with its specification in a very short period. You are required to send you quotations and intimate the terms of getting payment and delivery period in clear terms & conditions :-

Sr.No.	Material with specifications	Quantity required
1.	Moving Coil wattmeter 0-250 V	30 Nos.
2.	Portable type Moving Iron Ammeter 0-10 A	30 Nos.
3.	Portable type wattmeter 0-2000 W	30 Nos.

(i) The material supplied by you should be a exactly according to the specifications laid down in the order.

(ii) The envelop containing quotations may please be mentioned as '**quotation**'

(iii) The last date for receipt of quotations is 30/5/08

- (iv) Your quotations will be valid for two months after the issue of this letter.
- (v) The Payment will be made within one month from the date of receipt of material.
- (vi) You are to submit the Bill in triplicate for the cost of material supplied.
- (vii) F.O.R. Destination

### **Opening of the quotation or Tender**

After receiving the quotations within due date these are entered in the receipt register maintained in the office. These quotations are opened by the committee consisting of three Gazetted officers in the presence of suppliers or their nominated representatives on the date and time mentioned in the sent quotation letters. For safety there may not be any change in the rates of quotations received, the purchase committee Sign each and every Page of the quotations received. On each quotation entry is to be made as the Sr. No. of quotation opened out of the total no. of quotations received in the office. Suppose if first quotation out of seven quotations is opened then it will be marked as 1/7 in circle. (i.e. 1/7)

### **Comparative Statement**

Comparative statement is prepared by the office purchase clerk after opening the quotations for making a comparison of rates quoted by different suppliers. The supplier which has quoted the lowest rates can be seen directly from the single page. The comparative statement thus prepared is thoroughly checked up by a committee comprising of purchase officer, accounts officer and the technical advisor, the rates and terms of supply offered by each supplier. The lowest rates offered by individual supplier are marked with red pen for issue of supply order after confirming the material offered so for supply is the same as per the specifications.

The supplier who has quoted lowest rates is asked to deposit some earnest money because in case the supplier fails to supply the material within the specified date, in that case his earnest money deposited will be forfeited.

**Table 1.4. Comparative Statement**

Name of Office of Purchase Officer .....	Date .....
Quotation Notice No. ....	Due Date of opening ..... Time .....
Approved Requisition No. ....	No. of suppliers to whom quotation letters sent .....
	No. of suppliers offered quotations .....



1. 2. 3. 4.

Sr.No.	Complete specifications of items	Quantity	M / s X ..... .....	M/s Y ..... .....	M / s Z ..... .....	M / s ..... .....	Recom- menda- tions
1.							
2.							
3.							
4.							

1. Name and designation of person who prepared the statement

2. Name and designation of inspection officer

3. Chief Purchase Officer

4. Accounts officer

.....

.....

Seal

Signature .....

Signature .....

Signature .....

Signature .....

In case of emergency :

There should be at least three quotations for issue of supply order. In some cases such as hospital, technical institutions, etc. if these are only two quotations in that case one quotation from the market can be collected personally with the permission of Head of Deptt. The supply order may be issued to the party offered lowest rates.

**(iv) Purchase orders**

All the Purchase orders must carry the following information :

1. Purchase order number and date.
2. Detailed specifications of the items as quoted by the supplier/ agreed additional specifications, if any.
3. Value of the purchase order.
4. Name of the suppliers.
5. Due date of delivery.
6. Quantity of items ordered.
7. Taxes if any to be specified in the order.
8. Despatch details as agreed to.
9. Mode of payment as agreed to, advance, discount etc.
10. Inspection system as agreed to.

### Purchase Order

From :

Principal

Govt. Polytechnic Ambala City (Haryana)

Memo No ....

Dated .....

To

M/s Ashirwad Enterprises

Asaf Ali Road

Delhi - 6

**Subject : Purchase order for supply of Material**

Sir,

With reference to your quotation No.

Dated .....

The rates offered by your firm have been found lowest. The terms & conditions offered by your firm are also acceptable. Please supply the material mentioned below on terms and conditions already agreed upon:-

S.No.	Item name with complete specifications	Qty.	Rate	Total Amount	Remarks
1.					
2.					
3.					
4.					

As per terms and conditions mentioned below :

1. Last date for receipt of materials is .....
2. For all legal disputes, the jurisdiction will be Ambala.
3. Deposit 25% of the cost of material as earnest money before supply of material is undertaken.
4. 70% of the cost of material will be deposited in your bank account and the balance amount will be paid only when the material quality and quantity is varified and material is received in good condition as per specifications.
5. Form 'D' will be issued to your firm for exemption in sales tax.
6. Rates : F.O.R. Destination.
7. All local taxes will be paid by the institution.

**Copies for information and necessary action to .....**

1. Accounts branch

Signature

2. Store incharge

Principal Govt. Polytechnic Ambala city

3. H.O.D. (Elect.)

4. Requisition officer

5. Copy for information in to Purchase office.

Signature .....

## 1.10 Tender

Tender is an offer made by the supplier in reply to the letter of quotation for supply of material on the basis of certain terms and conditions. Alongwith the tender some money is to be deposited which is called earnest money which is a guarantee by the tenderer that the party is bound to supply the required material if its tender is found competitive but on pre-decided conditions only.

## 1.11 Tender Notice

For certain heavy purchases, the information to be made available through the prominent news papers is called '**Tender Notice**'. Always the tender notice is given in all the news papers of the region.

## 1.12 Modes of Tendering

The usual modes of tendering are mentioned below :

- |                       |                     |
|-----------------------|---------------------|
| 1. Open Tendering.    | 3. Global Tendering |
| 2. Limited Tender     | 4. Single Tender    |
| 5. Proprietary Tender | 6. Spot Tendering   |

1. **Open/Public Tendering.** It is a system whereby even non-registered suppliers/dealers are free to participate. For this one of the following methods should be adopted :

(a) By giving an advertisement in at least three leading news papers of English language for all India Circulation. It can also be given in Indian Trade Journal/India Export Service Bulletin (IESB)

(b). Addressing all the known sources for a particular product.

2. **Limited Tender.** In this only the most likely and suitable sources are informed.

3. **Global Tendering.** Where items to be procured are not easily available there, Global tendering shall be restored to. Advertisements may be given to leading news papers in addition. Copies of the tender documents may be made available to the Trade Commissioners of Foreign Embassies in India.

4. **Single Tender.** When the purchase of an item is finalised on the basis of a single offer or an offer from a single source is invited then it is called a single Tender Purchase.

5. **Proprietary Tender.** This type of tender is addressed only to a proprietary manufacturer/supplier because no equivalent or near equivalent is available from any other source.

6. **Spot Tendering.** This is considered only in case of emergency requirements.

## 1.13 Practical Example of Tender Notice

The tender notice is given in all the **prominent daily news papers of the country**. A detailed example of tender notice published recently in some of the News Papers is reproduced here.

**Haryana State Electricity Board**  
**Office of the Superintending Engineer (Purchases)**  
**132 KV Grid Sub-Station, Panchkula (Haryana)**  
**Tender Notice**

No. 2000/PK/Har./726

Dated : 10-12-2008

1. Sealed tenders are invited for the purchase and installation of 132 kV/33 kV transformer for installation at grid sub-stations on form 'C' on behalf of Superintendent Engineer (Purchases) HSEB Panchkula.

<i>Sr. No.</i>	<i>Description of material</i>	<i>Quantity</i>	<i>Approximate cost</i>	<i>Earnest money</i>	<i>Cost of tender form</i>	<i>Date of completion of work and date of receipt of tender</i>	<i>Class of contractor eligible for the contract</i>	<i>Date of opening of tender with time</i>
				<i>Rs.</i>				
1.	Power transformer 20 MVA 3 phase, 50 Hz, 132/33 kV, with all protective and tap changer components F.O.R. Panchkula HSEB store and installation at site	20 Nos.	32.5 Lac	5000/-	75/-	22-2-2000 22-4-2000	class 1 to class V	27-2-2000 2 p.m.

**Note :** Earnest money should be in the form of Demand Draft in favour of Superintendent Engineer (Purchases) Haryana State Electricity Board Panchkula.

**For Special Attention of Contractors :** Contractors mentioned at serial No. 8 above and registered with Superintendent Engineer Chandigarh are eligible to apply for tender form. The tenders can also be accepted from unregistered contractors whose annual turn-over is Rs. 5000000/- and belonging to Panchkula or Chandigarh. But such contractors should register themselves with the Superintending Engineer in the above mentioned class of contractors before their tender form is accepted or within one month from the date of submission of the

tender form which ever the date falls earlier, otherwise, their tender is liable to be rejected and earnest money forfeited. The contractors should know clearly that production of attested copy of registration form along with application for issue of tender form is essential. Apart from this, the contractors should also produce copy of their income tax return (copy of income tax return which is filed annually with income tax department).

#### 1.14 Availability of Tender Form

The tender forms will be available on payment of Rs. 500/- in cash from the following office on any working day from 10 a.m. to 5 p.m.

- (i) Executive Engineer 132 kV Substation Ambala (Haryana)
- (ii) Executive Engineer 132 kV Substation Sonapat (Haryana)
- (iii) Executive Engineer 132 kV Substation Hissar (Haryana)

The tenders can be handed over by registered post or personally. It will be in the interest of the tenders that they should deposit the tender form personally to avoid any delay or loss during transaction. No tender will be accepted after due date.

#### 1.15 Opening of tender form

The tenders will be opened in the office of Superintendent Engineer (Purchase) Panchkula on date and time already mentioned in the tender form in the presence of Superintendent Engineer and two other senior officers authorised by Chief Engineer. The contractors are supposed to be present personally at the time of opening of tender form.

##### Terms and conditions

1. The number of power transformers to be purchased and their installation can be increased or decreased depending upon situation. The number given in the tender form is just an estimated requirement.

2. Tender without the earnest money can be accepted. The demand draft in favour of the said officer should be payable at the local bank only. The demand draft should be valid for minimum of six months duration from the date of opening of tender form.

3. The responsibility of damage to the transformer during transportation will be that of the supplier/contractor. The department will not be responsible for that under any circumstances.

4. The transportation of transformer upto worksite including loading and unloading will be that of the supplier.

5. Tenders should be submitted on prescribed tender forms duly signed by the tenderer one each page.

6. All entries by the tenderer should be in ink of same colour. Erasing and overwritings are not allowed.

All corrections must be signed by the tenderer.

7. The sealed tenders will be accepted. Unsealed tenders will not be accepted.

8. The sealed envelope containing tender form should also indicate on it the (a) tender notice number ----- dated ----- (b) Name of newspaper in which tender notice was published (c) Last date of submission of tender form (d) name of tenderer should be very clearly written.

9. One contractor can submit one tender form only.

10. The tenders can be accepted only from registered contractors only. The unregistered contractor can submit the tender form on certain conditions which can be seen in the above office personally.

11. The Superintendent Engineer reserves the right to accept any tender or can approve any part of the tender. The tenders can be rejected without assigning any reason.

12. The parties whose tenders are found to be offering comparatively high rates will receive back their earnest money on the same day.

13. The party or contractor whose tender is accepted must sign the contract bond otherwise, their earnest money is liable to be forfeited to Govt. and tender cancelled.

14. The material as per laid specifications will only be accepted. Any material found to be not as per specifications will be rejected and that material will be carried back by the contractor at his own expenses.

15. If the party does not supply material even after acceptance of the tender and issue of supply order, in that case, his earnest money will be forfeited.

16. If the officer responsible for purchase and issuing tender notice desires, he can extend the date of filling of tender. But this extension of date will appear in all major newspapers of the region.

17. The following interins penalty will be deducted from the bills of the contractor in case of slow interim progress of supply/work.

<i>S.No.</i>	<i>% of completion period</i>	<i>% of progress required</i>	<i>Penalty in default</i>
1.	25%	10%	1% of bonded amount
2.	50%	30%	3% of bonded amount
3.	75%	60%	6% of bonded amount
4.	100%	100%	10% of bonded amount

18. The contractor will submit the following documents alongwith their bill:

(a) No claim certificate.

(b) B and L form.

(c) Handing over charge paper on inventory form duly signed by the user department concerned, failing which an amount to

the extent of 5% of the bill will be deducted which shall be refundable when complied with.

19. All bills are subject to a deduction of 10% towards security which is refundable at the end of one year maintenance period from the date of actual completion of the work.

20. The work/supply by the contractor can be got examined by the Govt. from any other authority, even outside the department and any defect in the work/material supplied pointed out by them will have to be rectified by the contractors at their own cost and deduction proposed on account of bad work or defective supply will be deducted from their bills.

21. All the papers signed by the parties to this contract and bond together and sealed shall be deemed to form part of the contract bond and shall be read as conditions of contract.

Sd.

Superintendent Engineer (Purchases)  
HSEB Panchkula  
Haryana

### **Extension of Date of Tender**

No. 2000/PK/Har/727

Date 22-12-2008

The tender notice published on behalf of supdt. Engineer (Purchases) No. 2000/PK/Har./726 dated 10-12-2008 in connection with purchase of 132 K.V. Power transformer, the date of receipt of tender form is hereby extended upto 3-1-2009 (11.30 a.m.). The tenders will now be opened at 2 p.m. on the same day.

The terms and conditions will remain same.

Supdt. Engineer (Purchases)  
HSEB Panchkula Haryana

### **1.16 Quotation**

The offer made by the supplier or manufacture in terms of rates in a sealed envelope to reply to a letter of quotation for supply of material or undertaking some work on the basis of certain terms and conditions is called '**quotation**'. The quotation letter is sent only to selected supplier/parties.

### **1.17 Another Practical Example of Tender Notice**

**HARYANA VIDYUT PRASARAN NIGAM LIMITED**

**Tender Enquiry No. REC-082**

**Dated : 03.12.2008**

**NIT No. 503**

Sealed Tenders in two part are invited in quadruplicate by the Chief Engineer/MM, HVPNL, Power Colony, Industrial Area Phase-II, Panchkula for the construction of following 132 kV and 66 kV sub-stations on Turn Key basis in the State of Haryana :-

<i>Sr. No.</i>	<i>Name of work</i>	<i>Scope of work</i>
(i)	143 kV sub-station Nidana	132 kV sub-station with 6 Nos. bays of 132 kV voltage level (including 2 Nos. spare bays) and 1 × 20/25 MVA, 132/33 kv Power Transformer + 1 × 4 MVA, 33/11 kv (Supplied by HVPNL) Power Transformer
(ii)	66 kV sub-station Nimoth	66 kV sub-station with 6 Nos. bays of 66 kV voltage level (including 2 Nos. spare bays) and 1 × 12.5/16 MVA, 66/11 kv Power Transformer.

1. The detailed scope of works is given in the bidding documents.

2. The details of cost of bid documents, date of sale of bid documents, date of submission and date of opening of bids, amount of bid security to be submitted along with the bid are as under :-

<i>Bid Document No.</i>	<i>Cost of Bidding Document (in Rs.)</i>	<i>Date of sale of Bidding Documents starts w.e.f.</i>	<i>Opening date of Bids of 11.00 Hrs.</i>	<i>Amount of Bid Security</i>
REC-082	10,000	06.12.2008	10.1.2009	Rs. 13 Lacs

The bids will be received upto 10.30 hrs and will be opened at 11.00 hrs. on the dates mentioned above in the presence of bidder's representatives who choose to attend the office of CE/MM, HVPNL, Panchkula.

3. A complete set of Bidding Document can be purchased by any interested bidder on submission of written application to the above and upon payment of Rs. 10,000 in the shape of demand draft payable to Accounts Officer/cash, Haryana Vidyut Prasaran Nigam Limited, Panchkula on all working days from 0900 hrs. to 1700 hrs.

4. The Bids must be accompanied by the above amount of Bid Security in the shape of Bank guarantee and delivered in the above office on or before the date and time given above.

5. HVPNL reserves the right to cancel/withdraw the invitation for Bids without assigning any reason and shall bear no liability whatsoever consequent upon such a decision.

6. Any bidder whose technical bid is not found as per the NIT requirements would be liable for rejection and in that case the price bid would not be opened.

7. The telegraphic tenders are not acceptable.

8. The qualification requirements for the Bidders and procedure of submission of tenders are given in Instruction to Bidders in the Bidding Documents.

9. The tenders shall be valid for 4 months from the date of opening of 1st Part and 3 months from the date of opening of Price bid whichever is later.

**Sd/- Superintending Engineer/MM-II,  
for CE/MM, HVPNL, Panchkula**



### 1.18. INTERNATIONAL SYSTEM (SI) OF UNITS

The System International d'Unites originally proposed by the Comite International des Poids et Mesures (CIPM) and subsequently recommended by the General Conference on Weights and Measures by the International Standards Organisation (ISO) and by the International Electrotechnical Commission (IEC) are known commonly as the SI units (not S.I. unit). It is very essential that all concerned adhere to the style recommended for SI units. Students of engineering should, taken care in using and writing the SI units correctly. Some such units are given below :-

1. This system employs the following basic units :

	<i>Units</i>	<i>Symbol</i>
Length	metre	m
Mass	kilogramme	kg
Time	second	s
Thermodynamic temperature	kelvin	K
Electric current	ampere	A
Luminous intensity	candela	cd
<i>Supplementary Units are :</i>		
Plane angle	radian	rad
Solid angle	steradian	sr

2. Derived units are in general power products or quotients of basic units with factors 1 (coherent units). Some of them have standardized names and often also standardized symbols.

Examples are the following :

	<i>Units</i>	<i>Symbol</i>
Velocity	metre per second	m/s
Area	square metre	m <sup>2</sup>
Volume	cubic metre	m <sup>3</sup>
Density	kilogramme per cubic metre	kg/m <sup>3</sup>
Force	newton	$N = \text{kgm/s}^2$
Pressure	newton per square metre	N/m <sup>2</sup>
Power	watt	$W = J/s, J = Nm = \text{kgm}^2/s^3$
Voltage	volt	V
Resistance	ohm	$\Omega = V/A$
Frequency	hertz	Hz = s <sup>-1</sup>

3. Non-coherent units are connected to basic or derived units by a *constant factor* preferably a power 10<sup>3</sup>. In using these powers, some standardized prefixes are the following :

<i>Power</i>	<i>Prefix</i>	<i>Symbol</i>
$10^{12}$	tera	T
$10^9$	giga	G
$10^6$	mega	M
$10^3$	kilo	k
$10^{-2}$	centi	c
$10^{-3}$	mili	m
$10^{-6}$	micro	$\mu$
$10^{-9}$	nano	n
$10^{-12}$	pico	p

The use of double prefixes should be avoided. Example : not kW<sub>W</sub>, but GW

4. Requirements of common usage permit in special cases the use of non-coherent units derived by other factors, such as :-

<i>Name</i>	<i>Symbol</i>	<i>Equal to</i>
Hour	h	3600 s
Day	24 h	
Bar	b	$10^5 \text{ N/m}^2$

5. There are many other units and names in legal or common use in various countries such as inch, pound, gallon kilogramme force (= kilopond), atmosphere (of varying definitions), hectopieze (= bar), Pascal ( $\text{Pa} = \text{N/m}^2 = 1000 \text{ N}$ ), thermie ( $\text{th} = 10^6 \text{ cal}$ ), kilocalorie ( $\text{kcal} = 4.1868 \text{ KJ}$ ), degree Fahrenheit etc. If a person desires to use such units each quantity should be given first in SI units and followed in brackets by the unit of common usage as in the above example.

6. Correct way of writing full names of units in lower cases : kelvin, newton, joules etc.




### 1.19. Conventional Electrical Symbols


The representation of an object in a simplest way on a drawing is called a symbol. In engineering drawing commonly graphical symbols are employed to denote the name of electrical components and instruments along with various accessories used. These symbols must convey the same meaning to everyone who reads the drawing. These symbols are standardized by the Bureau of Indian standards according to internally agreed conventions as adopted by International Electrotechnical Commission. In some of other books it is possible that the students may come across different symbols from the ones used in this book. An attempt have been made in this book to use only standardization symbols approved by the Bureau of Indian standards (ISI).

As Drawing is the language of engineers, so it is advised to make it a habit to refer to the Indian Standard specification (ISS) to ensure the correctness of a symbol.

## List of Symbols

### 1. Kind of Current

(a) Direct Current	
(b) Alternating Current	
(c) Power Frequency	

Apparatus and machines suitable either for  d.c. or a.c. (universal)

### 2. System of Distribution

a.c. of  $m$ -phase and frequency  $m \sim f$

*Example :*

(a) a.c., single phase, 50 Hz	$1 \sim 50 \text{ Hz}$
(b) a.c., three phase, 50 Hz	$3 \sim 50 \text{ Hz}$
(c) a.c., three phase, 50 Hz, 415 V	$3 \sim 50 \text{ Hz, 415 V}$

Neutral

*Example :*





(a) a.c., three-phase, with neutral, 50 Hz	$3N \sim 50 \text{ Hz,}$
(b) a.c., three-phase, with neutral, 50 Hz 415 V (240 V between phase and neutral,	$3N \sim 50 \text{ Hz, 415 V}$
d.c. two conductor 110V 2—110V	

d.c., three conductors, including neutral 220 V, 110 V between outer conductors and neutral	$2N-220 \text{ V}$
---	--------------------



Positive polarity 

Negative polarity 

### 3. Symbols of Lines

Line or cable : existing	
planned	
Underground Cable	
Overhead line (general symbol)	

### 4. Conductors

Conductors or a group of several conductors	
Flexible conductor	

**Note.** Use one or several half circles reversely drawn; two half circles are never to be used because of a possible confusion with symbol for alternating current.

*Two conductors :*

(a) Single line representation



(b) Multiline representation



*Three conductors :*

(a) Single line representation



(b) Multiline representation



*n conductors :*  $\frac{n}{/}$

*Example :*

*Four conductors :*

(a) Single line representation



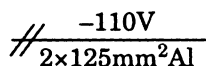
(b) Multiline representation



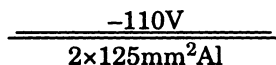
**Indication of conductor particulars**

(a) *Example:* d.c. circuit, 110 V, two conductors of 125 mm<sup>2</sup> of aluminium

(a) Single line representation

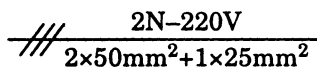


(b) Multiline representation

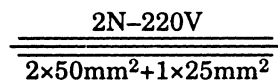


(b) *Example:* d.c. circuit, 220 V (110 V between outer conductors and neutral), two conductors of 50mm<sup>2</sup> with neutral of 25 mm<sup>2</sup>

(a) Single line representation

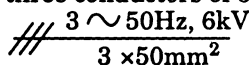


(b) Multiline representation

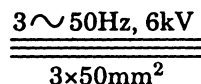


(c) *Example:* Three-phase circuit 50Hz, 6kV, three conductors of 50 mm<sup>2</sup>

(a) Single line representation

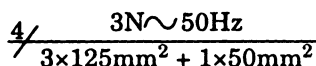


(b) Multiline representation

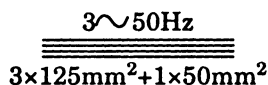


(d) *Example:* Three-phase circuit, 50Hz, 3 conductors of 125 mm<sup>2</sup> with neutral of 50 mm<sup>2</sup>

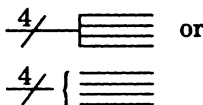
(a) Single line representation

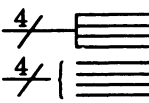
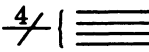


(b) Multiline representation

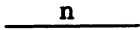


(c) **Changing over from a single line representation to a multiline representation.**



(d) Changing over from a single line representation to a multiline representation.  or 

*Example : Four conductors*

(e) Group of  $n$  conductors which follow the same way on the diagram. 

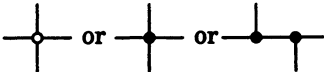
5. Terminals and Connections of Conductors

Terminal  $\circ$  or  $\bullet$



Junction of conductors

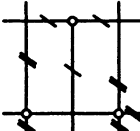
Double junction of conductors



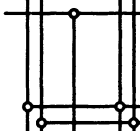
Crossing without electrical connection



Crossing and connecting conductors



Single line representation



Multiline representation

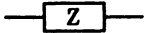


6. Circuit Elements

Non-reactive resistance or non-reactive resistor



Impedance



Inductance, inductor





Winding





Capacitance, capacitor



**Note :** The distance between the plates should not be greater than one-fifth of the length of the plates.

Earth  Frame or chassis connection 

Fault  Frame or chassis earth connection 

*Example : Position of fault to frame*

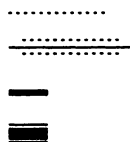


Screen

*Example* : Screened conductor or screened cable

Magnetic core

Laminated core



## 7. Variability

**Note :**

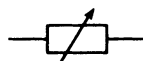
(a) Variability is 'inherent' when the variable quantity depends on qualities of the device itself, for example, when the resistance changes with the change of voltage or with change of temperature.

(b) Variability is 'non-inherent' when the variable quantity is controlled by an external device, for example, when the resistance is controlled by a regulator.

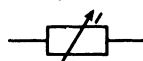
(c) The sign of variability should be drawn across the main symbol at about 45° to the centre line of the symbol.

*Example of variable resistors :*

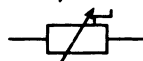
(a) General symbol



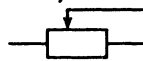
(b) Continuously variable



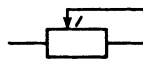
(c) Variable in steps



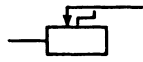
(d) With moving contact (general symbol)



(e) With moving contact continuously variable



(f) With moving contact, variable in steps



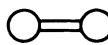
(g) Voltage divider with moving contact



## 8. Rotating Machines

**Mechanically coupled machines :**

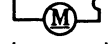
d.c. two wire series generator (G) or motor (M)



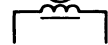
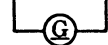
d.c. two wire series generator (G) or motor (M), separately excited.



d.c. two wire shunt generator (G) or motor (M),

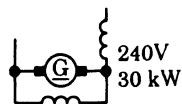


d.c. two wire generator (G) or motor (M), compound excited, short shunt

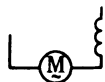


# 9. Symbol showing terminals, brushes and numerical data :

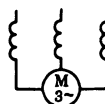
*Example* : d.c. two wire generator, compound excited, short shunt, 240V, 30kW



a.c. series motor single phase



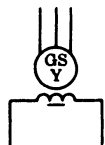
a.c. series motor three phase



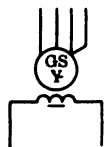
Synchronous generator (GS) or synchronous motor (MS) single-phase



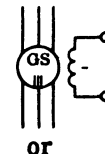
Synchronous generator (GS) or synchronous motor (MS), three-phase, star connected, neutral not brought out.



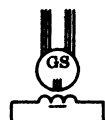
Synchronous generator (GS) or synchronous motor (MS), three-phase, star connected, neutral brought out.



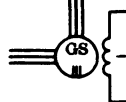
Synchronous generator (GS) or synchronous motor (MS), three-phase, both leads of each phase brought out.



or

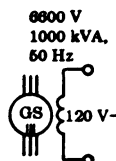


or



# 10. Symbol showing terminals, brushes and numerical data :

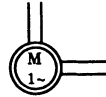
*Example* : Synchronous Generator or Synchronous Motor (MS), three-phase, both leads of each phase brought out, 6600 V, 1000 kVa, 50 Hz, 120 V d.c.



Induction motor, squirrel cage, single-phase



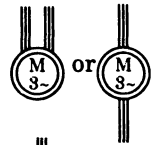
Induction motor, squirrel cage, single-phase, leads of split phase brought out



Induction motor, squirrel cage, three phase delta connected



Induction motor, three phase, squirrel cage, both leads of each phase brought out.



Induction motor, three phase wound rotor..

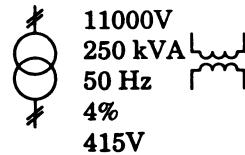


## 11. Transformers

Single phase transformers, with two or three-phase windings :

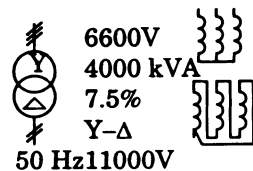
*Example:* 11,000/415 V, 250 kVA, 50 Hz, short circuit voltage 4%

*Single line representation*      *Multiline representation*



Three phase transformers, with two separate windings

*Example:* Star delta 6600/1100 V, 4000 kVA, 50 Hz, Connection Y-  $\Delta$



Short circuit voltage 7.5%

## 12. Auto-transformer :

(a) Auto transformer, single-phase



(b) Auto transformer, three-phase Star connected



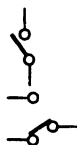


(c) Auto transformer, single-phase  
with continuous voltage regulation



### 13. Switchgear

Switch-general symbol

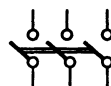


(a) Two way

(b) Intermediate



Three-pole switch, multiline representation



Three-pole switch, single line representation



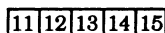
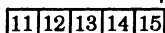
Circuit breaker



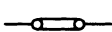
Isolator



Terminal trip



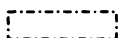
Link



Open link



Distribution board cubical box



### 14. Contacts

Socket



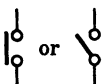
Plug



Plug and socket



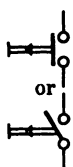
Relay or contactor contact,  
normally open (NO)



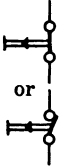
Relay or contactor contact,  
normally closed (NC)



Push-button with  
momentary closed  
contact (normally  
open contact



Push-button with  
momentary open contact  
(normally  
closed contact



Thermal overload relay contact



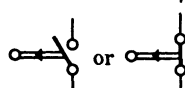
Time-delay relay contact



Limit switch (NC contact)



Limit switch  
(NO contact)



### 15. Relays and Contactors

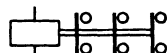
Coil of electro-magnetic relay or contactor



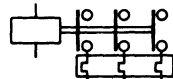
Thermal overload relay



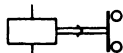
Electrically operated three-pole contactor



Electrically operated three-pole contactor with thermal overload device in all three-poles



Time delay relay (TDR)



## 16. Lighting circuit fuse-boards

(a) Main fuse-board without switches



(b) Main fuse-board with switches



(c) Distribution fuse-board without switches



(d) Distribution fuse-board with switches



Power circuit fuse-boards

(a) Main fuse-board without switches



(b) Main fuse-board with switches



(c) Distribution fuse-board without switches



(d) Distribution fuse-board with switches



## 17. Switch and Switch Outlets

One way switch

(a) Single Pole



(b) Two-Pole



(c) Three-Pole



Two-way switch



Intermediate switch



Push-button or bell-push



## 18. Socket Outlets

Socket outlets, 5A



Socket outlets, 15A



Combined switch and socket outlet, 5A



## 19. Lamp and Lighting Apparatus

Lamp or outlet for lamp X Group of three 40 W lamps: 3×40 W

Lamp mounted on wall or light bracket X

Lamp mounted on ceiling X Fluorescent lamp —

Group of three 40 W fluorescent lamps ≡

## 20. Fans

Ceiling fan ∞



Bracket fan —



Exhaust fan ⊗



Fan regulator □










## 21. Earthing

Earth point




**22. Miscellaneous Apparatus**

Fuse		Signal lamp	
Indicator		Bell	
Horn		Siren	
Buzzer			

**23. Electrical appliances**

(a) General — 

Note : If necessary use designation to specify

(b) Heater — 

(b) Storage type electric water heaters — 