

Standard Bidding Document

PMU-216/26-27 Procurement of Insulator, Beam, Column & Pipe
(Goods)

National

Single Stage-One Envelope



September 02, 2026

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General Conditions of Contract

A. General

1. Definitions

1.1 Unless the context otherwise requires, the following terms whenever used in this Contract shall have the same meaning and shall be interpreted as indicated

- a. "Applicable Law" means the laws and any other instruments having the force of law in the Government's Country, or in such other country as may be specified in the Special Conditions of the Contract (SC), as they may be issued and in force from time to time;
- b. "Procuring Agency" means:-
 - a. any Ministry, Division, Department or any Office of the Government;
 - b. any authority, corporation, body or organization established by or under a Law or which is owned or controlled by the Government;
- c. "The Contract" means an agreement enforceable by law;
- d. "The Contract Price" means the price payable to the Bidder under the Contract for the full and proper performance of its contractual obligations;
- e. "Ancillary Services" means those services ancillary to the provision of Goods, such as transportation and insurance, and any other incidental services, such as installation, commissioning, provision of technical assistance, training, and other such obligations of the Bidder covered under the Contract;
- f. "GCC" means the General Conditions of Contract contained in this section;
- g. "SCC" means the Special Conditions of Contract by which the GCC may be amended or supplemented;
- h. "Day" means calendar day unless indicated otherwise.
- i. "Effective Date" means the date on which this Contract comes into force and effect.
- j. "The Bidder" means the individual or corporate body whose Bids to provide the Goods has been accepted by the Procuring Agency;
- k. "The Project Site," where applicable, means the place or places named in Bids Data Sheet and technical Specifications;
- l. "Government" means the Government of Pakistan;
- m. "Subcontractor" means any entity to which the Bidder subcontracts any part of the Goods.
- n. "Service" means any object of procurement other than goods or works;
- o. "Party" means the Procuring Agency or the Bidder, as the case may be, and "Parties" means both of them;
- p. "Foreign Currency" means any currency other than the currency of the country of the Procuring Agency;

q. "Completion Date" means the date of completion of the contract by the Bidder as certified by the Procuring Agency;

r. "In Writing" means communicated in written form with proof of receipt;

s. "Local Currency" means the currency of Pakistan;

2. Application and Interpretation

2.1 These General Conditions shall apply to the extent that they are not superseded by provisions of other parts of the Contract.

2.2 In interpreting these Conditions of Contract headings and marginal notes are used for convenience only and shall not affect their interpretations unless specifically stated; references to singular include the plural and vice versa; and masculine include the feminine. Words have their ordinary meaning under the language of the Contract unless specifically defined.

3. Applicable Law

3.1 The contract shall be governed and interpreted in accordance with the laws of Pakistan, unless otherwise specified in SCC.

4. Governing Language

4.1 The Contract as well as all correspondence and documents relating to the Contract exchanged between the Bidder and the Procuring Agency, shall be written in the **English language** unless otherwise stated in the SCC. Supporting documents and printed literature that are part of the Contract may be in another language provided these are accompanied by an accurate translation of the relevant passages in English, in which case, for purposes of interpretation of the Contract, this translation shall govern.

5. Notices

5.1 Any notice, request, or consent made pursuant to this Contract shall be in writing and shall be deemed to have been made when delivered in person to an authorized representative of the Party to whom the communication is addressed, or when sent by registered mail, telex, telegram, or facsimile to such Party at the address specified in the SCC.

6. Delivery/Location

6.1 The Goods shall be delivered to such locations as the Procuring Agency may approve and as specified in SCC.

7. Authorized Representatives / Authority of Member in charge

7.1 Any action required or permitted to be taken, and any document required or permitted to be executed, under this Contract by the Procuring Agency or the Bidder may be taken or executed by the officials specified in the SCC.

B. Commencement, Completion, Modification, and Termination of Contract

8. Effectiveness of Contract

8.1 This Contract shall come into effect on the date the Contract is signed by both parties and such other later date as may be stated in the SCC.

9. Commencement of Services

9.1 The Bidder shall confirm availability of Key Experts and begin carrying out the Services not later than the number of days after the Effective Date specified in the SCC.

10. Program

10.1 Before commencement of the Services, the Bidder shall submit to the Procuring Agency for approval a Program showing the general methods, arrangements, order and timing for all activities. The Services shall be carried out in accordance with the approved Program as updated.

11. Starting Date/Expiration Date

11.1 The Bidder shall start carrying out the Services Five (05) days after the date the Contract becomes effective, or at such other date as may be specified in the SCC.

11.2 Unless terminated earlier pursuant to Clause **GCC 15** hereof, this Contract shall expire at the end of such time period after the Effective Date as specified in the SCC.

12. Entire Agreement

12.1 This Contract contains all covenants, stipulations and provisions agreed by the Parties. No agent or representative of either Party has authority to make, and the Parties shall not be bound by or be liable for, any statement, representation, promise or agreement not set forth herein.

13. Modification

13.1 Any modification or variation of the terms and conditions of this Contract, including any modification or variation of the scope of the Services, may only be made by written agreement between the Parties. However, each Party shall give due consideration to any Bids for modification or variation made by the other Party.

13.2 In cases of any modifications or variations, the prior written consent of the Procuring Agency is required.

14. Force Majeure

14.1 Definition

For the purposes of this Contract, “Force Majeure” means an event which is beyond the reasonable control of a Party and which makes a Party’s performance of its obligations under the Contract impossible or so impractical as to be considered impossible under the circumstances.

14.2 No Breach of Contract

The failure of a Party to fulfill any of its obligations under the contract shall not be considered to be a breach of, or default under, this Contract in so far as such inability arises from an event of Force Majeure, provided that the Party affected by such an event (a) has taken all reasonable precautions, due care and reasonable alternative measures in order to carry out the terms and conditions of this Contract, and (b) has informed the other Party as soon as possible about the occurrence of such an event.

14.3 Extension of Time

Any period within which a Party shall, pursuant to this Contract, complete any action or task, shall be extended for a period equal to the time during which such Party was unable to perform such action as a result

of Force Majeure.

14.4 Payments

During the period of their inability to perform the Services as a result of an event of Force Majeure, the Bidder shall be entitled to continue to be paid under the terms of this Contract, as well as to be reimbursed for additional costs reasonably and necessarily incurred by them during such period for the purposes of the Services and in reactivating the Service after the end of such period.

15. Termination

15.1 By the Procuring Agency

The Procuring Agency may terminate this Contract in case of the occurrence of any of the events specified in paragraphs (a) through (e) of this Clause. In such an occurrence the Procuring Agency shall give at least thirty (30) calendar days' written notice of termination to the Bidder in case of the events referred to in (a) through (d); at least sixty (60) calendar days' written notice in case of the event referred to in (e);

- a. If the Bidder fails to remedy a failure in the performance of its obligations hereunder, as specified in a notice of suspension;
- b. If the Bidder becomes (or, if the Bidder consists of more than one entity, if any of its members becomes) insolvent or bankrupt or enter into any agreements with their creditors for relief of debt or take advantage of any law for the benefit of debtors or go into liquidation or receivership whether compulsory or voluntary;
- c. If the Bidder fails to comply with any final decision reached as a result of arbitration proceedings;
- d. If, as the result of Force Majeure, the Bidder is unable to perform a material portion of the Services for a period of not less than sixty (60) calendar days;
- e. If the Procuring Agency, in its sole discretion and for any reason whatsoever, decides to terminate this Contract;

15.2 By the Bidder

The Bidder may terminate this Contract, by not less than thirty (30) calendar days' written notice to the Procuring Agency, in case of the occurrence of any of the events specified in paragraphs (a) through (d) of this Clause.

- a. If the Procuring Agency fails to pay any money due to the Bidder pursuant to this Contract and not subject to dispute within forty-five (45) calendar days after receiving written notice from the Bidder that such payment is overdue.
- b. If, as the result of Force Majeure, the Bidder is unable to perform a material portion of the Services for a period of not less than sixty (60) calendar days.
- c. If the Procuring Agency fails to comply with any final decision reached as a result of arbitration.
- d. If the Procuring Agency is in material breach of its obligations pursuant to this Contract and has not remedied the same within forty-five (45) days (or such longer period as the Bidder may have subsequently approved in writing) following the receipt by the Procuring Agency of the Bidder's notice specifying such breach.

C. Obligations of the Bidder

16. General

16.1 Standard of Performance

1. The Bidder shall deliver the product and carry out the Services with all due diligence, efficiency and economy, in accordance with generally accepted professional standards and practices, and shall observe sound management practices, and employ appropriate technology and safe and effective equipment, machinery, materials and methods. The Bidder shall always act, in respect of any matter relating to this Contract or to the Services, as a faithful adviser to the Procuring Agency, and shall at all times support and safeguard the Procuring Agency's legitimate interests in any dealings with the third parties.

16.2 Law Applicable to Goods

The Bidder shall deliver the goods in accordance with the Contract and in accordance with the Law of Pakistan and shall take all practicable steps to ensure that any of its Experts and Sub-Bidders, comply with the Applicable Law.

17. Conflict of Interests

17.1 Bidder Not to Benefit from Commissions and Discounts.

The remuneration of the Bidder shall constitute the Bidder's sole remuneration in connection with this Contract or the Services, and the Bidder shall not accept for their own benefit any trade commission, discount, or similar payment in connection with activities pursuant to this Contract or to the Services or in the discharge of their obligations under the Contract, and the Bidder shall use their best efforts to ensure that the Personnel, any Subcontractors, and agents of either of them similarly shall not receive any such additional remuneration.

17.2 Bidder and Affiliates Not to be Otherwise Interested in Project

The Bidder agree that, during the term of this Contract and after its termination, the Bidder and its affiliates, as well as any Subcontractor and any of its affiliates, shall be disqualified from providing Goods for any project resulting from or closely related to the Services.

17.3 Prohibition of Conflicting Activities

Neither the Bidder nor its Subcontractors nor the Personnel shall engage, either directly or indirectly, in any of the following activities:

- a. during the term of this Contract, any business or professional activities in the Government's country which would conflict with the activities assigned to them under this Contract;
- b. during the term of this Contract, neither the Bidder nor their Subcontractors shall hire public employees in active duty or on any type of leave, to perform any activity under this Contract;

18. Confidentiality

18.1 Except with the prior written consent of the Procuring Agency, the Bidder and the Experts shall not at any time communicate to any person or entity any confidential information acquired in the course of the contract.

19. Insurance to be Taken Out by the Bidder

19.1 The Bidder(a) shall take out and maintain, and shall cause any Subcontractors to take out and maintain, at its (or the Subcontractors', as the case may be) own cost but on terms and conditions approved by the Procuring Agency, insurance against the risks, loss or damage, and for the coverage, as shall be specified in the SCC; and (b) at the Procuring Agency's request, shall provide evidence to the Procuring Agency showing that such insurance has been taken out and maintained and that the current premiums have been paid.

20. Bidder's Actions Requiring Procuring Agency's Prior Approval

20.1 The Bidder shall obtain the Procuring Agency's prior approval in writing before taking any of the following actions:

- (a) appointing such members of the Personnel not provided by the Bidder;
- (b) changing the Program of activities; and
- (c) any other action that may be specified in the SCC.

21. Reporting Obligations

21.1 The Bidder shall submit to the Procuring Agency the reports and documents in the numbers, and within the periods as prescribed by the Procuring Agency.

22. Liquidated Damages

22.1 If the Supplier fails to deliver any or all of the Goods or to perform the Services within the period(s) specified in the Contract, the Procuring Agency shall, without prejudice to its other remedies under the Contract, deduct from the Contract Price, as liquidated damages, a sum equivalent to the percentage specified in SCC of the delivered price of the delayed Goods or unperformed Services for each week or part thereof of delay until actual delivery or performance, up to a maximum deduction of the performance security (or guarantee) specified in SCC. Once the said maximum is reached, the Procuring Agency may consider termination of the Contract pursuant to **GCC Clause 15**.

22.2 Correction for Over-payment

If the Intended Completion Date is extended after liquidated damages have been paid, the Procuring Agency shall correct any overpayment of liquidated damages by the Bidder by adjusting the next payment certificate. The Bidder shall be paid interest on the overpayment, calculated from the date of payment to the date of repayment, at the rates specified in SCC.

22.3 Lack of performance penalty

If the Bidder has not corrected a Defect within the time specified in the Procuring Agency's notice, a penalty for Lack of performance will be paid by the Bidder. The amount to be paid will be calculated as a percentage of the cost of having the Defect corrected, assessed as specified in the SCC.

23. Performance Guarantee

23.1 Within Seven (07) days from the issuance of acceptance letter from the Procuring Agency, the successful Bidder shall furnish the Performance Guarantee in shape of ----- at the discretion of the PA in the amount **specified in SCC**. In case the amount of Bids security is equal or greater than

23.2 The proceeds of the Performance Guarantee shall be payable to the Procuring agency as compensation for any loss resulting from the Supplier's failure to complete its obligations under the Contract.

23.3 The Performance Guarantee shall be denominated in the currency of the Contract, or in a freely convertible currency acceptable to the Procuring agency and shall be in the acceptable form as specified in SCC.

23.4 The Performance Guarantee will be discharged by the Procuring agency and returned to the Supplier not later than thirty (30) days following the date of completion of the Supplier's performance obligations under the Contract, including any warranty obligations, unless otherwise **specified in SCC**.

24. Fraud and Corruption

24.1 The Procuring Agency requires the Supplier to disclose any commissions or fees that may have been paid or are to be paid to agents or any other party with respect to the Bidding process or execution of the Contract. The information disclosed must include at least the name and address of the agent or other party, the amount and currency, and the purpose of the commission, gratuity or fee.

25. Sustainable Procurement

25.1 The Bidder shall conform to the sustainable procurement contractual provisions, if and as specified in the SCC.

D. Bidder's Personnel

26. Description of Personnel

26.1 The titles, agreed job descriptions, minimum qualifications, and estimated periods of engagement in the carrying out of the Services of the Bidder's Key Personnel. The Key Personnel listed by title as well as by name are hereby approved by the Procuring Agency.

27. Removal and/or Replacement of Personnel

27.1 Except as the Procuring Agency may otherwise agree, no changes shall be made in the Key Personnel. If, for any reason beyond the reasonable control of the Bidder, it becomes necessary to replace any of the Key Personnel, the Bidder shall provide as a replacement a person of equivalent or better qualifications.

27.2 If the Procuring Agency finds that any of the Personnel have (i) committed serious misconduct or have been charged with having committed a criminal action, or (ii) have reasonable cause to be dissatisfied with the performance of any of the Personnel, then the Bidder shall, at the Procuring Agency's written request specifying the grounds thereof, provide as a replacement a person with qualifications and experience acceptable to the Procuring Agency.

27.3 The Bidder shall have no claim for additional costs arising out of or incidental to any removal and/or replacement of Personnel.

E. Obligations of the Procuring Agency

28. Assistance and Exemptions

28.1 The Procuring Agency shall use its best efforts to ensure that the Government shall provide the Bidder such assistance and exemptions as specified in the SCC.

29. Change in the Applicable Law

29.1 If, after the date of this Contract, there is any change in the Applicable Law with respect to taxes and duties which increases or decreases the cost of the related Services rendered by the Bidder, then the remuneration and reimbursable expenses otherwise payable to the Bidder under this Contract shall be increased or decreased accordingly by agreement between the Parties, and corresponding adjustments shall be made to the amounts referred in the SCC.

30. Services and Facilities

30.1 The Procuring Agency shall make available to the Bidder and the Experts, for the purposes of the Services and free of any charge, the services, facilities and property described , at the times and in the manner specified in the SCC or terms of reference.

30.2 In case that such services, facilities and property shall not be made available to the Bidder, the Parties shall agree on (i) any time extension that it may be appropriate to grant to the Bidder for the performance of the Services, (ii) the manner in which the Bidder shall procure any such services, facilities and property from other sources, and (iii) the additional payments, if any, to be made to the Bidder as a result thereof.

F. Payments to the Bidder

31. Contract Price

31.1 The price payable shall be in Pakistani Rupees unless otherwise specified in the SCC. Prices charged by the Supplier for Goods delivered under the Contract shall not vary from the prices quoted by the Supplier in its Bid.

32. Terms and Conditions of Payment

32.1 Payments will be made to the Bidder according to the payment schedule stated in the SCC and as per actual invoice submitted by the Bidder.

32.2 Unless otherwise stated in the SCC, the advance payment shall be made against the provision by the Bidder of a bank guarantee for the same amount, and shall be valid for the period stated in the SCC. Any other payment shall be made after the conditions listed in the SCC for such payment have been met, and the Bidder have submitted an invoice to the Procuring Agency specifying the amount due.

33. Currency of Payment

33.1 Any payment under this Contract shall be made in the currency(ies) specified in the SCC.

G. Quality Control

34. Identifying Defects

34.1 The principle and modalities of Inspection of the Goods by the Procuring Agency shall be as indicated in the SCC. The Procuring Agency shall check the Bidder's performance and notify him of any Defects that are found. Such checking shall not affect the Bidder's responsibilities. The Procuring Agency may instruct the Bidder to search for a Defect and to uncover and test any service that the Procuring Agency considers may have a Defect. Defect Liability Period is as defined in the SCC.

35. Correction of Defects, and

Lack of Performance Penalty

35.1 The Procuring Agency shall give notice to the Bidder of any Defects before the end of the Contract. The Defects liability period shall be extended for as long as Defects remain to be corrected.

35.2 Every time notice a Defect is given, the Bidder shall correct the notified Defect within the length of time specified by the Procuring Agency's notice.

35.3 If the Bidder has not corrected a Defect within the time specified in the Procuring Agency's notice, the Procuring Agency will assess the cost of having the Defect corrected, the Bidder will pay this amount, and a Penalty for Lack of Performance.

36. Taxes and Duties

36.1 A Supplier shall be entirely responsible for all taxes, duties, fees, etc., incurred until delivery of the contracted Goods to the Procuring Agency.

H. Settlement of Disputes

37. Alternate Dispute Resolution

37.1 The disputes between the parties to the contract may be settled in accordance with Public Procurement Rules, 2004.

37.2 The procuring agency shall refer the matter to the Chief Justice Islamabad High Court or Managing Director PPRA or the Secretary Ministry of Law & Justice for appointment of Arbitrator.

37.3 The fee for the Arbitrator shall be specified in Pak Rupees as determined by the appointing authority which shall be borne and shared equally by the contracting parties.



Special Conditions of Contract

SECTION VIII. SPECIAL CONDITIONS OF CONTRACT

The following Special Conditions of Contract shall supplement the General Conditions of Contract. Whenever there is a conflict, the provisions herein shall prevail over those in the Conditions of Contract. The corresponding clause number of the GCC is indicated in parentheses.

Number of GC Clause

Amendments of, and Supplements to, Clauses in the General Conditions of Contract

Number of GC Clause 1

Definitions

The Procuring Agency is: PMU HESCO (Hyderabad Electric Supply Company (HESCO)), Assistant Manager Procurement PMU Office, Banglow No. A-1, Power Wing Colony, Hussainabad., Hyderabad, Hyderabad (District), Hyderabad (Division), Sindh (Province).

The Supplier is:

The title of the subject procurement is: PMU-216/26-27 Procurement of Insulator, Beam, Column & Pipe

Number of GC Clause 3

Applicable/Governing Law:

The Contract shall be interpreted in accordance with the laws of Islamic Republic of Pakistan

Number of GC Clause 4

Language:

The language of the Contract, all correspondence and communications to be given, and all other documentation to be prepared and supplied under the Contract shall be in **English**.

Number of GC Clause 5

Notices:

The addresses for the notices are:

Procuring Agency:

PMU HESCO (Hyderabad Electric Supply Company (HESCO)), Assistant Manager Procurement PMU Office, Banglow No. A-1, Power Wing Colony, Hussainabad., Hyderabad, Hyderabad (District), Hyderabad (Division), Sindh (Province).

+92-337-219-2717

amprocpmu@hesco.gov.pk

Contractor/ Bidder:

[Name, address and telephone number].

The Contractor/ Bidder's Representative(s)

[Name, address, telephone number and e-mail address]

Number of GC Clause 7.1

The Authorized Representatives are:

For the Procuring Agency:

PMU HESCO (Hyderabad Electric Supply Company (HESCO)), Assistant Manager Procurement
PMU Office, Banglow No. A-1, Power Wing Colony, Hussainabad., Hyderabad, Hyderabad (District),
Hyderabad (Division), Sindh (Province).

+92-337-219-2717

amprocpmu@hesco.gov.pk

For the Bidder:

Name:

Designation:

Address:

Number of GC Clause 8

Effectiveness of the contract

Number of GC Clause 9

Commencement of Contract:

Number of GC Clause 11.2

Expiration of Contract:

Number of GC Clause 15

Termination

In the event of termination of the contract due to any reason as already defined in the General Conditions of Contract, the Bidder shall be responsible for providing to the Authority the Goods till the time of alternate arrangements.

Number of GC Clause 17

Conflict of Interest:

The Procuring Agency reserves the right to determine on a case-by-case basis whether the Bidder should be disqualified from providing goods or services due to a conflict of a nature described in Clause GCC 17.

Number of GC Clause 22

Liquidated Damages

If the Bidder fails to provide services as required under the contract or in case of any data loss/data breach or any incident compromising the data security or other such failures related to any services, the Bidder shall pay to the Procuring Agency as Liquidated Damages at a rate of **0.06% to 10.00%** of the Contract value, in accordance with the extent of performance failure & the cost of investigating such incidents as judged by the Authority.

Number of GC Clause 23

Performance Guarantee:

The amount of performance guarantee shall be **10.00%** of the contract price in acceptable form of **Bank Guarantee**

Number of GC Clause 32

Payment terms:

Payment will be made to the Bidder against the procured Goods and services according to the actual invoice or running bills submitted by the Bidder against the services provided within the time given in the conditions of the contract.

Number of GC Clause 33

Currency of Payment:

All the payment to be released to the contractor/Bidder shall be in Pakistani Rupees.

Number of GC Clause 34

Identifying Defects:

The Authority reserves the right at any time to inspect the premises of the provider to inspect the goods and monitor the goods being provided.

Inspections & Tests Requirements

For being Brand New, bearing relevant reference numbers of the equipment (Certificate from supplier)

For the Country of Origin as quoted by the Supplier (Certificate from manufacturer)

For conformance to specifications and performance parameters, through Prior to delivery inspection (Inspection Report by Procurement Committee / Inspection Team)

Two authorized representatives of Director General (Procurement) will carry out pre delivery inspection at manufacturer works at supplier expenses including travelling (return air tickets for places of inspection located out of Hyderabad), local transportation, boarding & lodging in any A class accommodation and daily allowance (including travel time), as per Govt. of Pakistan Policy. The said payment will be made to the inspectors before issuance of Inspection Certificate.

Delivery & Documents

Supplier's invoice in triplicate showing Goods' description, quantity, unit price, and total amount

Delivery Challan duly acknowledged and signed by the consignee.

GRN issued by concerned Deputy Manager, Regional Store HESCO MCPL Workshop Jamshoro.

Warranty Certificate as per warranty clause.

Inspection Certificate as per inspection clause

Confirmation letter of acceptance of performance Bond/Security by the Manager (Procurement) PMU HESCO.

Certificate to the effect that the billed amount has not been claimed or received earlier (Non-payment certificate).

Professional Tax paid certificate by the firm (if applicable).

All Federal & Provincial Taxes will be applied as per prevailing laws.

Copy of General Sales Tax/Excise Duty Invoice.

the manufacturer/supplier in its invoices shall also give an undertaking, in case of omission of any deductible amount; HESCO's claim at any later stage (through pre-audit / post audit) shall be acceptable to them.

As per directions of FBR dated. 3.9.2015 conveyed vide C.E (Operation) PEPCO vide letter No. 1918-28 dated. 17.09.2015, the payment to the registered persons may be linked with the active taxpayer status of the suppliers as per FBR database.

Integrity pact (if applicable) on prescribed Performa duly signed and stamp.

Visual inspection certificate issued by inspector at the time of delivery in store.

Visual inspection certificate confirming the quantity, accessories (if any), packaging etc are consistent with relevant contract Clauses issued by Deputy Manager Regional Store at the time of delivery in store.

Sales Tax return cum payment Challan for the month of delivery of material.

Copy of GRN duly stamped and signed by the respective consignees.

Sales Tax Invoice as per GRN above.

Any increase/decrease in the existing tariff of custom duty/Sales tax or any other tax is imposed or charged by the Government of Pakistan/Provincial Government, the same will be adjusted by the Manager Project Financing PMU on production of documentary evidence.

Number of GC Clause 37

Following is the guidance for Dispute Resolution

- i. If any dispute of any kind whatsoever shall arise between the Authority and the Bidder in connection with or arising out of the Contract, including without prejudice to the generality of foregoing, any question regarding its existence, validity, termination and the execution of the Contract – whether during developing phase or after their completion and whether before or after the termination, abandonment or breach of the Contract – the parties shall

seek to resolve any such dispute or difference by mutual diligent negotiations in good faith within 14 (fourteen) days following a notice sent by one Party to the other Party in this regard.

ii. At future of negotiation the dispute shall be resolved through mediation and mediator shall be appointed with the mutual consent of the both parties.

iii. At the event of failure of mediation to resolve the dispute relating to this contract such dispute shall finally be resolved through binding Arbitration by sole arbitrator in accordance with Arbitration Act 1940. The arbitrator shall be appointed by mutual consent of the both parties. The Arbitration shall take place in Islamabad, Pakistan and proceedings will be conducted in English language.

iv. The cost of the mediation and arbitration shall be shared by the parties in equal proportion however the both parties shall bear their own costs and lawyer's fees regarding their own participation in the mediation and arbitration. However, the Arbitrator may make an award of costs upon the conclusion of the arbitration making any party to the dispute liable to pay the costs of another party to the dispute.

v. Arbitration proceedings as mentioned in the above clause regarding resolution of disputes may be commenced prior to, during or after completion of the contract.

Notwithstanding any reference to the arbitration herein, the parties shall continue to perform their respective obligations under the Contract unless they otherwise agree that the Authority shall pay the Bidder any monies due to the Bidder.

Rules of procedure for arbitration proceedings:

Any dispute between the Authority and a Bidder who is a national of the Islamic Republic of Pakistan arising in connection with the present Contract shall be referred to adjudication or arbitration in accordance with the laws of the Islamic Republic of Pakistan including Arbitration Act 1940, however above provision shall prevail in referring the case to the Arbitrator.

Place of Arbitration and Award:

The arbitration shall be conducted in English language and place of arbitration shall be at Islamabad. The award of the arbitrator shall be final and shall be binding on the parties.



Bid Securing Declaration

Form 9: Bid Securing Declaration

Date: *[insert date (as day, month and year)]*

Bid No.: **P105793**

To: **PMU HESCO (Hyderabad Electric Supply Company (HESCO)), Assistant Manager Procurement PMU Office, Banglow No. A-1, Power Wing Colony, Hussainabad., Hyderabad, Hyderabad (District), Hyderabad (Division), Sindh (Province).**

We, the undersigned, declare that:

We understand that, according to your conditions, Bids must be supported by a Bid Securing Declaration.

We accept that we will be blacklisted and henceforth cross debarred for participating in respective category of public procurement proceedings for a period of (not more than) six months, if fail to abide with a bid securing declaration, however without indulging in corrupt and fraudulent practices, if we are in breach of our obligation(s) under the Bid conditions, because we:

1. have withdrawn or modified our Bid during the period of Bid Validity specified in the Form of Bid;
2. Disagreement to arithmetical correction made to the Bid price; or
3. having been notified of the acceptance of our Bid by the Procuring Agency during the period of Bid Validity, (i) failure to sign the contract if required by Procuring Agency to do so or (ii) fail or refuse to furnish the Performance Security or to comply with any other condition precedent to signing the contract specified in the Bidding Documents.

We understand this Bid Securing Declaration shall expire if we are not the successful

Bidder, upon the earlier of (i) our receipt of your notification to us of the name of the successful Bidder; or (ii) twenty-eight (28) days after the expiration of our Bid.



Contract Form

SECTION IX: CONTRACT FORMS

THIS AGREEMENT made the ____ day of _____ 20____ between **PMU HESCO (Hyderabad Electric Supply Company (HESCO)), Assistant Manager Procurement PMU Office, Banglow No. A-1, Power Wing Colony, Hussainabad., Hyderabad, Hyderabad (District), Hyderabad (Division), Sindh (Province).**

(hereinafter called “the Procuring Agency”) of the one part and [name of Bidder] of [city and country of Bidder] (hereinafter called “the Bidder”) of the other part:

WHEREAS the Procuring Agency invited Bids for provision of goods, viz., **PMU-216/26-27 Procurement of Insulator, Beam, Column & Pipe (P105793)** and has accepted a Bids by the Bidder for the provision of Goods in the sum of [contract price in words and figures] (hereinafter called “the Contract Price”).

NOW THIS CONTRACT WITNESSETH AS FOLLOWS:

1. In this Contract words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Contract, In the event of any ambiguity or conflict between the Contract Documents listed below, the order of precedence shall be the order in which the Contract Documents are listed below:-

1. This form of Contract;
2. the Form of Bids and the Price Schedule submitted by the Bidder;
3. the Schedule of Requirements;
4. the Technical Specifications;
5. the Special Conditions of Contract;
6. the General Conditions of the Contract;
7. the Procuring Agency’s Letter of Acceptance; and
8. [add here: any other documents]

3. In consideration of the payments to be made by the Procuring Agency to the Bidder as hereinafter mentioned, the Bidder hereby covenants with the Procuring Agency to provide the Goods related services and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Procuring Agency hereby covenants to pay the Bidder in consideration of the provision of Goods and the remedying of defects therein, the Contract Price or such other sum as may become payable under the

provisions of the contract at the times and in the manner prescribed by the contract.

IN WITNESS whereof the parties hereto have caused this Contract to be executed in accordance with their respective laws the day and year first above written.

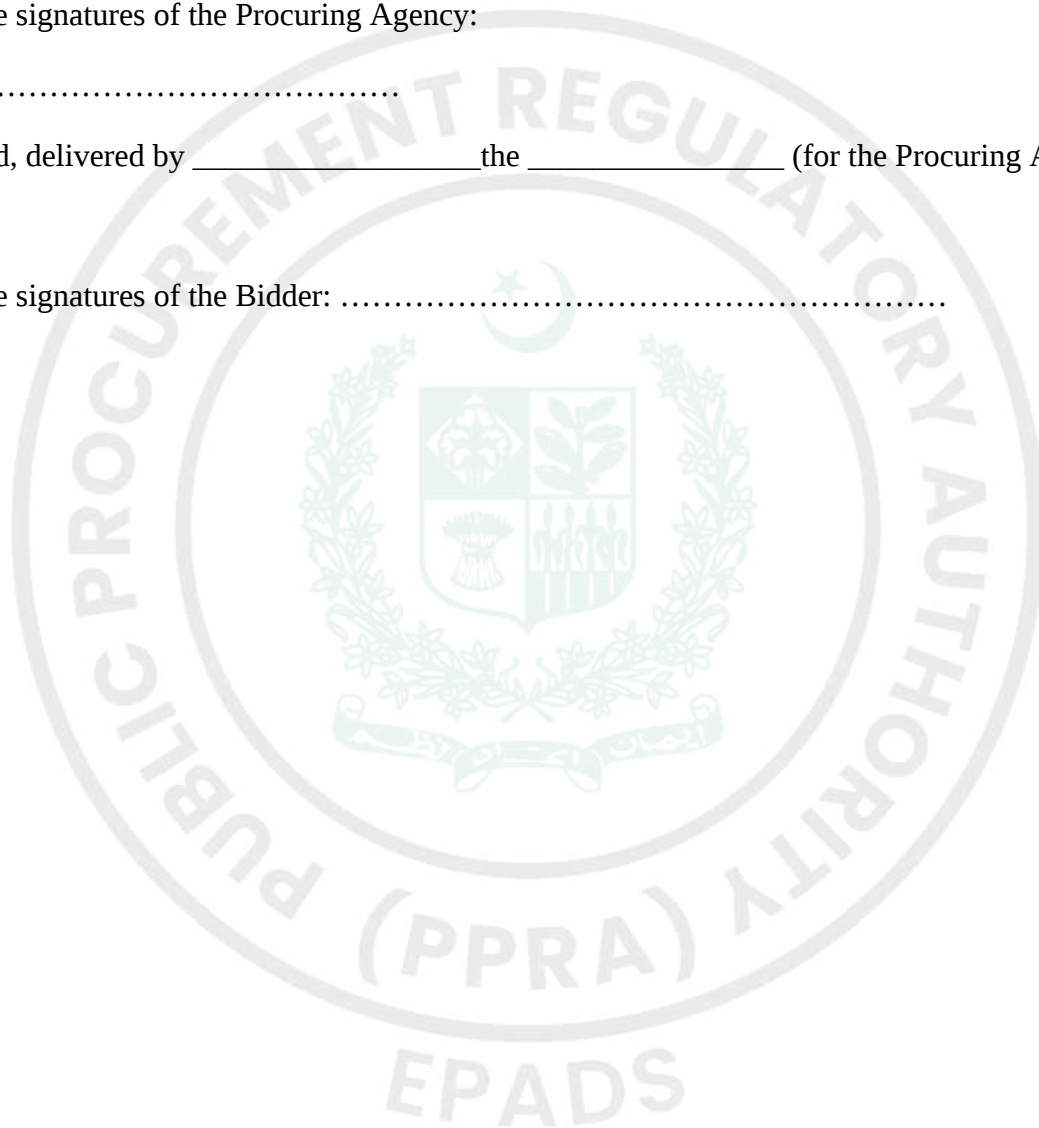
Signed, sealed, delivered by _____ the _____ (for the Procuring Agency)

Witness to the signatures of the Procuring Agency:

.....

Signed, sealed, delivered by _____ the _____ (for the Procuring Agency)

Witness to the signatures of the Bidder:





Integrity Pact

Integrity Pact

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC. PAYABLE BY THE SUPPLIERS OF GOODS, SERVICES & WORKS IN CONTRACTS WORTH RS.10.00 MILLION OR MORE

Contract

Number: Contract

Value: Contract Title:

Dated:

[Name of Supplier] hereby declares that it has not obtained or induced the procurement of any contract, right, interest, privilege or other obligation or benefit from Government of Pakistan or any administrative subdivision or agency thereof or any other entity owned or controlled by it (GoP) through any corrupt business practice.

Without limiting the generality of the foregoing [Name of Supplier] represents and warrants that it has fully declared the brokerage, commission, fee etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, sponsor or subsidiary, any commission, gratification, bribe, finder's fee or kickback, whether described as consultations fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP, except that which has been expressly declared pursuant hereto.

[Name of Supplier] certifies that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with GoP and has not taken any action or will not take any action to circumvent the above declaration, representative or warranty.

[Name of Supplier] accepts full responsibility and strict liability for making and false declaration, not making full disclosure, misrepresenting fact or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other right and remedies available to GoP under any law, contract or other instrument, be voidable at the option of GoP.

Notwithstanding any rights and remedies exercised by GoP in this regard, [Name of Supplier] agrees to indemnify GoP for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoP in an amount equivalent to ten times the sum of any commission, gratification, bribe, finder's fee or kickback given by [Name of Supplier] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP.



Performance Guarantee Form

Performance Guarantee Form

To: **PMU HESCO (Hyderabad Electric Supply Company (HESCO)), Assistant Manager Procurement PMU Office, Banglow No. A-1, Power Wing Colony, Hussainabad., Hyderabad, Hyderabad (District), Hyderabad (Division), Sindh (Province).**

WHEREAS *[name of Bidder]* (hereinafter called “the Bidder”) has undertaken, in pursuance of Contract No. *[reference number of the contract]* dated *[insert date]* for provision of Goods (hereinafter called “the Contract”).

AND WHEREAS it has been stipulated by you in the said Contract that the Bidder shall furnish you with a Bank Guarantee by a reputable bank for the sum specified therein as security for compliance with the Bidder’s performance obligations in accordance with the Contract.

AND WHEREAS we have agreed to give the Bidders guarantee:

THEREFORE, WE hereby affirm that we are Guarantors and responsible to you, on behalf of the Bidder, up to a total of *[amount of the guarantee in words and figures]*, and we undertake to pay you, upon your first written demand declaring the Bidder to be in default under the Contract and without cavil or argument, any sum or sums within the limits of *[amount of guarantee]* as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until the: *[insert date]*

Signature and seal of the Guarantors

[name of bank or financial institution]

[address]

[date]





Annexure

Technical Specifications/requirement

Bidder offer the material as per the specification/requirement attached.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Technical Specifications/requirement** (page number: 71)

Technical Specifications/requirement

Bidder offer the material as per the specification/requirement attached.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Technical Specifications/requirement** (page number: 124)

Technical Specifications/requirement

Bidder offer the material as per the specification/requirement attached.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Technical Specifications/requirement** (page number: 136)

Technical Specifications/requirement

Bidder offer the material as per the specification/requirement attached.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Technical Specifications/requirement** (page number: 141)

Technical Specifications/requirement

Bidder offer the material as per the specification/requirement attached.

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Technical Specifications/requirement** (page number: 160)

Price Schedule for Tender

Note: The **Grand Total Price** must be same as the Bid Quoted Price

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Price Schedule for Tender** (page number: 181)

Past Experience and Completed Contracts

annexure for Past Experience and Completed Contracts

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Past Experience and Completed Contracts** (page number: 182)



Procurement Forms

Past Experience and Completed Contracts

For the qualification of the bidder regarding the past experience and completed contracts detailed document is attached in the Annexures attached at the end.

See Form Under Additional Forms and Documents: **Past Experience and Completed Contracts** (page number: 183)

Historical Contract Non-Performance, and Pending Litigation and Litigation History

Litigation History

Bidders are requested to submit details of all litigation, arbitration and other claims whether pending, threatened or resolved in the last five years. The above stated information should be completed as per prescribed format and submitted along with required attachments.

The missing or incomplete information / documents may render the bid substantially non-responsive. In this regard, the Purchaser does not have an obligation to request any document / certificates.

See Form Under Additional Forms and Documents: **Historical Contract Non-Performance, and Pending Litigation and Litigation History** (page number: 184)

Financial Capacity and Net Worth Evaluation Form

Financial Criteria

-The bidder should have sound financial health. In order to determine the same, the bidder shall provide its up to date audited financial statements/ other financial statements acceptable to employer i.e. balance sheet, income statement, and cash flow statements for the last 3 years (three years). The bidder's Net worth for each last 3 years should be positive. In this context the bidder is required to fill in the relevant forms of this bidding document and submit the same with the bid.

-A bidder/or all partners combined in case of JV has to have sufficient financing sources, liquid assets, unencumbered real assets, lines of credit, available to meet the total cash flow demands of the contract. The cash flow availability be at least 25% of the estimated amount.

See Form Under Additional Forms and Documents: **Financial Capacity and Net Worth Evaluation Form** (page number: 186)

Average Annual Turnover

The bidder shall have an *average annual turnover in the last 3 years equal to or more than that 1.5 times of the estimated price*. The annual turnover of partners in a JV shall be calculated by summing their individual turnovers. In case of JV, all JV partners shall combine meet the said requirement







SPECIFICATION P-139:80

FABRICATION OF STEEL STRUCTURES



PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY
DESIGN DEPARTMENT, POWER,

C O N T E N T S

0. Foreword
1. Scope
2. Steel
3. Nuts and Bolts
4. Fabrication
5. Galvanizing
6. Sign Plates
7. Tests
8. Acceptance and Rejections
9. Test Methods
10. Packing
11. Drawings

PRINTING HISTORY

First approved on 19th July, 1980.

First Amendment October, 1982.

SPECIFICATION P-139:80
FABRICATION OF STEEL STRUCTURES.

AMENDMENT NO.1, DATED: 3RD OCTOBER, 1982.

1. Clause 4.3

Add the following para at the end of clause 4.3

"For the high tensile steel (yield point equal or higher than 35 kg/mm²) holes shall be directly drilled at the definitive diameter or punched and reamed out; The difference between the punched and reamed diameter shall be at the minimum 4 mm."

2. Clause 4.6

The following para is to be added at the end of the clause 4.6.

"Diameter of a punch hole shall not vary in all the thickness of the member or gusset. The difference between both hole diameters on each face of the piece shall be lower than the tenth of the punched thickness, with a maximum of 1.2 mm. For the thickness lower than 5 mm, maximum difference is fixed at 15 mm."

3. Clause 7.2.1

Delete the clause 7.2.1 and add the following:-

1. Visual examination
2. Varification of dimension and weight
3. Assembly test
4. Chemical Composition (check analysis)
5. Tensile Tests
6. Bend tests
7. Impact tests
8. Galvanizing tests

4. Clause 9.8

Add the following after clause 9.7

Impact Tests

"The test shall be performed in accordance with ISO 630."

SPECIFICATION P-139: 80

FABRICATION OF STEEL STRUCTURES

0 FOREWORD

0.1 This standard has been introduced by WAPDA and has been prepared by the transmission line section of the office of the Chief Engineer (Design).

0.2 This standard is intended only for the purpose of technical specification to facilitate fabrication of steel structures and does not include provision of contract.

0.3 This specification is subject to periodic revision as and when required.

1 SCOPE

This specification covers fabrication, galvanizing, testing and packing of transmission line towers and sub-station structures.

2 STEEL

2.1 In fabricating structures the contractor shall use structural steels having chemical composition and tensile properties as specified. The steel shall be made either by open hearth, basic oxygen or electric furnace process.

2.2 Requirement

2.2.1 Chemical Composition

2.2.1.1 The steels shall conform to the following chemical composition.

E l e m e n t	Composition Percent	
	Mild Steel	High Tensile Steel
Carbon	0.26	0.20
Manganese	0.85	1.35
Phosphorus Max.	0.04	0.04
Sulphur Max.	0.05	0.05

2.2.1.2 The Contractor may propose structural steel conforming to latest applicable industry standards specification and recommended practices having different chemical composition provided such steel has the yield point and min. elongation as specified in clause 2.2.2. In this case the type and specifications of steel will have to be approved by WAPDA. The following information shall be supplied by the Contractor:

- Ultimate tensile strength
- Minimum Guaranteed yield strength
- Minimum elongation
- Detail of test piece
- Chemical Composition

2.2.2 Tensile Properties

The steels shall conform to the requirements as to tensile properties prescribed below.

	<u>Mild Steel</u>	<u>High Tensile Steel</u>
Tensile strength kg/mm ²		
Minimum	40	50
Maximum	56	80
Yield points kg/mm ²		
Minimum	26	35
Elongation in 200mm gauge length percent, minimum		
Upto 8mm thickness	16	15
Over 8mm thickness	20	18

2.2.3 Bend Test Requirement

The steels shall withstand the following Bend Test Requirements.

Type of Material	Thickness of Material	Ratio of bend diameter to thickness for specimen
Mild Steel	Upto 25 mm	1
High Tensile Steel	Upto 25 mm	2

3 NUTS AND BOLTS

All bolts and nuts shall be made from mild steel to WAPDA Specification P-19 and shall be of size M 16. The bolts shall be provided with one flat washer under each nut.

Washers shall not be less than 5 mm thickness and only one thickness of washer shall be used. The diameter of the washer hole shall be 1.5 mm larger than the bolt diameter and the outside diameter of washer shall not be less than 1.5 mm larger than the diagonal of the nut. All connection bolts, nuts, lock nuts and washers shall be furnished in excess of actual number required in quantity at least 5% greater than actual requirements sufficient to compensate for normal field losses.

4 FABRICATION

4.1 All fabrication shall be performed according to approved drawings in a thorough and workman like manner in accordance with the best practice of a modern shop. All structural material shall be straight and cleaned of all rust and dirt before being laid out or worked in any manner. Necessary straightening shall be done in a manner that will not injure the material. Sharp kinks or bends shall be a cause for rejection.

4.2 In shearing and punching only sharp dies and punches shall be used, shearing and punching shall be done to guage and no variation in length shall be allowed except where otherwise noted on the shop detail drawing. No variation shall be allowed in a group or cluster of holes, and the centre to centre distance between the end holes in a piece shall not vary more than 1 mm.

4.3 Bolts holes shall be 1.5 mm to 2 mm larger than the normal bolt diameter. Bolts holes shall be cylindrical and perpendicular to members, shall be clean out and without torn or ragged edges and shall be free of burrs, rough edges, and punch cracks. Holes shall be accurately located and well matched.

4.4 Welding

All welding shall be performed in accordance with the latest edition of the "Code for Arc and Gas Welding in Building Construction," as formulated by the American Welding Society. A shield-arc welding process shall be used. All welds shall be as shown on the drawings and shall be made in such a manner that residual shrinkage stresses will be reduced to a minimum.

P-139:80.

4.5 Marking

All structural members shall be marked with the correct designation shown on the shop drawing. Marking shall be done by stamping the members prior to galvanizing with numerals or letters of 12 mm minimum height, and shall be clearly legible after galvanizing.

4.6 Tolerances

Ease of assembling the structure in the field is of utmost importance. The structure shall be so manufactured that all members carrying the same mark shall be interchangeable when assembled. The structure shall fit without undue pressing and no reaming or drifting of holes shall be required. When erected, the structures shall not deviate from the vertical by more than 1/300.

The Contractor shall be responsible for the correct fitting of all parts and shall replace free of cost any defective materials discovered during erection and shall pay all costs of the correction in the field of any errors not previously discovered.

The Cross sectional area or weight of each structural size shape shall not vary more than 2.5% from the theoretical or specified amounts.

The permissible variation from dimensions for structural size steel shapes shall not exceed the prescribed limits in ASTM A6.

5 GALVANIZING

5.1 After all the shop work is complete, all structural materials shall be hot dip galvanized to conform to WAPDA Specification P-82. Prior to galvanizing the material shall be drilled, punched, cut or otherwise fabricated as required, freed from burrs, cleaned and thoroughly prepared, so that the zinc coating shall be adherent, dense, smooth, continuous and uniform. It shall also be completely free from lumps, blisters, uncoated or porous spots, black spots, dross, flux or any other imperfection. All structural steel warped by the galvanizing process shall be straightened by re-rolling or pressing. The material shall not be hammered or otherwise straightened in a manner which may injure the galvanized coating.

All bolts and nuts shall be hot dip galvanized including threaded portions in accordance with WAPDA Specification P-82. Nuts shall have finger tight fit on bolts and develop the full strength of bolts.

5.2 Brittleness

All necessary precautions shall be taken in the composition of steel and in its fabrication and preparation for galvanizing to prevent embrittlement of any item or parts of items including bolts and nuts. For detecting embrittlement WAPDA Specification P-82 shall be followed.

6 SIGN PLATES

All the sign plates shall be fired ceramic surfaces on steel base plates. The ceramic enamel shall completely cover the front and back of the plates and also the edges of plates and the interior edges of the attachment holes. The enamel around the holes shall be protected by means of fibre washers.

7 TESTS

7.1 Manufacture's Tests

The Manufacturer shall select two samples from each heat to carry out the following tests to satisfy himself that the products comply with the specification.

7.1.1 For Sections and Plates

1. Chemical Composition (Ladle Analysis)
2. Tensile Tests
3. Bend Tests

7.1.2 For Nuts and Bolts

- | | | |
|--|---|---------------|
| 1. Proof Load test |) | |
| 2. Ultimate Tensile Strength test |) | According |
| 3. Ultimate tensile strength test under eccentric load |) | to |
| 4. Cold bend test |) | WAPDA |
| 5. Hardness test |) | Specification |
| 6. Galvanizing test |) | P-19 |

The Manufacturer shall maintain a record of tests carried out by him for examination by Inspector.

7.2 Acceptance Tests

The following acceptance tests shall be carried out:

7.2.1 For Sections and Plates

1. Visual examination
2. Verification of dimensions and weights
3. Prototype tests
4. Chemical composition (Check analysis)
5. Tensile tests
6. Bend Tests
7. Galvanizing test

7.2.2 For Nuts and Bolts

1. Verifications of dimensions)
2. Visual inspection) According
3. Proof load test) to
4. Ultimate tensile strength test) WAPDA
5. Galvanizing test) Specification P-19.

The Contractor shall render all necessary assistance to the Inspector in carrying out above mentioned tests.

8 ACCEPTANCE AND REJECTION

8.1 Chemical Composition

To indicate adequately, the chemical composition of a heat or a lot, the minimum number of samples selected to represent the heat shall be as follows:

	<u>No. of Samples</u>
50 tons or more	2
50 tons or less	1

If a piece fails to meet the requirement the lot shall be rejected.

8.2 Tensile Properties

Two tension and two bend tests shall be made from each heat and strength unless the finished material from a heat and strength gradation is less than 50 tons, where one tension and one bend test will be sufficient. However when material from one heat and strength gradation differs 9 mm in thickness, one tension and one bend

test shall be made from both the thickness and the thinnest material rolled in that strength gradation regardless of weight represented.

Two tension and two bend tests shall be made on every finished shape for every 10 tons.

If a test piece fails to meet the requirement the lot shall be rejected.

8.3 Assembly Test

One structure of each type shall be tested.

8.4 Galvanising

The acceptance and rejection on the basis of galvanizing test will be according to WAPDA Specification P-82.

8.5 Dimensional and Finish Defects

The number of sample units inspected shall be equal to the first sample size given in Table-V. If the number of defective units found in the first sample is equal to less than the first acceptance number, the lot shall be acceptable. If the number of defectives found in the first sample is equal to or greater than the first rejection number, the lot shall be rejected. If the no. of defectives found in the first sample is between the first acceptances and rejection number, a second sample of the size given by the plan shall be inspected. The number of defectives found in the first and the second samples shall be accumulated. If the cumulative number of defectives is equal to or greater than the second rejection number, the lot shall be rejected.

TABLE-V

Sample size code letters	Sample	Sample Size	Cumulative sample size	Acceptance Number	Rejection Number
2 to 8	First	1	1	0	1
	Second	-	-	-	-
9 to 15	First	2	2	0	2
	Second	2	4	1	2
16 to 25	First	3	3	0	2
	Second	3	6	1	2
26 to 50	First	5	5	0	2
	Second	5	10	1	2
51 to 90	First	8	8	0	2
		8	16	1	2

Sample size code letters	Sample	Sample Size	Cumulative sample size	Acceptance Number	Rejection Number
91 to 150	First	13	13	0	3
	Second	13	26	3	4
151 to 280	First	20	20	1	4
	Second	20	40	4	5
281 to 500	First	32	32	2	5
	Second	32	64	6	7
501 to 1200	First	50	50	3	7
	Second	50	100	8	9

8.6 Nuts and Bolts

The sampling acceptance, and rejection of nuts and bolts will be according to WAPDA Specification P-19.

9 TEST METHODS

9.1 Visual Examination

The test samples shall be examined visually for the following:

Visual Examination

Examination

Defects

Material

Not as specified in relevant clauses.

Construction

Not of the shape given in relevant drg.

Finish

Galvanising not proper, presence of burrs, black and bare spots, dross and projection.

9.2 Verification of Dimensions and Weight

The binding dimensions of the material shall be measured and weighed and shall be as shown on the relevant approved drawings subject to the tolerances given in clause 4.4.

9.3 Assembly Test

One structure of each type shall be assembled completely in the shop to verify the dimensions and suitability for field erection. Reaming or unfair holes shall not

be permitted and only a reasonable amount of drifting will be allowed in assembling. Poorly matching holes shall be cause for rejection.

9.4 Chemical Composition Tests

9.4.1 Ladle Analysis

An analysis of each heat of steel shall be made by the manufacturer to determine percentages of the elements specified below. This analysis shall be made from a test ingot taken during the pouring of the heat. The chemical composition thus determined shall be reported to the purchaser and shall conform to the requirements specified in clause 2.2.1.

9.4.2 Check Analysis

9.4.2.1 Analysis shall be made from finished material representing each heat or lot. The chemical composition thus determined shall not vary from the range or limits specified in clause 2.2.1.1 by more than the amounts specified below, but the several determinations of any elements in a heat may not vary both above and below the specified range.

E l e m e n t	For Mild Steel		For High Tensile Steel	
	Under the Limit	Over the Limit	Under the Limit	Over the Limit
Carbon	.03	.04	.03	.04
Manganese	.06	.08	.09	.12
Phosphorus	-	.01	-	.01
Sulphur	-	.01	-	.01

9.4.2.2 In case of an approved specification as referred to in sub clause 2.2.1.2 the chemical composition and tolerances of the approved specification be applicable.

9.5 Tensile Test

The test shall be performed in accordance with ISO-82.

9.6 Bend Test

The bend test specimens shall stand being bent cold through 180 deg. without cracking to an internal diameter of the specimen as prescribed in clause 2.2.3.

9.7 Galvanising Test

9.7.1 This test shall be carried out on all ferrous parts complying with the following requirements.

1. Weight of zinc coating
2. Uniformity of zinc coating
3. Adherence of zinc coating
4. Embrittlement tests

9.7.2 Test samples for determination of compliance to the tests specified shall be performed in accordance with WAPDA Specification P-82 and shall be taken from each lot. The lot shall consist of a quantity as specified in the relevant specification.

10 PACKING

10.1 All material shall be suitably packed to final destination. Heavy pieces such as legs and large cross arm members may be packed separately or in bundles of not more than 1000 kg. with all pieces in the bundle having the same mark of the same structure. All bundles of angles shall be securely fastened at three or more locations with galvanized steel binding straps not smaller than 1x20 mm of 1350 kg. tensile strength.

10.2 All small pieces such as bolts, washers, plates and other small fittings shall be packed in strong wooden boxes with a gross weight of 50 to 100 kgs. The boxes should be strong enough to withstand rough handling. Bolts of different sizes and lengths shall be packed in separate bags before boxing. Groups of packages or bundles may be packed in the same wooden boxes. In general, separate packages less than about 50 kg. each should not be used.

11 DRAWINGS

11.1 The contractor will be supplied with single line diagram indicating the various dimensions, angle sizes used, sizes of bolts used, type of steel and various standards/process to be followed for fabrication and galvanizing of the structure.

11.2 After placing of contract, the contractor shall submit for approval, the following drawings based on single line diagram provided in the clause.

11.2.1 Shop Details Drawings

The detailed drawings shall show shop details including

of dimensions, shearing, punching, bevel cutting, bending and identification mark and weight for each member.

11.2.2 Erection Drawings

Erection drawings showing each member with its identification mark, location and position of the outstanding leg of angles, number and size of connection bolts and all erection details.

11.2.3 Footing Installation Drawings

Footing erection drawings showing each member with its identification mark and number and size of connection bolts, and all dimensions required for the proper setting and positioning of anchor bolts or stub angle footings with relation to the centre, of the structure.

11.2.4 Bills of Material

Bills of material for each tower shall show the quantity, kind, size, length, weight and assembly mark for each member, including bolts, washers, plates and all fittings complete for each structure.

* * * * *

SPECIFICATION P-82:81
(UDC NO. 669,585,5)

ZINC COATINGS



PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY
DESIGN DEPARTMENT, POWER

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0. Foreword
1. Scope
2. Materials
 - Weight and Thickness of Zinc Coatings
4. Test Methods
5. Tests
6. Test Samples, Acceptance and Rejection
7. Passivation Treatment

PRINTING HISTORY

First edition March, 1971.

Second edition August, 1980.

Third edition July, 1981.

SPECIFICATION P-82: 81

(USC No. 669.588.5)

ZINC COATINGS

0 FOREWORD

- 0.1 This specification has been prepared by the Design Department of Power Wing, WAPDA and lays down specification for protective zinc coatings applied on iron and steel.
- 0.2 This standard is intended only for the purpose of procurement of materials and does not include the provisions of a contract.
- 0.3 This standard is subject to periodical revisions as and when required.
- 0.4 This specification is mainly based on ASTM A. 50 and A. 219, A.153.68, A.154.55, A.525.67, A.121.66, B 261-63, BS 443: 1961.

1 SCOPE

- 1.1 The specification lays down test for the zinc coatings which has been deposited either by Hot Dip method or by Electrodeposit Method on the articles as classified below. It also covers the weight of zinc coatings which shall be required per square meter of the surface area or its thickness.

Classification	Description of articles
Class A-Fabricated products	Fabricated products from rolled, pressed and forged steel shapes, channels, angle iron, T shapes, plates, bars and strips e.g. structural poles, tubular poles, pipes, channels and angle iron for platforms of pole mounting transformers, capacitors and voltage regulators, lattice steel cross bracket etc.
Class B-Castings	Castings, iron, malleable iron and steel.
Class C-Rolled pressed and forged articles	Rolled, pressed and forged articles such as insulator pins, anchor-shackle, eye-nuts, clamps, cotter pins, thimbles, covers, deadend clamps etc.
Class D-Nuts and bolts etc.	Nuts, bolts, washers, nails, rivets, screws and similar articles.
Class E-Steel Wires	Steel structural strands, steel wire strands for overhead transmission lines, guys, messengers, spur wires, tie wires and barbed wires.
Class F-Steel sheets	Steel sheets of all types and sizes

2 MATERIAL

- 2.1 The zinc used in electro-depositing and hot dip galvanizing shall be slab and shall conform to the following chemical composition:

Lead Max	1.6 percent
Iron Max	0.05 percent
Cadmium Max	0.50 percent
Zinc Min	98.0 percent

3 WEIGHT AND THICKNESS OF ZINC COATINGS

- 3.1 The weight of zinc coating by hot dip method on various articles shall be as per table-I below or otherwise specified in the relevant standards.

TABLE-I: WEIGHT OF ZINC COATINGS

Classification	Description of articles	Wt of Zinc Coating	
		Individual samples gm/sqm	Average of 3 samples gm/sqm
Class A Fabricated Products	Fabricated products from rolled pressed and forged steel shapes, channels and angle iron, T-shapes, plates bars and strips e.g. structural poles, tubular poles, pipes, channel and angle iron for platform of pole mounting transformers, capacitors and voltage regulators, lattice steel crossarm bracket etc.		
	i) When the thickness of steel is 3 mm to 6 mm	550	610
	ii) 6mm and heavier material	610	700
	iii) Pipe for service-mast only	350	400
	iv) Distribution transformer station hardware & cross-arm braces.	450	500
Class B Castings	Castings, cast iron malleable iron and steel	550	610
Class C Rolled, pressed and forged articles	Rolled, pressed and forged articles such as anchor shackle, eye-nuts, clamps, cotter pins, thimbles, covers, deadend clamps etc.		
	i) 4.75mm and over in thickness and over 200mm in length	550	610

11)	Under 4.75 mm in thickness and over 200 mm in length.	380	460
111)	200mm and under in length and any thickness	330	400
iv)	Hardware of service-mast other than pipe, insulator pins & D-shackle assembly	450	500

Class D
Nuts and
Bolts etc.

i)	Bolts, nuts and drive screws (over 9.5 mm in diameter) and similar articles, transmission tower bolts, washers 5 mm and over in thickness.	305	380
ii)	Screws and bolts (9.5 mm and under in diameter) rivets, nails and similar articles, washers under 5 mm in thickness.	260	305

Class E

Steel Wires

The weight of zinc coating on steel structural strands, steel wire stand for overhead transmission lines, guys, messengers, spur wires and tie wires for similar purposes shall be as under:-

<u>Stranded wire</u> <u>dia mm</u>	<u>Weight of zinc</u> <u>coating (gm/sqm)</u>
0.20 to 0.30	45
0.31 to 0.39	60
0.40 to 0.50	90
0.50 to 0.79	120
0.75 to 1.00	150
1.00 to 1.50	170
1.50 to 2.00	(200)
2.01 to 2.50	225
2.50 to 3.00	250
3.01 to 4.00	275
4.01 and above	300

ii) The minimum weight of zinc coating in gm/sqm on barbed wires shall be as under:

<u>dia mm</u>	
2.5 including and above	250.00
2.0 to 2.4 mm	200.00
1.5 to 1.9 mm	1500.00

Class F

Steel Sheets

The minimum weight of zinc coating in gm/sqm on galvanized steel sheets shall be as under:-

Coating class	Average of triple spot test	Min. single spot test
2.75	716.00	610.00
2.5	640.00	550.00
2.25	564.00	490.00
2.00	503.00	427.00
1.75	427.00	366.00
1.50	350.00	305.00
1.25 commercial	274.00	244.00

3.2 Thickness of Zinc Coating by Electrodeposit Method

3.2.1 The minimum and average thickness of zinc coating, except threaded parts, by electrodepositing on steel articles shall be as under:-

Coating class	Local thickness (mm)	Average thickness (mm)	Application conditions
Class G	.025	.038	Outdoor
Class H	.008	.013	Indoor

3.2.2 The minimum and average thickness of zinc coating on threaded parts of steel articles shall be as under:-

Diameter (mm)	Average thickness minimum (mm)	Average thickness maximum (mm)
1.50 to 6.00	0.005	0.0065
6.01 to 12.00	0.0065	0.008
12.01 to 20.00	0.008	0.010

3.3 One gram of zinc per square meter of surface, based upon mathematical calculation, shall correspond to a coating thickness of 0.00014 mm.

4 TEST METHODS

4.1 Weight of Zinc Coating on Galvanized Sheets

4.1.1 Test Samples

Test specimens shall be (50 ± 0.25) mm square, except for material narrower than 50 mm wide, in which case test specimens shall be of such a length that the area of the specimen is 2500 sq mm. When it is not possible to secure a specimen of 2500 sq mm in area, a smaller size may be used but it is recommended that a specimen of not less than 1,300 sq mm be used.

4.1.1.2 The specimens shall be clean, they shall be washed with solvent naphtha or other suitable solvent, then with alcohol and dried thoroughly.

4.1.2 Test Method

4.1.2.1 Reagents

1) Antimony chloride solution:-

Dissolve 20 grams of Sb_2O_3 or 32 gm of $SbCl_3$ in 1000 ml of HCl (sp.g. 1.19)

4.1.2.2 Weigh the specimens obtained in accordance with 4.1.1 to the nearest 0.01 g. After weighing immerse each specimen singly in a solution made by adding 5 ml of antimony chloride to 100 ml of HCl (specific gravity 1.19) to cover the specimen and allow to remain therein until the violent evolution of Hydrogen has ceased and only a few bubbles are being evolved. This requires about 15 to 30 sec. The same solution may be used repeatedly until the time required for stripping becomes inconveniently long. The temperature of the stripping solution shall at no time exceed $38^\circ C$. After stripping, wash the specimen by scrubbing them under running water, dip in hot water and wipe or blow dry. Again weigh the specimen to the nearest 0.01 g.

4.1.2.3 Calculations

a). The loss in weight represents the weight of zinc coating in grams on the specimen; to find the weight of zinc coating per sq meter proceed as follows:-

$$\text{Wt of coating in grams per square meter of steel surface} = \frac{\text{Loss in wt in grams} \times 10^6}{A}$$

Where A = Area of stripped sample in sq mm

4.2 Weight of Zinc Coating on Galvanized Wire

4.2.1 Test Sample

4.2.1.1 The specimens of galvanized wire may be of any length over 300 mm, but preferably about 600 mm. Where a continuous length is not available, shorter specimens totalling 300 mm but preferably 600 mm shall be used.

4.2.1.2 The specimen shall be cleaned by washing with solvent naphtha or other suitable solvent, then rinsed with Alcohol and dried thoroughly.

4.2.2 Test Method

4.2.2.1 Test method shall be the same as described in clause 4.1.2.

4.2.3 Test Results

4.2.3.1 Calculate the weight of zinc coating as follows:

$$C = \frac{W_1 - W_2}{W_3} \times d \times M$$

Where C = Wt of zinc coating in grams per sqm
 W_1 = Original weight of specimen in grams
 W_2 = Weight of stripped specimen in grams
 M = a constant = 1950
 d = diameter of stripped wire in mm

4.3 Weight of Zinc Coating on Articles Covered under Class A, B, C&D

4.3.1 Test Samples

- i) Samples for weight of coating determination, shall be selected in accordance with clause 6.4 or as specified in the relevant specification.
- ii) In the case of threaded articles, such as bolts and screws, the determination shall be made on a portion of the article that does not include any thread.
- iii) The specimens shall be cleaned by washing with solvent naphtha or other suitable solvent, then rinsed with Alcohol and dried.

4.3.2 Test Procedure

The procedure shall be the same as described in clause 4.1.2.

4.3.3 Test Results

- ##### 4.3.3.1
- Determine the total coated area of the specimen to the nearest 5 sq mm. Alternatively for specimens of uniform thickness of base metal, such as piece of plate or pipe, determine the average thickness of the specimen to the nearest 0.25 mm.

4.3.3.2 Calculation

Calculate the weight of zinc coating by using the formula:

$$C = \frac{W_1 - W_2}{A} \times N$$

Where C = Wt of zinc coating in gms/sqm of surface
 W_1 = Original wt of specimen in grams
 W_2 = Weight of stripped specimen in grams
 A = Coated area of the specimen in sq mm.
 N = A constant = (1000400)

- (b) If the specimen has a uniform thickness of base metal, the weight of the zinc coating may be calculated using the following formula:-

$$C = \frac{W_1 - W_2}{W_2} \times G \times Z$$

Where C = Wt of zinc coating in gm/sqm of the surface

W_1 = Original weight of the specimen in grams

W_2 = Weight of stripped specimen in grams

G = Thickness of stripped specimens in mm

Z = A constant = 3935

4.4 Test for Thickness of Electrodeposit Coating

4.4.1 Microscopic Test

The thickness of coating shall be determined on cross-sections taken perpendicular to the significant surfaces by the microscopic method described in the methods given below.

4.4.2 Test Specimens

- 4.4.2.1 To determine compliance with a specified minimum thickness of electrodeposited zinc, section the specimen at one or more significant surface where such a minimum may be expected.

4.4.3 Test Method

- 4.4.3.1 Hold the specimen rigidly and in such a position that the surface to be tested is perpendicular to the flat surface that is to be ground and polished (A deviation of 10 degrees from normal introduces an error of about 2% in thickness). The pieces may be plated first with a relatively thick coating of copper to protect the edges during grinding and polishing. On zinc deposit the first layer of copper from a cyanide solution after which, if desired, an acid copper solution may be used.
- 4.4.3.2 Grind and polish the section to be examined by regular metallographic methods, using successively finer abrasives the last being no coarser than 500 mesh. Polish zinc coating with minimum pressure in the direction from the hard basis metal to the soft coating, and alternatively at 45° and 135° angle to the plated surface.
- 4.4.3.3 Then treat the surface in such a manner as to obtain the maximum contrast between the coatings and the adjacent metals. Obtain such contrast by etching either the coating or the adjacent metal by an appropriate reagent. Suitable etching is desirable even when a contrast exists, since it will remove any soft metal that may have spread over a harder metal.

4.4.3.4 The following typical reagents are suitable for etching plated coatings:-

Chromic Acid (Cr O ₃)	200 g/Litre
Sodium Sulphate Na ₂ SO ₄	15 g/Litre

4.4.3.5 Measure the thickness of coating at any desired point on the exposed section by either of the methods described below:

- i) Measure the thickness with a filar micrometer ocular that has been calibrated in order to determine the value of the unit scale division against a scale graduated so accurately that the error will not exceed 2% for example, the scale may be graduated to 0.01 mm.
- ii) Project the image of the specimen especially of those specimens having very thin coatings, at a known and properly calibrated magnification on the ground-glass focusing plane of the camera of a metallographic microscope. Measure the width of the projected line of deposit with a graduated linear scale, the reading divided by the magnification shall give the thickness of the coating.

4.5 Adherence of the Coating Tests

4.5.1 Galvanized Sheets:

4.5.1.1 Galvanized steel sheets shall withstand a bend through 180° in any direction without flaking of coating on the outside surface.

4.5.1.2 The sample under test shall be gripped in a hand operated vice with smooth jaws and shall be bent through 180° over a mandrel twice as thick as the sample if weight of zinc coating is equal or more than 525 grams/sq.m. The sample shall be folded over a mandrel equal to the thickness of sample if the weight of zinc coating is less than 525 grams/sq.m.

4.5.2 Galvanized Wire

4.5.2.1 Zinc coated wire shall be capable of being wrapped at a rate not exceeding 15 turns per minute in a close helix of at least two turns around a cylindrical mandrel equal to three times the nominal diameter of wire under test, without cracking or flaking the zinc coating to such an extent that any zinc can be removed by rubbing with the bare fingers.

4.5.3 Articles covered under Class A, Class B and C - Heavy Materials

4.5.3.1 The pivoted hammer may be used to determine adherence of zinc coating on steel products 8 mm thick and heavier covered under class A, B and C. This test is applicable to flat surfaces only and shall not be used on round and curved surfaces. The hammer used

shall conform to fig 4. The hammer blow shall be controlled by clamping or holding the pivoted base of the handle firmly on a horizontal surface of the galvanized member and allowing the hammer head to swing freely through an arc from vertical position to strike the horizontal surface. As illustrated in fig 2 the test shall consist of two or more standard blows forming parallel impressions with 6.5 mm spacing along a common axis so located that no part of an impression shall be closer than 13.0 mm to the edge of the member. Removal or lifting of the coating in the area between the impressions shall constitute failure. An extruded ridge less than 3 mm wide shall be disregarded. The specimen shall be tested in several places throughout its length.

4.5.4 Articles covered under Class A, Class B and Class C - Small and Light Materials.

4.5.4.1 Small and light materials which are liable to deflect or deform under the hammer blow and curved or round articles which cannot be hammered properly should be tested by this method.

4.5.4.2 The adherence of zinc coating to the surface of the base metal shall be determined by cutting or prying with a stout knife, applied with considerable pressure in a manner tending to remove a portion of the coating. It shall only be possible to remove small particles of the coating by paring or whittling and it shall not be possible to peel any portion of the coating so as to expose the base metal.

4.6 Uniformity of Coating Test

4.6.1 Test Solution

4.6.1.1 The copper sulphate solution shall be made by dissolving approximately 36 parts by weight of commercial copper sulphate crystals in 100 parts by weight of distilled water. Heat may be used to complete the solution of copper sulphate crystals. If heated, the solution shall be allowed to cool. The solution shall then be agitated with an excess of powdered cupric hydroxide $\text{Cu}(\text{OH})_2$ about 0.81 gms/litre of solution. The presence of an excess of cupric hydroxide will be shown by the sediment of this reagent at the bottom of the vessel. The neutralized solution shall be allowed to stand for 24 hour and then filtered or decanted.

4.6.1.2 The test solution shall have a specific gravity of 1.186 at 18°C. To adjust a solution of improper specific gravity, add distilled water when the specific gravity is high, and add a copper sulphate solution of a higher specific gravity when the test solution is low in specific gravity.

4.6.1.3 Wire specimens shall be tested in a glass container at least 50mm in inside diameter for 2.5 mm dia wire and smaller, and at least 75.0 mm in inside diameter for wire larger in diameter than 2.5 mm dia. The container shall be filled with fresh test solu-

tion to a depth of at least 100.0 mm. This quantity of solution shall be used for the simultaneous testing of one to seven test specimens. The solution shall be discarded after completion of the test and fresh solution used for any additional tests.

4.6.1.4 For testing articles other than wire, the quantity of copper sulphate solution required for each test will depend on the superficial area of the test specimen and the weight of coating. The quantity should not be less than 40 ml per gm of zinc coating on the specimen and shall be sufficient to cover the specimen so that the top surface of the solution is at least 13 mm above the top of the section of the specimen under test. The solution shall be discarded after completion of the test and fresh solution used for any additional tests.

4.6.2 Test Samples

4.6.2.1 The specimens selected for test shall be free from abrasion or cuts in the zinc coating, except those which may occur during manufacture or the preparation of the specimen for testing. Specimens of wire may be hand straightened.

4.6.2.2 The specimens shall be cleaned with a volatile organic solvent such as carbon tetrachloride, gasoline, or benzene, then rinsed with alcohol, and finally, thoroughly washed with clean water and wiped dry with clean cotton cloth. Test specimens shall be brought to a temperature of 15° to 21°C prior to beginning of the test.

4.6.2.3 Abnormal cases may arise when, by reason of unusual surface conditions, the copper sulphate solution will not act normally on the zinc coating. If there is any question of abnormality of performance of test specimens, the specimens shall be discarded and new ones selected. The new specimen shall be cleaned in alcohol, rinsed and wiped dry and then immersed for 3 minutes in a solution consisting of 1 part by volume of ammonium hydroxide (sp. gravity 0.90) and nine parts of water. The specimens may be scrubbed with cotton cloth during this immersion. After cleaning the specimens shall be washed and wiped dry and then tested in accordance with the procedure laid down below.

4.6.3 Test Method

4.6.3.1 The test specimen shall be immersed in the copper sulphate solution, which shall be maintained at a temperature of 16 to 20°C. The specimens shall remain in a fixed position in the solution for exact 1 minute. If a ½ minute dip is specified, it shall be given to the specimens after completion of all of the 1 min dip. There shall be no agitation of the solution during the immersion period and the specimen shall not be allowed to touch each other or the sides of the container. After each dip, the specimens shall be washed immediately in the rinsed water, and a fibre bristle brush shall be used to remove

any copper deposit that may have formed on the zinc coating. Before returning the specimens to the test solution they shall be well drained of excess rinse water and wiped dry with a clean cloth.

- 4.6.3.2 Successive dips of 1 min. each shall be continued, with washing and wiping of the test specimens after each dip, until the specimens have withstood the required number of dips specified in table-II or until the end point has been reached.

TABLE-II: WEIGHT OF COATING AND NUMBER OF DIPS

Weight of Coating gm/sqm	No of Dips	
	1 minute	half minute
300 and above	4	-
270 to 299	3	1
240 to 269	3	-
180 to 239	2	-
140 to 179	1	1
90 to 139	1	-
75 to 89	-	1

- 4.6.3.3 A recommended device for holding test specimens of wire in a fixed position is shown in fig 1. A similar device may be used for holding specimens of other small articles that are not required to be fully immersed in the test solution. Specimens that are completely immersed may be suspended by a string.

4.7 Visual Inspection

- 4.7.1 The galvanized surface shall be free from such imperfection as lumps, uneven coatings, blisters, gritty areas, uncoated spots, ash and flux inclusions, globules or heavy deposits of zinc which will interfere with the intended use of the material will not be permitted.

- 4.7.2 Following is the list of defects, their significance and possible remedies:-

Condition	Causes	Recommended Actions	Ground for Rejection
Bare Spots	Paint, grease or oil residues	Check cleaning particles	Materials may be
	Scale or rust residues	Check pickling particles	accepted
	Residual welding slag	Blas-clean welds, Avoid coated rods.	where bare spots are
	Breakdown of pre-flux coating	Check preflux and drying conditions	in accordance with clause 4.7.2.

	Aluminium content of bath too high	Regulate aluminium additions	
	Rolling defects in basis steel	Check steel supply	
	Articles in contact during galvanizing	Keep articles separated.	
General Roughness	Analysis or original surface condition of steel.	Check steel supply	Material may be accepted provided adhesion is good and degree of roughness is not too critical.
	Overpickling	Reduce pickling use inhibitor.	
	High galvanizing temperature and/or long immersion time.	Adjust galvanizing conditions	
Pimples	Entrapped dross particles	Avoid agitation of dross layer check carry-over of pickle salts.	Material with finally disposed pimples covering not more than 0.5% of the area may be accepted.
Lumpiness and Runs	Withdrawal speed too high	Remove work slowly	Materials of class ABC may be accepted whereas of class D,E, F rejected.
	"Cold" galvanizing bath	Increase temperature	
	Delayed run-off from seams, joints bolt holes, etc.	Remove work slowly	
	Articles in contact during withdrawal.	Keep articles separated	
Flux Inclusion	Steel flux burnt on during dipping	Refresh or renew flux blanket	Materials shall not be accepted.
	Surface residues on steel	Check steel preparation	
	Flux picked up from top of bath	Skim before withdrawal.	

4.7.3 Articles covered under class A, B & F shall be completely free from uncoated spots. However small localized uncoated spots on fabricated pressed, forged and casted articles covered under class A, B & C may be ignored upto maximum of 0.25% of the total area. The area of such individual spots shall not exceed 0.5 square cm. Uncoated spots shall be patched with galvanizing repair paint.

4.8 Embrittlement Tests

4.8.1 Galvanized Angle Test (for angle irons only)

4.8.1.1 Test Requirements

- i) The elongation measured in accordance with clause 4.8.1.2 (ii) shall not be less than 5 percent except as specified in para 4.8.1.2 (ii).
- ii) When the specimen does not show 5 percent elongation, the reduction in thickness shall be measured in accordance with clause 4.8.1.2 (ii). The sum of the percentage of elongation plus the average percentage reduction of thickness shall not be less than 10.

4.8.1.2 Test Procedure

- i) For determining the elongation after fracture, a 51 mm gauge length (Fig 2) shall be prick-punched in the middle of the edge of the vertical leg of the angle along a line parallel to its length and centred directly under the hole. After the test, the sum of the distance along this line from each punch mark to the corresponding edge of the fracture shall be measured to 0.25 mm with a flexible scale, and the percentage of elongation calculated. For specimens under 13.0 mm in thickness or those in which the distance from the edge of the hole to the edge of the angle is less than 10 mm, the elongation shall be measured over a 25 mm gauge length.
- ii) For determining the percentage reduction of thickness after fracture, the reduction shall be measured with a ball point micrometer at the 3 locations indicated in fig 3; namely (a) outer side of hole, (b) inner side of hole, (c) middle of leg. The percentage reduction of thickness shall be calculated on the basis of the original thickness of the angle and the average of the three values at a, b and c.

- iii) The length of the test specimen and the distance between the supports are shown in the following table:-

Length of angle L (mm)	Length between supports	
	L_1 (mm)	Minimum length L_2 (mm)
Upto 100 mm incl.	356.0	457.0
Over 100 mm to 150mm incl.	508.0	610.0
Over 150 mm to 200mm incl.	762.0	915.0

- iv) The kind of hole, punched, sub punched and reamed, or drilled, shall be that employed in the fabricated material which the specimen represents. The dimensional values, diameter, and location of hole, shall be not less than those employed in the structural details. Care shall be taken not to place the hole near stamped or rolled identification marks.
- v) The test shall be made upon galvanized specimens having a temperature not below 60° and not over 90°F when tested.
- vi) The test may be made in a universal testing machine, or by other means such as a press or bulldozer with the load applied slowly.

4.8.2 Embrittlement Tests for Materials covered under class B, C & D.

- 4.8.2.1 The test is suitable for galvanized steel hardware of such shape and size that permit bending such as bolts, tower steps, insulator clevises, braces, rods etc. Clamp one end of the article in a vice and bend the other end through an angle of 90 degrees of about a diameter equal to the dia or thickness of the article under test. A suitable length of pipe may be used as a lever to assist bending. The article after bending shall show no cracks on the outside surface of bend. If such a test is made on threaded articles, it shall be made on un-threaded portion. In case of completely threaded articles, the threads shall be removed and the 90 degrees bend shall be about a diameter equal to the reduced diameter of the article.
- 4.8.2.2 Castings and steel hardware of such shape or size that they do not permit bending, may be struck a sharp blow with a hammer of suitable weight. If the material is not embrittled, it should not crack under such a blow. However, if the article is tested to destruction, a white lustrous, coarse grain appearance of the resulting fracture is indicative of embrittlement and shall be cause for rejection.

5 TESTS

- 5.1 Tests on galvanized shall be carried out as per table - III below or otherwise specified in the relevant standard. Tests where applicable are marked 'O'.

TABLE-III: TESTS ON GALVANIZING

Test	Class A	Class B	Class C	Class D	Class E	Class F	Articles galvanized by electrodeposit method
Visual Inspection	O	O	O	O	O	O	O
Wt. of zinc coating (on hot dip articles)	O	O	O	O	O	O	X
Thickness of zinc coating	X	X	X	X	X	X	O
Uniformity of coating test	O	O	O	O	O	O	X
Adherence of coating test	O	O	O	X	O	O	O
Embrittlement test	O	O	O	O	X	X	X

6 TEST SAMPLES - ACCEPTANCE AND REJECTION

- 6.1 The manufacturer shall provide all necessary facilities including testing equipment for carrying out tests free of cost to WAPDA. The cost of test samples destroyed during tests shall be borne by the manufacturer.
- 6.2 The WAPDA representatives shall have access at all times while work on WAPDA's contract is being performed. The manufacturer shall afford the WAPDA representative all reasonable facilities to satisfy him that the galvanizing is being furnished in accordance with the specifications.
- 6.3 For visual inspection, articles shall be grouped into lots and test specimens shall be selected from a lot at random in accordance with table-IV. If the number of defective units does not exceed one, the lot shall be accepted. If the number of defective units exceeds two, the entire lot shall be rejected. In case the defective being two, another sample of double the quantity given in table-IV shall be selected at random and the test repeated. In case of any failure from the second selection, the entire lot shall be rejected.
- 6.4 Test specimens from each sample for determination of compliance to the tests specified in clause 5.2, 5.3, 5.4 and 5.5 shall be taken from each lot. The lot shall consist of a quantity

TABLE - IV

Material Description	Lot	Visual Inspection	NO. OF SAMPLES			Embrittlement Test
			Wt. of galvanizing test or thickness of zinc coatings	Uniformity and adherence of coating test		
1. Class A, B, C & D						
i) Fabricated, rolled, pressed, forged and cast articles covered under class A,B, C & D not more than 300 mm in length.	1000 units	100 units	3 units	3 units	3 units	
ii) Fabricated, rolled, pressed, forged and cast articles covered under class A,B, C & D more than 300 mm in length	500 units	100 units	3 units	3 units	3 units	
2. Class E						
Galvanized steel wires, barbed wires binding wires etc.	100 coils or 10 km in length of wire of same size in form of coils whichever is less.	10 coils	3 sample coils shall be selected from each lot and test specimens shall be cut from each coil as per clause 6.5 of this specification.	3 sample coils shall be selected from each lot and test specimen shall be cut from each coil as per cl. 6.6 of this specification		
3. Class F						
Galvanized steel sheets.	500 sheets of same size or 1000 kg in wt. whichever is less.	25 sheets	3 sample sheets shall be selected from each lot and test specimens shall be cut from each coil as per clause 6.5 of this specification	3 sample coils shall be selected from each lot and test specimen shall be cut from each coil as per clause 6.6 of this specification		

Galvanized articles by electrodeposit method.

The procedure for sampling shall be the same as described above for hot dip galvanized articles.

as specified in Table-IV below or as otherwise specified in the relevant specification. If any sample fails to comply with the requirements laid down in this standard, another set of samples as per table-IV shall be taken from the remaining lot and test repeated. In case of any failure in the second set of samples, the whole lot shall be rejected.

6.5 Test samples from sheets or coils (Class E,F) for determination of weight of zinc coating shall be obtained as follows:

- i) When cut from coil, one sample from the centre and two samples from both ends of coil shall be taken.
- ii) When cut from sheet, one sample from the centre and two samples from diagonally opposite corners shall be taken.

6.6 Test specimens from each sample sheets and coils for determination of adherence and uniformity of coating shall be obtained as follows:

- i) When cut from coil, sample shall be selected from one end of the coil.
- ii) When cut from sheet, sample shall be taken from one corner of the sheet.

7 PASSIVATION TREATMENT

7.1 Zinc coatings applied by electrodeposit method shall be given full passivation treatment for maximum protection from corrosion by the following process.

7.2 The zinc plated components shall be well rinsed, then immersed for 5 to 10 seconds in a passivation solution of following composition:

Sodium dichromate	182 g/litre
Free sulphuric acid	6 ml/litre

After passivation the components shall be well rinsed in running water and then dried in warm air.

7.3 Passivation process other than one specified above, may be used subject to prior approval by WAPDA.

Encls: Figures 1,2,3, 4 and table IV.

m.y

BARBED WIRE



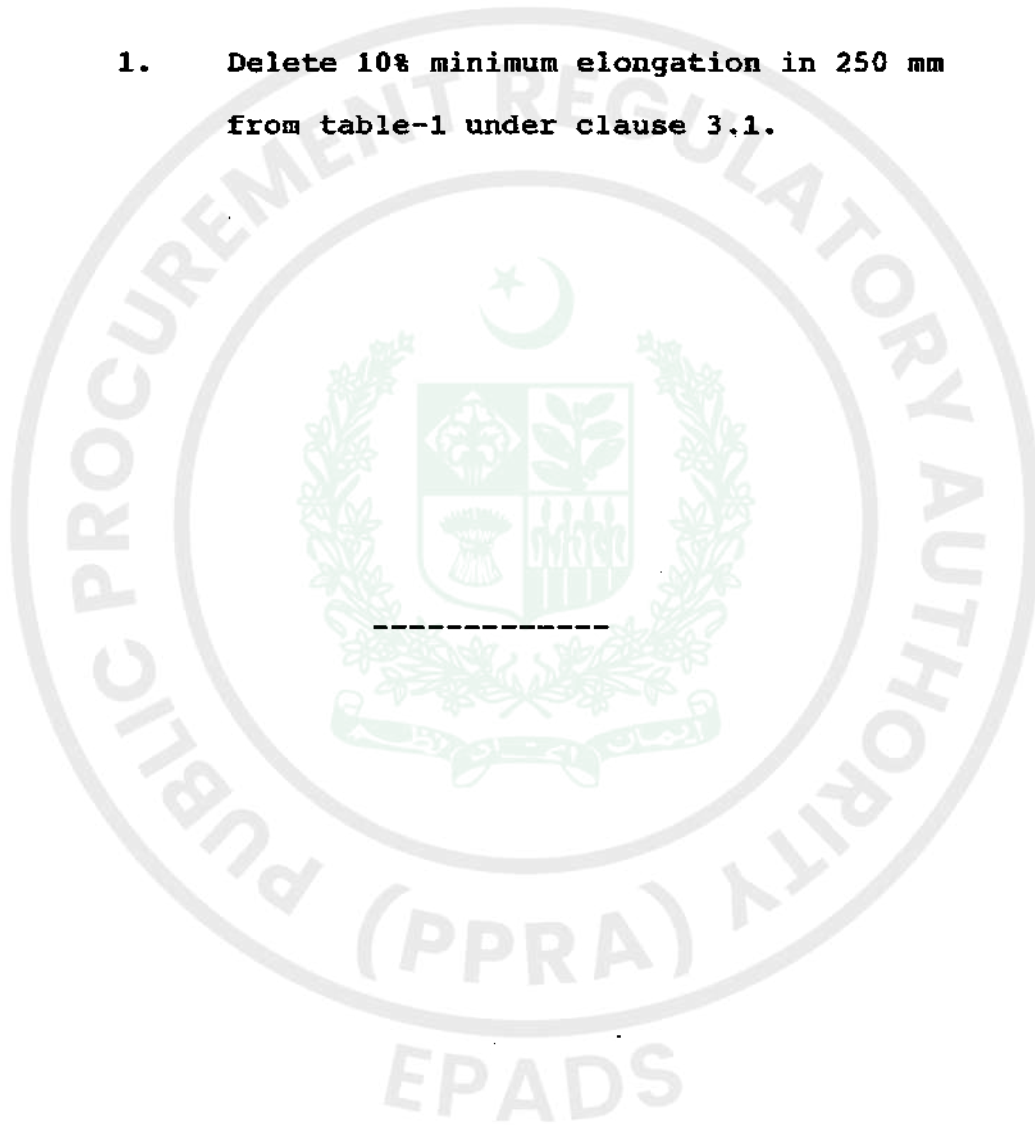
PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY
DESIGN DEPARTMENT, POWER WING

SPECIFICATION P-162:81

BARBED WIRE

AMENDMENT NO.1 DATED: 5TH JANUARY, 1989.

- 1. Delete 10% minimum elongation in 250 mm
from table-1 under clause 3.1.**



C O N T E N T S

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PRINTING HISTORY

First edition , December, 1981

Amendment No. 1 dated 5th January, 1989.

SPECIFICATION P-162: 81

(UDC 621.315.52)

BARBED WIRE

0 FOREWORD

- 0.1 This standard specification has been prepared by the Standards and Research Directorate of the Design Department (Power), WAPDA, Lahore.
- 0.2 This specification is intended only for the purpose of procurement of material and does not include the provisions of contract.
- 0.3 This specification is subject to revision as and when required.
- 0.4 This specification supersedes PD-76 on Barbed Wire.

1 SCOPE

- 1.1 Barbed wire is used on 11 kV steel structures and 11kV reinforced concrete poles for anticlimbing purposes.

2 MATERIAL

- 2.1 The base metal of the barbed wire shall be of good commercial quality of steel wire made from steel produced by the open hearth, basic oxygen or electric furnace process.

3 DIMENSIONS, CHARACTERISTICS AND TOLERANCES

- 3.1 The size and characteristics of the zinc coated barbed wire shall be as given in table-I.

TABLE - I

Nominal diameter of zinc coated barbed wire.	Minimum breaking strength of single wire	Minimum elongation in 250 mm	Net weight of barbed wire on each reel	Shape of Barbs
mm	Kg		Kg	
2.00	115	10%	50	Round

- 3.2 The permissible variation from the nominal diameter of barbed wire shall be ± 0.13 mm.
- 3.3 The average spacing of barbs shall not exceed the specified spacing and no individual spacing shall vary from

the specified spacing by more than 19 mm, when measured from the edge of one barb at the strand to the corresponding edge of the adjacent barb.

4 CONSTRUCTION REQUIREMENTS

- 4.1 The barbed wire shall be formed from two strand galvanized wires complying with the requirements of clause 3 twisted together with an approximate lay of 50 mm, with four point barbs spaced at 100 mm intervals as shown in Fig.1. The barbs shall be wrapped around two strand wires once and round a single strand once, making in all, two turns round the strand wires. The barbs shall be wrapped around the strand wires by a method which prevents slipping to expose the four barbs approximately 90° apart in a plane at right-angles to the strand wire. The point of the barbs shall have a length of 13 ± 3 mm and shall be sharp and cut at an angle not greater than 35° to the axis of the barb.
- 4.2 The barbs shall be made from 2 mm dia galvanized steel wire complying with the requirements of clause 3.
- 4.3 Splicing of individual strand wires by means of a wrap joint or an electric butt weld is permitted, before galvanizing. Not more than three joints shall be allowed in one length of wire on the reel.
- 4.4 Splicing or joints shall be made in a workmanlike manner.

5 GALVANIZING

- 5.1 The wire shall be hot dip galvanized in accordance with WAPDA specification P-82 "Zinc Coating". The weight of zinc coating shall be 200 gms/sq meter.

6 FINISH

- 6.1 The zinc coated steel wires shall be clean, smooth and free from harmful defects prior to being stranded.

7 SAMPLING, ACCEPTANCE AND REJECTION

- 7.1 Each consignment shall be divided into lots containing 50 reels in each lot. A sample of 5 reels shall be drawn at random from each lot.
- 7.2 The sample shall be subjected to visual examination and verification of dimensions. If the number of defective reels is one, the lot shall be accepted. If the number of defective reels is two, another sample of 5 reels shall be drawn at random and subjected to tests. If the number

of defective reels is again two or more, the lot shall be rejected.

- 7.3 Specimen shall be cut from all the reels selected as per clause 7.1 for galvanizing test and breaking strength and elongation test. If one specimen fails the lot shall be accepted. If the number of failures is more than one, the lot shall be rejected.

8 TESTS

The following tests shall be carried out:

1. Visual examination
2. Verification of Dimensions
3. Galvanizing Test
4. Breaking Strength & Elongation Test

9 TEST METHODS

9.1 Visual Examination

Barbed wire shall be visually examined for defects given below in Table-2.

TABLE-2 VISUAL EXAMINATION

Examination	Defects
1. Material	Not as specified
2. Construction	Strands not uniformly twisted, Barbs not sharp, not tightly wrapped and uniformly spaced as per clause 4.
3. Finish	Galvanizing not proper

9.2 Verification of Dimensions

The diameter of individual wires shall be measured at four different points on each reel. The measurements shall be within the specified values with the permissible variations given in clause 3.

9.3 Galvanizing Test

The galvanizing test shall be carried out on individual strand wires in accordance with Wapda Specification P-82 "Zinc Coating".

9.4

9.4 Breaking Strength & Elongation Test

The breaking strength & elongation of individual strand wires shall be tested using suitable Tensile Testing Machine.

10 PACKING AND MARKING

10.1 The barbed wire shall be supplied, on wooden reels. The reels shall be made from high quality wood and shall be of sound construction, as such shall be able to withstand the usual rigours of transportation and handling in the field.

10.2 There shall be only one length of barbed wire on each reel.

10.3 The manufacturer shall provide the following markings on the outer side of flanges in a legible and indelible manner.

1. Wapda Specification Number
2. Manufacturer's Name or Trade Mark
3. Serial Number of the Reel
4. Address of the Consignee

10.4 The manufacturer shall stamp the following information on metallic plates which shall be nailed to both sides of the reel.

1. Size of barbed wire
2. Net weight and gross weight in Kg.
3. Serial number of the reel.

10.5 Both sides of the reel shall have an arrow marking indicating the direction of rolling.

Encls: Fig. 1.



FIG. 1

DANGER AND SIGN PLATES



**PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY
DESIGN DEPARTMENT (T&G) POWER**

SPECIFICATION P-104: 76

DANGER AND SIGN PLATES

AMENDMENT NO. 1 DATED 12TH DECEMBER, 1981

1. Clause 4.2: a) Delete the following words in 2nd and 3rd line:

" galvanising and thermal shock".

- b) Add clause 4.3 after clause 4.2 as under:

"Clause 4.3 Three random samples of danger, number and phase plates selected from a lot of 1000 units shall be subjected to resistance to thermal shock test. Similarly three random samples of fixtures shall be subjected to galvanising test. If two or more than two units fail to meet the requirements, the entire lot shall be rejected. If one unit fails another group of three samples shall be selected at random from the same lot and above tests repeated. If any sample from the second group fails, the entire lot shall be rejected".

C O N T E N T S

0. *Foreword*
1. *Scope*
2. *Construction Requirements & Design*
3. *Tests*
4. *Sampling, Acceptance & Rejection*
5. *Test Methods*
6. *Marking and Packing*

PRINTING HISTORY

First approved on 24th April, 1976

First amendment on 12th Dec. 1981

DANGER AND SIGN PLATES

0 FOREWORD

0.1 This specification has been prepared by the Standards and Research Directorate of the Design Department (Power) WAPDA, Lahore.

0.2 This specification is intended only for the purpose of procurement of material and does not include the provision of the contract.

0.3 A specification on danger plate was issued in July, 1965 in the form of SDI-33. Then in January, 1972 a product description "PD-127" was issued on this subject.

Now a self-contained detailed specification is being issued under the Wapda Specification series which supercedes the above two publications namely SDI-33 & PD-127.

1 SCOPE

1.1 This specification covers vitreous enamelled danger and sign plates for use on distribution and transmission lines. It also covers the fixture for 11 KV and 33 KV danger plates.

2 CONSTRUCTION REQUIREMENTS AND DESIGN

2.1 Material

2.1.1 The danger and sign plates shall be made of high grade sheet steel of thickness 1.5 mm.

2.1.2 The fixture for danger plate for 11 and 33 KV shall be manufactured from mild steel.

2.2 Vitreous Enamelling

2.2.1 The danger and sign plates shall be enamelled on both sides and they shall be thoroughly cleaned before enamelling.

2.2.2 The enamel shall be of even thickness, reasonably free from cracks, patches, pin holes, blisters and shall have a uniform gloss.

2.2.3 Number of Coats of Vitreous Enamel Three coats of vitreous enamel shall be applied on the danger and number plates. The first coating of black enamel shall be applied on both sides of the plates. The other two coats of white vitreous enamel shall be applied on the front side of the plates only.

In case of phase plates, three coats of vitreous enamel shall be applied. The first coat of the black enamel shall be applied on both sides. The other two coats of red, yellow and blue colour shall be applied as specified

on both sides of the plate.

- 2.2.4 Lettering The lettering both of English and Urdu on the danger plates shall be red enamelled and the sizes of the lettering shall be as given in drawing No. PDW/DF-205. The danger symbol shall also be enamelled in red colour and its size shall be as marked on the drawing.

The height of lettering for "Number Plate" shall be 75 mm and the width shall be 25 mm. The letters shall be spaced at 6 mm from each other.

2.3 Danger Plate

- 2.3.1 The danger plate shall be vitreous enamelled and made of high grade sheet steel of 1.5 mm thickness.

- 2.3.2 The size of the plate shall be 260 x 200 x 1.5 mm and shall be manufactured in accordance with the drawing No. PDW/DF-205. The holes shall be provided as shown in the drawing.

- 2.3.3 The danger plates shall be marked with the voltage value i.e. 11000, 33000, 66000, 132000, 220000 and 500000. This marking should appear at the place shown in the drawing.

2.4 Number Plate

- 2.4.1 The number plate shall be of 200 x 150 x 1.5 mm size and shall be made in accordance with the drawing No. PDW/DF-207. Two nos holes shall be provided as shown in the drawing.

- 2.4.2 The code of the line and the tower number shall be red enamelled and shall be provided as specified. The code and tower number shown on the drawing are only for reference.

- 2.4.3 The assembly of the number and danger plate to be fixed on the tower has also been shown in drawing No. PDW/DF-207 for reference.

2.5 Phase Plate

- 2.5.1 The phase plate shall be of 115mm diameter with a hole of 12mm diameter as shown in the drawing PDW/DF-207. These plates shall be red, blue and yellow enamelled as specified.

2.6 Fixture for Danger Plates

- 2.6.1 The danger plate fixture is to be supplied only with 11KV & 33 KV danger plates and shall be manufactured in accordance with the dimensions given in drawing No. PDW/DF-206.

- 2.6.2 The fixture shall be hot dip galvanised in accordance with WAPDA Specification P-82. The average and minimum weight of coating shall be 610 and 550 gm/sq meter respectively. This corresponds to a thickness of 0.086mm and 0.077 mm respectively. The holes shall be drilled before galvanising.
- 2.6.3 The finish of the fixture shall conform to best commercial practice. The galvanising shall be completely free from lumps, blisters, uncoated or porous spots, black spots, dross, flux or other imperfection.
- 2.6.4 Four Nos bolts and nuts shall be supplied with each fixture as shown in the drawing in accordance with WAPDA Specification P-19 and plain steel washers shall be supplied in accordance with WAPDA Specification P-20.
- 2.6.5 Bolts, nuts and washers to be supplied with the fixture shall be electro-galvanised in accordance with WAPDA Specification P-82. The minimum thickness of coating shall be as follows:-

Local thickness	0.025 mm
Average thickness	0.038 mm

3 TESTS

- 3.1 The following sample tests shall be carried out on the samples selected for testing as per clause 4.

- 1) Visual examination
- 2) Verification of dimensions
- 3) Galvanising test (on fixture only)
- 4) Resistance to thermal shock (vitreous enamel finish)

4 SAMPLING, ACCEPTANCE AND REJECTION

- 4.1 Danger, number, phase plates and fixtures offered for acceptance shall be divided into lots containing upto 1000 units in each lot. A sample of 50 units shall be drawn at random from each lot.
- 4.2 The selected samples shall be subjected to the visual examination, verification of dimensions, galvanising and thermal shock tests. If the number of defective units is four, the lot shall be accepted. If the number of defective units is more than five the lot shall be rejected. If the number of defective units is five, another sample of 50 units shall be selected at random and subjected to tests. If the number of defective units is again five or more the lot shall be rejected and if the number of defective units is four or less the lot shall be accepted.

5 TEST METHODS

5.1 Visual Examination

The plates and fixtures shall be visually examined in the light of the following table:-

TABLE - 1 VISUAL EXAMINATION

<u>Examination</u>	<u>Defects</u>
Construction	Not of the shape given in drawings. Any crack on the nuts, bolts.
Material	Not of proper material.
Finish	Galvanising of bolts, nuts, washers and fixture not proper, presence of black spots, blisters, flux, dross, un-coated areas or any other defects. Bolts and nuts, rusty. Threads marred. The plates not properly enamelled, presence of cracks, patches, pin-holes, blisters or any other defect. Letters and numbers broken or not properly enamelled.
Marking	Missing or in-complete.

5.2 Verification of Dimensions

Dimensions of the danger, number, phase plates and fixtures shall conform to those given in drawing No. PDW/DF-205, 206 and 207 with allowable tolerances as marked on the individual drawing. Any variation from the specified dimensions shall constitute a defect.

5.3 Galvanising Test

The galvanising of the bolts, nuts, washers and fixtures shall be tested in accordance with WAPDA Specification P-82 "Zinc Coatings". The weight/thickness of coating shall conform to the values given in clause 2.6.2 & 2.6.5.

5.4 Resistance to Thermal Shock

This test shall be carried out by subjecting the test specimen to radiant heat so as to reach a steady temperature of 185 - 195°C in about ten minutes. The temperature shall be measured by means of a surface pyrometer in contact with the top surface of the heated part of the specimen.

Remove the radiant heat and within 5 seconds quench the surface with 1000 ml of water at 15-20°C direct from an aspiator or other container through a 5 mm diameter tube, the end of the tube being 150 mm above the centre of the

heated portion of the test specimen. The flow rate of water shall be adjusted to 10 ml. per second. It is convenient to mark the test area to ensure that the water is correctly applied. Dry the plate, replace in the same position under radiant heat source and repeat this procedure until six cycles have been completed.

Assessment of Results. After subjecting the test specimen to the above test, the vitreous enamel surface shall be considered to be resistant to thermal shock provided that the enamel shows no signs of flaking-off or crazing.

6 MARKING AND PACKING

6.1 Danger plates & number plates for 66 KV lines and above

The danger plates and number plates shall be packed in strong wooden boxes containing 100 plates in each box. The packing shall be strong enough to withstand the rigours of transportation by rail or road.

6.2 Danger plates & fixtures for 11 & 33 KV plates

The danger plate/fixture shall be packed in strong wooden boxes with 100 plates/fixtures in each box. The packing shall be strong enough to withstand the rigours of transportation by rail or road.

6.3 Phase Plates

The phase plates shall be packed in strong wooden boxes. Each box shall contain 200 phase plates. The packing shall be strong enough to withstand the rigours of transportation by rail or road.

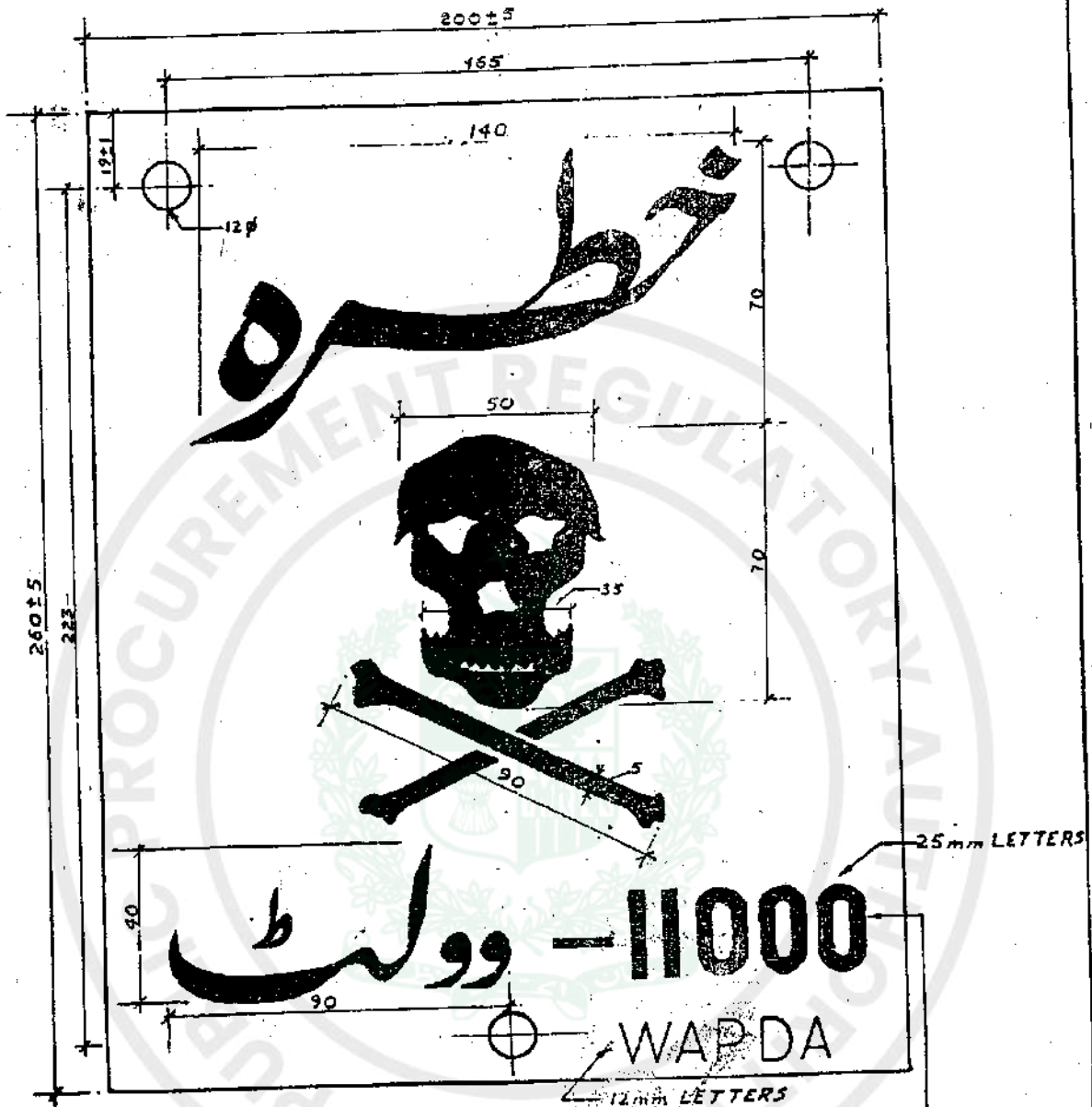
6.4 The packing box shall carry the following markings:

- (1) Wapda Specification number
- (2) Product Description with voltage rating in case of danger plates
- (3) Manufacturers' name or trade mark
- (4) Number of items in the box
- (5) Gross weight in kg
- (6) Address of consignee

6.5 Marking

6.5.1 The plates shall be marked clearly and idelibly with the wording "WAPDA" in red enamel as shown on the individual drawing in case of danger and number plates. This marking shall be white enamelled in case of red, yellow and blue phase plates. The wording "WAPDA" shall be punched on the fixture. The size of lettering shall be 12 mm in each case.

Encls: Drawing No. PDW/DF-205
PDW/DF-206
PDW/DF-207

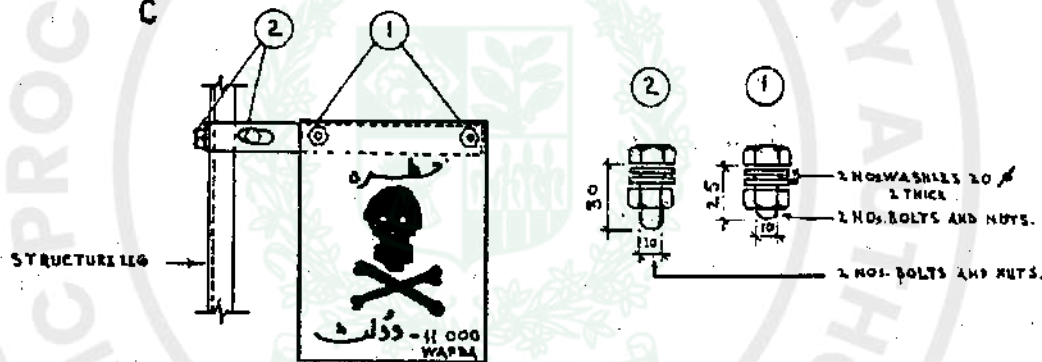
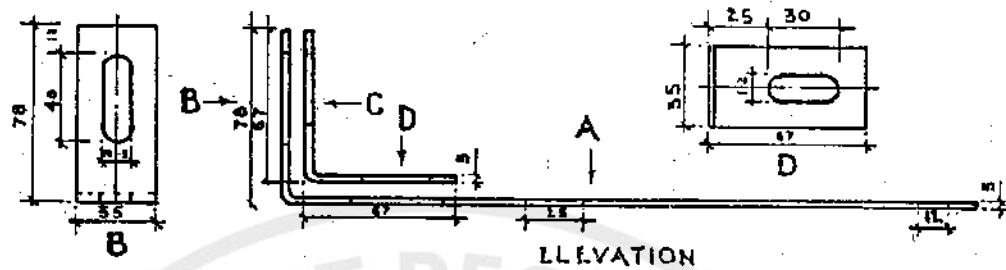


MATERIAL : HIGH GRADE SHEET STEEL
 THICKNESS OF PLATE : 1.5 mm
 LETTERS : RED ENAMELLED
 SYMBOL : RED ENAMELLED
 GROUND : WHITE ENAMELLED
 BACK SIDE : BLACK ENAMELLED

THE OTHER VALUES OF
 VOLTAGE (33,000 TO 500,000)
 TO BE GIVEN HERE.

ALL DIMENSIONS IN MILLIMETRES

PAKISTAN		DESIGN
WATER AND POWER DEVELOPMENT AUTHORITY		DEPARTMENT (POWER)
DANGER PLATE FOR DISTRIBUTION AND TRANSMISSION LINES		
DWN / <i>[Signature]</i>	A.E	SCALE —
TCD	<i>[Signature]</i> A.O.	DATE 19.4.76
CKD	DIR	DWG. NO. PDW/DF-205

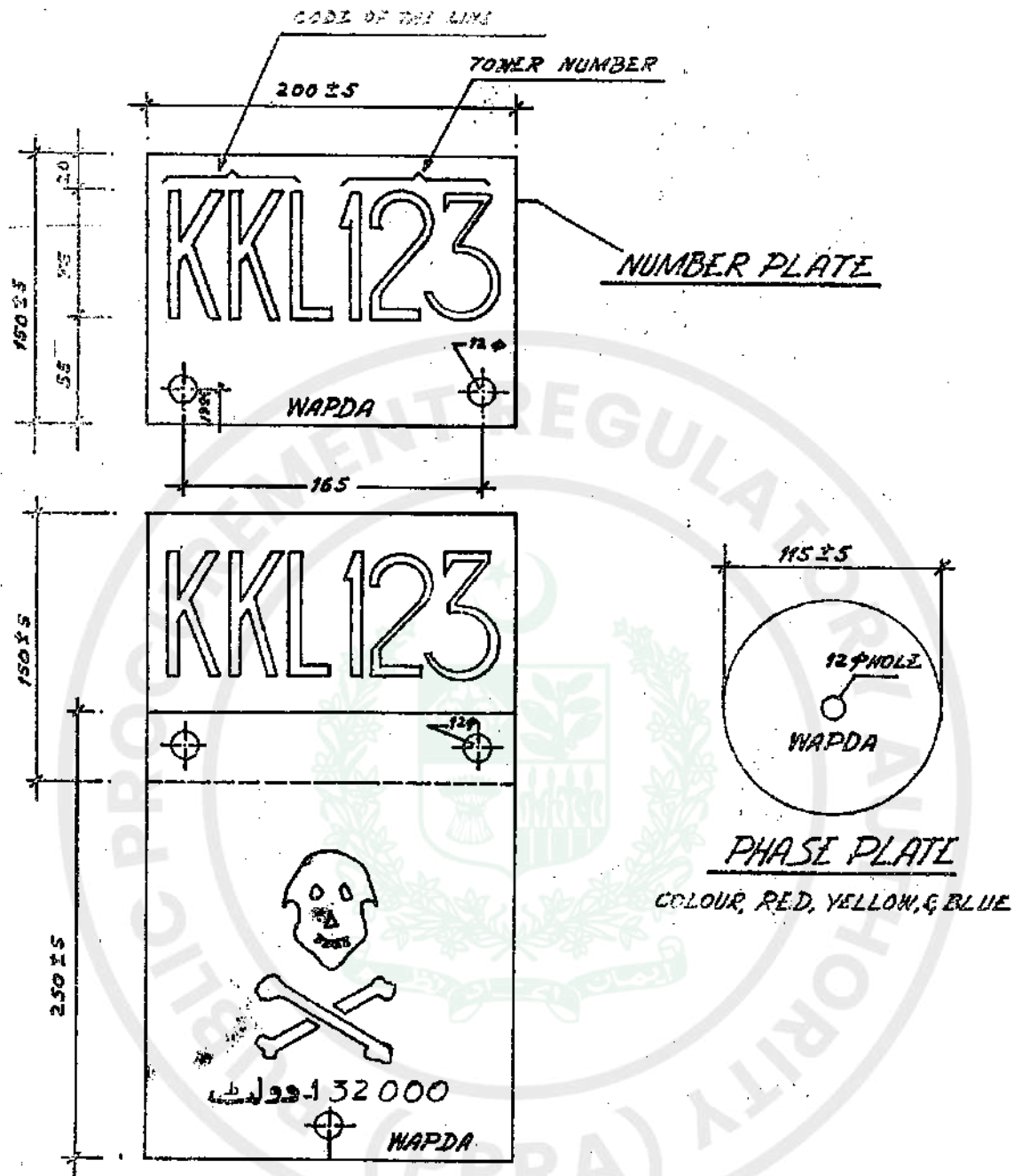


ASSEMBLY
FOR
11,000 & 33,000 VOLTS DANGER PLATE

ALLOWABLE TOLERANCE 5%
ON EACH DIMENSION

ALL DIMENSIONS IN MILLIMETRES

PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY		DESIGN DEPARTMENT POWER	
FIXTURE & ASSEMBLY FOR 11KV AND 33KV DANGER PLATE			
OWN.	AL.	SCALE	DATE: 19-4-76
FOR ASSEMBLY	DWG NO. PDW/DF.206		
CKD.			



ASSEMBLY OF NUMBER &
DANGER PLATE OF TRANSMISSION LINE.

ALL DIMENSIONS IN MILLIMETRES.

PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY		DESIGN DEPTT. POWER
<u>NUMBER PLATE & PHASE PLATE FOR TRANSMISSION LINES.</u>		
TCD. <i>Hussain</i>	D.E. SCALE-	DATE: -10-4-78
DWM	<i>Sadiq Qureshi P.D.</i>	DWS NO. PDW/DF-207
CXD.	DIR.	

C O N T E N T S

0. Foreword
1. Scope
2. Service Conditions
3. General Requirements
4. Switchgear Panel
5. Structure for Capacitor Banks
6. Bus Bars
7. Expulsion Fuse
8. Technical Data and Drawings

PRINTING HISTORY

First approved on October, 1982

First Amendment on December, 1982.

Revised and Amended Edition, 1989.

SPECIFICATION P-165:89

11,000 VOLT CAPACITOR BANKS AND CONTROL EQUIPMENT

0 FOREWORD

- 0.1 This specification has been prepared by the Standard and Research Directorate of Design Department, Power Wing, WAPDA.
- 0.2 This specification is intended for the procurement of material and does not include all the necessary provisions of a contract.
- 0.3 The specification for 11,000 Volt Capacitor Banks and Contact Switchgear was first issued in 1982. Later in 12/82 its amendment No.1 was issued. The Specification on Switchgear was mainly based upon P-44:79 Specification for 11,000 Volt Metalclad Switchgear. P-44 has since been revised twice and at present its 1987 edition is in force. Thus the changes in P-44 are required to be incorporated in P-165. Recently Capacitor Switch conforming to Specification P-185:89 has been introduced to control each 2.4 MVAR Section of the Capacitor Bank. Necessary changes in bus bar sizes and configuration have been made to accommodate the Capacitor Switch. The revised edition, incorporates besides other addition/alteration, the Amendment No.1 dated December, 1982.
- 0.4 This specification is subject to revision as and when required.

1 SCOPE

- 1.1 This specification covers materials, ratings, characteristics, construction details and tests for capacitor banks and control switchgear to be installed in substations.
- 1.2 A Capacitor Bank shall comprise of the following:
- i) Capacitors of 100 or 200 kVAR rating
 - ii) Racks for mounting of capacitors
 - iii) Expulsion type fuses for protection of individual capacitors
 - iv) Bus work, insulation and mounting arrangement
 - v) Other accessories.

The size of standard rack shall be 2400 kVAR. Racks shall be capable of being assembled together to form larger single banks.

The specification for Power Capacitors are covered separately under WAPDA Specification P-78:82.

- 1.3 The Control and Switching Equipment shall comprise of 11kV indoor switchgear alongwith necessary relays and accessories for switching and protection of capacitor banks. Cables for connection with the out-door capacitor banks are not included.

2 SERVICE CONDITIONS

2.1 Climatic Conditions

2.1.1 Atmospheric Conditions

It may be assumed that the air is not normally heavily polluted by dust, smoke, corrosive or flammable gases, vapours or salt. However at certain times of the year, severe dust storms may be experienced. Fine dust particles are present in the air and these are deposited on exposed surfaces.

2.1.2 Ambient Temperature

Maximum	50°C
Maximum mean over any 24 hours	45°C
Mean in any year	30°C
Minimum	-10°C

2.1.3 Relative humidity may range upto 100%.

The maximum value of the ambient temperature and humidity however do not occur simultaneously. During the monsoons high humidity may persist for many days at a time.

2.1.4 Altitude

Installation upto 1000m above sea level.

2.2 Supply System

- 2.2.1 The capacitor banks shall be suitable for installation in A.C. supply system of the following characteristics:

Nominal System Voltage	11kV
Nominal Voltage at Grid Stations	11.5kV
Rated Voltage	12kV
Frequency	50 Hz

3 GENERAL REQUIREMENTS

3.1 The capacitor banks shall be supplied as complete units in factory assembled form or in knock down condition which shall be assembled at site of erection. The unit block rating shall be 2400 kVAR and shall be supplied with properly sized bus bars, necessary insulators, unit earthing switch or separate earthing kit and other equipment as detailed in Clause 1.1.

3.2 The capacitor banks shall be erected outdoor in the switchyard. The capacitors shall be connected through metalclad switchgear panel to 11kV bus bar of the installed sub station for automatic switching of the capacitor banks. This switchgear panel shall be erected next to the incoming panel and busbars of both jointed together such that to each incoming transformer, one capacitor bank feeder is available.

General layout of the banks is given in drawing No. PDW/DF-383 Standard Switched Bank Capacitors are 2400, 3600, 4200, 6000 & 7200 kVAR.

3.3 Racks capacitor banks shall be switched on for improving 132/66kV side voltage so that the specified voltage level be maintained. The capacitor banks shall be switched off beyond certain voltage level. For this purpose voltage and time sensitive automatic switching controls shall be used. The equipment details are given in clause 4.3.4.

3.6 Capacitor banks shall be designed for the following insulation level:

- i) Rated lightning impulse withstand voltage .. 95kV
- ii) Rated one minute power frequency voltage (rms) .. 34kV

The minimum clearances shall be as under:-

- Phase to phase .. 160mm
- Phase to ground .. 125mm

1.7 The capacitor banks shall be supplied with built in earthing switch or a separate earthing kit to assure maintenance personnel safety while working on or around capacitor banks. The built in switch shall be mounted on capacitor mounting frame and operatable with a hook stick. The design of the separate earthing kit or built in earthing switch shall be provided by the manufacturer with the tender documents.

4 SWITCHGEAR PANEL

4.1 The switchgear shall be of the indoor type meant for automatic switching of the capacitor banks. It shall generally conform to Wapda Specification P-44:87 except as mentioned herein.

4.2 Panel Components

4.2.1 Each panel shall comprises the following equipment:

1. One Circuit Breaker
2. Three current transformers for over current protection and metering
3. Instruments
4. Relays
5. Hooter
6. Cable Termination Pad
7. Signalling Lamps ON/OFF Indications

4.3 Circuit Breaker

4.3.1 General

4.3.1.1 Circuit Breaker shall be of 25 KA breaking capacity. It shall be triple pole and all the three poles shall be coupled so as to operate simultaneously. The breakers shall be vacuum or SF₆ types. The breaker shall be draw out type suitable for indoor installation.

4.3.1.2 The breaker shall be capable of interrupting the required range of capacitor currents without restriking and allow capacitor currents to persist without making serious attempts at interruption until sufficient contact separation is reached which is able to withstand the recovery voltage twice as high as system voltage at half cycle after the first current pause.

4.3.1.3 The breakers shall be suitable for Electrical and Mechanical Switching operations as under:

1. Electrical: Switching operations at rated load : 10,000.
2. Mechanical: Switching operations : 10,000.

4.3.1.4 The closing springs of breakers shall be charged by an AC motor rated at 240V AC.

4.3.2 Characteristics and Ratings

The breaker shall have the following characteristics:

1. Current rating 630 Amps

2. Rated Voltage	12 kV
3. Frequency	50 Hz
4. Capacitor Switching Current	500 A
5. Breaking Current Symmetrical	25 kA
6. Making Current	63 kA
7. Rated one minute power frequency withstand voltage	36 kV
8. Rated lightning impulse withstand voltage	95 kV
9. Operation Duty	0-3mn-CO-3mn-CO
10. Total maximum break time	6 Cycles

4.3.3 Busbars

4.3.3.1 The busbars shall conform in general to clause 13 of wapda Specification P-44:87. The size of busbars shall be 2x100x10 so that they can be jointed to the incoming busbars standardised vide Dwg: No. PDW/TS-1630 of P-44:87. The busbar connections and joints shall be as detailed in Dwg: No. PDW/DF-297 of P-44:87.

4.3.4 Voltage and Time Sensitive Control

4.3.4.1 The voltage and time sensitive automatic capacitor switching control shall be of single pole type, flush mounted and suitable for installation in the switch-gear instrument compartment on the front door. The scale and range of operations shall be suitable for switching a 7200 kVAR capacitor bank. The accuracy shall be 2% of the full scale. Selector switches shall be provided for manual or automatic operation through "Automatic-Manual" and open-Neutral-Close switches.

4.3.4.2 The voltage sensitive control shall measure 132 & 66kV line voltage and as function of that quantity control the relay which in turn shall operate the switchgear. The relay shall be electronically controlled with an adjustable time delay. The instrument shall also be provided with adjustable band width range for setting switching IN and OUT voltages so that little variation in voltage shall not cause hunting.

4.3.5 Protection

5.3.5.1 110 Volts AC and a current of 5 Amps shall be available from the secondary voltage of the PT & CT respectively.

4.3.5.2 All the panels shall have overcurrent and earth fault protection which shall be provided by means of inverse induction type relays with two overcurrent elements and one earth fault element. The relay shall have three instantaneous elements. The relays shall conform to clause 14 of Wapda Specification P-44:87.

4.3.5.3 The capacitor unbalance detection relays shall be suitable for operation from a 5 Amps secondary of the bank neutral current transformers. The relays shall be of 2 steps type, the first step to give alarm on the failure of one capacitor unit and the second step to trip the breaker on the failure of the second capacitor unit.

4.3.5.4 The neutral unbalance protection scheme for the capacitor bank shall consist of double star with neutral connected to the current transformer as shown in Fig.2 CT's shall be mounted at a suitable place on the structure and shall operate the relay described in Clause 4.3.5.3.

4.3.6 Current Transformers

4.3.6.1 The current transformers shall conform in general to clause 15 of P-44.

4.3.6.2 For overcurrent protection and metering the current transformers shall have 400/200/5-5 transformers ratios.

4.3.6.3 The outdoor capacitor bank neutral current transformers shall be totally epoxy-resin covered or porcelain insulator type and completely weather proof. The primary current rating shall be 50A whereas the secondary current shall be 5A. The accuracy class shall be 5P20. The characteristics of insulator shall be as follows:

Min creepage distance	= 300mm
Dry arcing distance	= 150mm
Dry one minute Power Frequency withstand voltage	= 36kV
Lighting impulse withstand voltage	= 95kV

4.3.7 Voltage Transformers

The voltage transformer shall not be supplied. The secondary voltage of 110 Volts AC from the existing voltage transformer in the substation shall be used to operate the instruments and relays on the switchgear panels of the capacitor banks.

4.3.8 Instruments

The switchgear panel shall be provided with the follow-

ing instruments:

1. One voltmeter 0-15kV with selector switch
2. Three ammeters 0-250-500 Amps, one in each phase.

4.3.9 Control Wiring and Termination

The control cable and switchboard wiring cable shall conform to Wapda Specification P-100. The minimum size for voltage and current circuits shall be 2.5 sq. mm and 4 sq. mm respectively. The wire colour code and termination method shall be as per clause 18 of P-44:87.

4.3.10 Circuit Connection

Each panel shall have position for connection to outdoor capacitor bank through two 240mm² cables per phase. Space shall be provided for above cable connection with dry termination.

4.3.11 Tests

The switchgear panels shall be subjected to type and routine tests as listed in clause 22 of P-44:87. Certified type test reports may be accepted in lieu of the actual test.

5 STRUCTURE FOR CAPACITOR BANKS

5.1 General

The mounting structure shall be of extendable unit construction, each unit being suitable for 2400 kVAR capacitor bank with provision for mounting of fuses, cable terminations, insulators and rigid buses. The layout of the capacitor bank shall generally be in accordance with Drawing No. PDW/DF-383. The manufacturer shall offer alternate suitable design subject to approval of Wapda.

5.2 Material

All parts of the bank structure shall be made of hot dip galvanised steel sections having the following characteristics:

Tensile strength	41-56 kg/mm ²
Min. Yield point	23 kg/mm ²
Min. elongation	20% on 200mm gauge length

5.3 Construction Requirements

- 5.3.1 The steel structures shall be of bolted type construction and designed with sufficient stiffening and cross

bracing to adequately perform their functions under maximum conditions of loading and wind pressure of 150 kgs/sqm without any vibrations.

5.3.2 All steel parts including nuts and bolts shall be hot dip galvanised in accordance with Wapda Specification P-82:.. The average and minimum weight of zinc coating shall be 610 and 550 gm/sq meter respectively.

5.3.3 The capacitor bank shall generally be constructed in accordance with drawing No. PdW/DF-383 and shall meet the following requirements:

- i) Centre to centre distance of the capacitor unit 250mm
- ii) Minimum mounting height of the capacitor unit (bushing top) 2500mm
- iii) Minimum height of the busbar 3000mm

5.4 Tests

The steel structures shall be subjected to the following tests:

- i) Visual Examination
- ii) Verification of Dimensions as per approved manufacturer's drawings.
- iii) Galvanising tests as per Wapda Specification P-82.
- iv) Tensile Tests as per ISO/R-82.

6 BUS BARS

6.1 A set of three round or rectangular bus bars of 98% IACS electrical conductivity copper for connection to capacitors shall be provided. The size of bus bar shall be as per dwg. No. PDW/DF-383 (revised).

6.2 The manufacturer shall design the bus bars and joints so that temperature rise at joints and connections shall not be more than 40°C and shall submit all such design details with the bid.

6.3 The bus bars shall be of sufficient mechanical strength and rigidly supported over insulators as to withstand mechanical forces resulted from the short circuits.

6.4 All bus bars shall be insulated to prevent flashovers due to lizards and small birds etc; preferably with heat shrinkable tubing of polyolefine. Snap on PVC or equivalent material covers shall be provided at all joints and connectors. The thickness of insulation

	50 K	25 K
Dry one minute power frequency withstand voltage to ground	35kV	35kV
Wet one minute power frequency withstand voltage to ground	30kV	30kV
Temperature rise at rated current	40°C	40°C
Fuse link rating	50 K	25 K

7.4 Tests

- 7.4.1 All tests shall be carried out in accordance with IEC Publication IEC 549.
- 7.4.2 Certified type test reports may be accepted in lieu of the actual tests.
- 7.4.3 All fuses shall be subjected to routine tests by Wapda at the manufacturers works.

8 TECHNICAL DATA AND DRAWINGS

- 8.1 The manufacturer shall include in his offer complete engineering and test data with complete dimensional drawings, showing front, side and plan views of the complete capacitor bank and of individual parts. All leading dimensions and clearances in millimeters shall also be indicated.

Encls: Drawing No. PCW/DF-383(revised)

YK

shall be such as to withstand at least twice the rated voltage continuously. The manufacturer shall supply mechanical and electrical characteristics of the insulating materials.

- 5 All bus bars joints and connectors shall be tin or silver plated.
- 6 The bus bars shall be capable of being extended without difficulty on either side and provision shall be made for withstanding expansion and contraction of the bus bars and connections due to variations in temperature over a range of 80°C.

7 EXPULSION FUSE

- 7.1 The expulsion fuse for protection of the capacitors shall be outdoor type and shall be manufactured and tested in accordance with IEC Publication 549 and 282 and the requirements listed herein.

7.2 Constructional Requirements

- 7.2.1 The fuse shall generally be constructed for installation on switched capacitor banks as shown in general arrangement Drawing No. PDW/DF-383 (revised).
- 7.2.2 The design of the fuse shall be such that blown fuse is indicated and shall be detectable from the ground. Also there shall be no possibility of tracking and flashovers during its life time. The fuse length shall be replaceable type.
- 7.2.3 The contact design shall assure positive contact engagement and shall be tin or silver coated. The minimum thickness of silver coating shall be 20 microns.
- 7.2.4 The terminals shall be made of copper or brass materials and tin plated.
- 7.2.5 The standard fuse link for protection of 200 kVAR capacitor shall be 50K and for 100 kVAR capacitor shall be 25K. The time current characteristics of the fuse links shall be supplied.

7.3 Ratings

The fuse shall have the following ratings:

	50 K	25 K
Nominal voltage	11.5 kV	11.5 kV
Rated continuous current	50 Amps	25 Amps
Rated interruption current	5000 Amps	5000 Amps
Impulse withstand voltage to ground	95 kV	95 kV

ALUMINUM TUBING

FOR ADB-300C ONLY

CONTENTS

0. Foreword
1. Scope
2. Material
3. Dimensions
4. Requirements
5. Sampling
6. Tests
7. Packing

FOR ADB-300C ONLY

MANUAL

ALUMINUM TUBING

0 FOREWORD

- 0.1 This specification has been prepared by Design NTDC .
- 0.2 This specification is intended for the procurement of material and does not include all the necessary provisions of a contract.
- 0.3 This specification is subject to revision as and when required.

1 SCOPE

- 1.1 This specification describes Aluminum tubing for use as busbar in grid stations. The general intent of this specification is the supply of material equal to or superior to those actually described herein.

2 MATERIAL

- 2.1 The tubing shall be made from high conductivity hard-drawn Aluminium in accordance with 1050 serial alloy EN755-2 for tubes with 40 and 63 mm outer dia. The 3"SPS tube (SH40) should be in accordance with EN 573-1 having physical and mechanical properties as per EN 573-3, EN 755-1, 2 & 8 having a degree of purity of not less than 99 percent

Description	Value	Value	Value	Value	Value	Value
Outer dia mm	40	63	88.90	101.60	141.30	160
Tensile strength R_m (min)	10 kg/mm ²	10 kg/mm ²	25.48 kg/mm ²	25.48 kg/mm ²	25.48 kg/mm ²	25.48 kg/mm ²
0.2 Yield strength R_p (min)	7-12 kg/mm ²	7-12 kg/mm ²	20.39 kg/mm ²	20.39 kg/mm ²	20.39 kg/mm ²	20.39 kg/mm ²
Elongation (min)	6%	6%	8%	8%	8%	8%
Resistivity at 20°C	0.02874 Ω mm ² /m	0.02874 Ω mm ² /m	0.03 Ω mm ² /m	0.03 Ω mm ² /m	0.03 Ω mm ² /m	0.03 Ω mm ² /m

3 DIMENSIONS AND TOLERANCE

- 3.1 The tubing shall have following dimensions:

Description	Value	Value	Value	Value	Value	Value
Outer dia, mm	40	63	88.90	101.60	141.30	160
Wall thickness, mm	4	5	5	5.75	6.55	6.55
Length mm	12000	12000	12000	12000	12000	12000

- 3.2 The tolerance in dimensions shall be +/- 1 percent.

4 REQUIREMENTS

4 REQUIREMENTS

- 4.1 The tubing shall be commercially sound, straight and of uniform thickness throughout. It shall have smooth surface finish. The edges shall be rounded off and there shall be no cracks or burrs or sharp projections.

5 SAMPLING

- 5.1 The Aluminium tubings offered for inspection shall be divided into lots up to 10 units each. A sample of 10 tubings shall be drawn at random from each lot.
- 5.2 The selected samples shall be subjected to visual inspection and verification of dimensions. If the number of defective tubing is more than one, the lot shall be rejected.

6 TESTS

- 6.1 The following type of sample tests shall be carried out:

- i) Visual examination
- ii) Verification of dimensions
- iii) Tensile test
- iv) Resistivity test

6.2 Visual Examination

Individual items shall be visually examined for the defects given below:

Sr.No.	Examination	Defects
1.	Construction	i. Not of proper dimensions ii. Not of correct material iii. Any crack on the material
2.	Finish	i. Not free from roughness, sharp edges and projections which will interfere with the proper use of the article ii. Corner edges not rounded

6.3 Verification of Dimensions

The dimensions shall conform to clause 3

6.4 Tensile Test

The Aluminium tubing shall be subjected to tensile test in accordance with EN 573-3, EN 755-1, 2 & 8. The values shall be as specified in clause 2.1

6.5 Resistivity Test

The electrical resistance of tube shall be measured on one sample piece to an accuracy of at least one part in a thousand. The length of the specimen shall be sufficient to give the accuracy required and shall be suitable for the method of testing used. The resistance shall be measured at a temperature which shall not be less than 10⁰ C and not more than 30⁰ C. The measured resistance shall be corrected to the value at 20⁰ C by means of the formula.

$$R_{20} = R_T \left(\frac{1}{1 + \alpha (T - 20)} \right)$$

Where T = Temperature of measurement in ⁰C

R_T = Resistance at T⁰ C

R₂₀ = Resistance at 20⁰ C

And α = Temperature coefficient of resistance (= 0.00011 Ohm mm²/m)

7 PACKING

The tubing shall be bundled and banded in groups of three. The banding shall be at three locations with binding strap. The bundles shall be packed in wooden crates, capable of withstanding the rigors of transportation and handling.

FOR ADB-300C ONLY

SUPPORTING STEEL STRUCTURES
FOR GRID STATION EQUIPMENT



PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY
DESIGN DEPARTMENT (ISG)

C O N T E N T S

0. Foreword
1. Scope
2. Steel
3. Nuts and Bolts
4. Fabrication
5. Galvanizing
6. Sign Plates
7. Tests
8. Acceptance and Rejections
9. Test Methods
10. Packing
11. Drawings.

PRINTING HISTORY

First draft on March, 1986.

First revised approved edition Nov. 1991.

EPADS

SPECIFICATION P-182-91
SUPPORTING STEEL STRUCTURES
FOR GRID STATION EQUIPMENT

0 FORWARD

0.1 This standard has been introduced by WAPDA and has been prepared by the Standard & Research Section of the office of the Chief Engineer Design (S&R).

0.2 This standard is intended only for the purpose of technical specification to facilitate fabrication of supporting steel structures for Grid Station Equipment and does not include provision of contract.

0.3 This standard is prepared to resolve difficulties experienced by the field staff in replacing gridstation switchyard equipment viz isolators, circuit breakers, CTs, PTs & L.As which is a problematic and time consuming job requiring preparation of new drawings accommodating the foundations within the limited available space and minimum of power supply interruptions. To overcome these problems, steel supporting structures have been standardised which will result in rapid on-site replacement of the equipment irrespective of its type or make, minimising interruptions to power supply and financial saving as well.

0.4 This specification is subject to periodic revision as and when required.

1 SCOPE

1.1 This specification covers fabrication, galvanizing, testing and packing of supporting steel structures for Grid Station equipment.

2 STEEL

In fabricating structures the contractor shall use structural steels having chemical composition and tensile properties as specified. The steel shall be made either by open hearth, basic oxygen or electric furnace process.

2.2 Requirement

2.2.1 Chemical Composition

2.2.1.1 The steels shall conform to the following chemical composition.

Element	Composition Percent	
	Mild Steel	High Tensile
Carbon	0.26	0.30
Manganese	0.85	1.35
Phosphorus Max	0.04	0.04
Sulphur Max	0.05	0.05

2.2.1.2 The Contractor may propose structural steel conforming to latest applicable industry standards specification and recommended practices having different chemical composition provided such steel has the yield point and min. elongation as specified in clause 2.2.2.3. In this case the type and specifications of steel will have to be approved by WAPDA. The following information shall be supplied by the Contractor:

- Ultimate tensile strength
- Minimum Guaranteed yield strength
- Minimum elongation
- Detail of test piece
- Chemical Composition

2.2.2 Tensile Properties

The steels shall conform to the requirements as to tensile properties prescribed below.

	Mild Steel	High Tensile Steel
Tensile strength kg/mm^2		
Minimum	40	50
Maximum	56	80
Yield points kg/mm^2		
Minimum	26	35
Elongation in 200mm gauge length percent, minimum		
Upto 8mm thickness	16	15
Over 8mm thickness	20	18

2.2.3 Bend Test Requirement

The steels shall withstand the following Bend Test Requirements.

Type of Material	Thickness of Material	Ratio of bend diameter to thickness for specimen
Mild Steel	Upto 25mm	1
High Tensile Steel	Upto 25mm	2

3 NUTS AND BOLTS

All bolts and nuts shall be hexagonal type made from mild steel to WAPDA Specification P-19. The bolts shall be provided with one flat washer under each nut. All grouting bolts for fixing the structure to the foundation shall be from High Tensile Steel. Washers shall not be less than 5 mm thickness and only one thickness of washer shall be used. The diameter of the washer hole shall be 1.5 mm larger than the bolt diameter and the outside diameter of washer shall not be less than 1.5 mm larger than the diagonal of the nut. All connection bolts, nuts, lock nuts and washers shall be furnished in excess of actual number required in quantity at least 5% greater than actual requirements sufficient to compensate for normal field losses.

4 FABRICATION

4.1 All fabrication shall be performed according to the following drawings:

- | | |
|--|--|
| 1. Supporting steel structure for circuit breaker | Dwg. No. PDW/TS-3217
or
PDW/TS-3198 |
| 2. Supporting steel structure for Isolator
(Parallel Arrangement) | PDW/TS-3201
or
(Serial Arrangement) PDW/TS-3219
PDW/TS-3218 |
| 3. Supporting steel structure for Current & Voltage Transformers | PDW/TS-3204 |
| 4. Supporting steel structure for Lightning Arrester | PDW/TS-3203 |

The dimensions indicated on the above mentioned drawings are for guidance only. The manufacturer shall supply their own design drawings alongwith foundation drawings with his offer without affecting the interchangeability requirement of the foundation bolts as indicated in detail 'B' of the drawings.

All structural material shall be straight and cleaned of all rust and dirt before being laid out or worked in any manner. Necessary straightening shall be done in a manner that will not injure the material. Sharp kinks or bends shall be cause for rejection.

4.2 In shearing and punching only sharp dies and punches shall be used, shearing and punching shall be done to gauge and no variation in length shall be allowed except where otherwise noted on the shop detail drawing. No

variation shall be allowed in a group or cluster of holes, and the centre to centre distance between the end holes in a piece shall not vary more than 1 mm.

3. Bolt holes shall be 1.5 mm to 2 mm larger than the normal bolt diameter. Bolt holes shall be cylindrical and perpendicular to members, shall be cleaned out and without torn or ragged edges and shall be free of burrs, rough edges, and punch cracks. Holes shall be accurately located and well matched.

For the high tensile steel yield point equal or higher than 35 kg/cm² holes shall be directly drilled at the definitive diameter or punched and reamed out. The difference between the punched and reamed diameter shall be a minimum 4 mm.

4. Welding
All welding shall be performed in accordance with the latest edition of the "Code for Arc and Gas welding in Building Construction," as formulated by the American Welding Society. A shield-arc welding process shall be used. All welds shall be as shown on the drawings and shall be made in such a manner that residual shrinkage stresses will be reduced to a minimum.

5. Marking

All structural members shall be marked with the correct designation shown on the shop drawing. Marking shall be done by stamping the members prior to galvanizing with numerals or letters of 12 mm minimum height, and shall be clearly legible after galvanizing.

6. Tolerances

Ease of assembling the structure in the field is of utmost importance. The structure shall be so manufactured that all members carrying the same mark shall be interchangeable when assembled. The structure shall fit without undue pressing and no reaming or drifting of holes shall be required.

The Contractor shall be responsible for the correct fitting of all parts and shall replace free of cost any defective materials discovered during erection and shall pay all costs of the correction in the field of any errors not previously discovered.

The Cross sectional area or weight of each structural size, shape shall not vary more than 2.5% from the theoretical or specified amounts.

The permissible variation from dimensions for structural size steel shapes shall not exceed the prescribed limits in ASTM A6.

Diameter of a punch hole shall not vary in all the thickness of the member or gusset. The difference between both hole diameters on each face of the piece shall be lower than the tenth of the punch thickness, with a maximum of 1.2 mm. For the thickness lower than 5 mm, maximum difference is fixed at 3 mm.

5

GALVANIZING

5.1

After all the shop work is complete, all structural materials shall be hot dip galvanized to conform to WAPDA Specification P-82. Prior to galvanizing the material shall be drilled, punched, cut or otherwise fabricated as required, freed from burrs, cleaned and thoroughly prepared, so that the zinc coating shall be adherent, dense, smooth, continuous and uniform. It shall also be completely free from lumps, blisters, uncoated or porous spots, black spots, dross, flux or any other imperfection. All structural steel warped by the galvanizing process shall be straightened by re-rolling or pressing. The material shall not be hammered or otherwise straightened in a manner which may injure the galvanized coating.

All bolts and nuts shall be hot dip galvanized including threaded portions in accordance with WAPDA Specification P-82. Nuts shall have finger tight fit on bolts and develop the full strength of bolts.

5.2

Brittleness

All necessary precautions shall be taken in the composition of steel and in its fabrication and preparation for galvanizing to prevent embrittlement of any item or parts of items including bolts and nuts. For detecting embrittlement WAPDA Specification P-82 shall be followed.

6

SIGN PLATES

All the sign plates shall be fired ceramic surfaces on steel base plates. The ceramic enamel shall completely cover the front and back of the plates and also the edges of plates and the interior edges of the attachment holes. The enamel around the holes shall be protected by means of fibre washers.

7

TESTS

7.1

Manufacturer's Tests

The Manufacturer shall select two samples from each heat to carry out the following tests to satisfy himself that the products comply with the specification.

7.1.1 For Section and Plates

1. Chemical Composition (Ladle Analysis)
2. Tensile Tests
3. Bend Tests

7.1.2 For Nuts and Bolts

1. Proof Load test
 2. Ultimate Tensile Strength test")
 3. Ultimate tensile strength test)
under eccentric load
 4. Cold bend test)
 5. Hardness test
 6. Galvanizing test
- According to WAPDA Specification P-19

The Manufacturer shall maintain a record of tests carried out by him for examination by Inspector.

7.2 Acceptance Tests

The following acceptance tests shall be carried out.

7.2.1 For Section and Plates

1. Visual examination
2. Verification of dimensions and weights
3. Assembly tests
4. Chemical composition (check analysis)
5. Tensile tests
6. Bend Tests
7. Impact tests
8. Galvanizing tests

7.2.2 For Nuts and Bolts

1. Verifications of dimensions
 2. Visual inspection
 3. Proof load test
 4. Ultimate tensile strength test
 5. Galvanizing test
- According to WAPDA Specification P-19

The Contractor shall render all necessary assistance to the Inspector in carrying out above mentioned tests.

8.1 Chemical Composition

To indicate adequately, the chemical composition of a heat or lot, the minimum number of samples selected to represent the heat shall be as follows:

	<u>No. of Samples</u>
50 tons or more	2
50 tons or less	1

If a piece fails to meet the requirement, the lot shall be rejected.

8.2 Tensile Properties

Two tension and two bend tests shall be made from each heat and strength unless the finished material from a heat and strength gradation is less than 50 tons, where one tension and one bend test will be sufficient. However when material from one heat and strength gradation differs 9 mm in thickness, one tension and one bend test shall be made from both the thickness and the thinnest material rolled in that strength gradation regardless of weight represented.

Two tension and two bend tests shall be made on every finished shape for every 10 tons.

If a test piece fails to meet the requirement the lot shall be rejected.

8.3 Assembly Test

One structure of each type shall be tested.

8.4 Galvanising

The acceptance and rejection on the basis of galvanizing test will be according to WAPDA Specification P-82.

8.5 Dimensional and Finish Defects

The number of sample units inspected shall be equal to the first sample size given in Table-V. If the number of defective units found in the first sample is equal to less than the first acceptance number, the lot shall be acceptable. If the number of defectives found in the first sample is equal to or greater than the first rejection number, the lot shall be rejected. If the no of defectives found in the first sample is between the first acceptances and rejection number, a second sample of the size given by the plan shall be inspected. The number of defectives found in the first and the second samples shall be accumulated. If the cumulative number of defectives is equal to or greater than the second rejection number, the lot shall be rejected.

8 ACCEPTANCE AND REJECTION

8.1 Chemical Composition

To indicate adequately, the chemical composition of a heat or lot, the minimum number of samples selected to represent the heat shall be as follows:

	<u>No. of Samples</u>
50 tons or more	2
50 tons or less	1

If a piece fails to meet the requirement, the lot shall be rejected.

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9.7.2 Test samples for determination of compliance to the tests specified shall be performed in accordance with WAPDA Specification P-83 and shall be taken from each lot. The lot shall consist of a quantity as specified in the relevant specification.

9.8 Impact Tests

The test shall be performed in accordance with ISO 630.

10 PACKING

10.1 All material shall be suitably packed to final destination. Heavy pieces may be packed separately or in bundles. With all pieces in the bundle having the same mark of the same structure. All bundles of angles shall be secured, fastened at three or more locations with galvanized steel binding straps not smaller than 1x20 mm of 1350 kg. tensile strength.

10.2 All small pieces such as bolts, washers, plates and other small fittings shall be packed in strong wooden boxes with a gross weight of 50 to 100 kgs. The boxes should be strong enough to withstand rough handling. Bolts of different sizes and lengths shall be packed in separate bags before boxing. Groups of packages or bundles may be packed in the same wooden boxes. In general, separate packages less than about 50 kg. each, should not be used.

11 DRAWINGS

11.1 The contractor will be supplied with single line diagram indicating the various dimensions, angle sizes used, sizes of bolts used, type of steel and various standards/process to be followed for fabrication and galvanizing of the structure.

11.2 After placing of contract, the contractor shall submit for approval, the following drawings based on single line diagram provided in the clause.

11.2.1 Shop Details Drawings

The detailed drawings shall show shop details including of dimensions, shearing, punching, bevel cutting, bending and identification mark and weight for each member.

11.2.2 Erection Drawings

Erection drawings showing each member with its identification mark, location and position of the outstanding leg of angles, number and size of connection bolts and all erection details.

11.2.3 Footing Installation Drawings

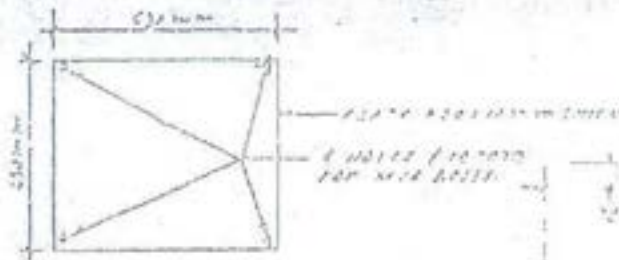
Footings erection drawings showing each member with its identification mark and number and size of connection bolts, and all dimensions required for the proper setting and positioning of anchor bolts with relation to the centre of the structure.

11.2.4 Bills of Material

Bills of material for each structure shall show the quantity, kind, size, length, weight and assembly mark for each member, including bolts, washers, plates and all fittings complete for each structure.

- Note:
- i) The scope of supply includes the foundation bolts (Rag Bolts) for grouting the steel structures.
 - ii) Suitable clamps shall be provided at appropriate places on the structures to hold the earth wires of the equipment at every 1000 mm.
 - iii) the following drawings are enclosed herewith:

1.	Dwg. No.	PDW/TS-320	1st revised dated 14.9.91)
2.	"	"	PDW/TS-3204 - do -
3.	"	"	PDW/TS-3219 - do -
4.	"	"	PDW/TS-3217 - do -
5.	"	"	PDW/TS-3218 - do -
6.	"	"	PDW/TS-3198 - do -
7.	"	"	PDW/TS-3201 - do -



SECTION A-A

VOLTAGE	A
33 KV	2320
66 KV	3135
132 KV	4310



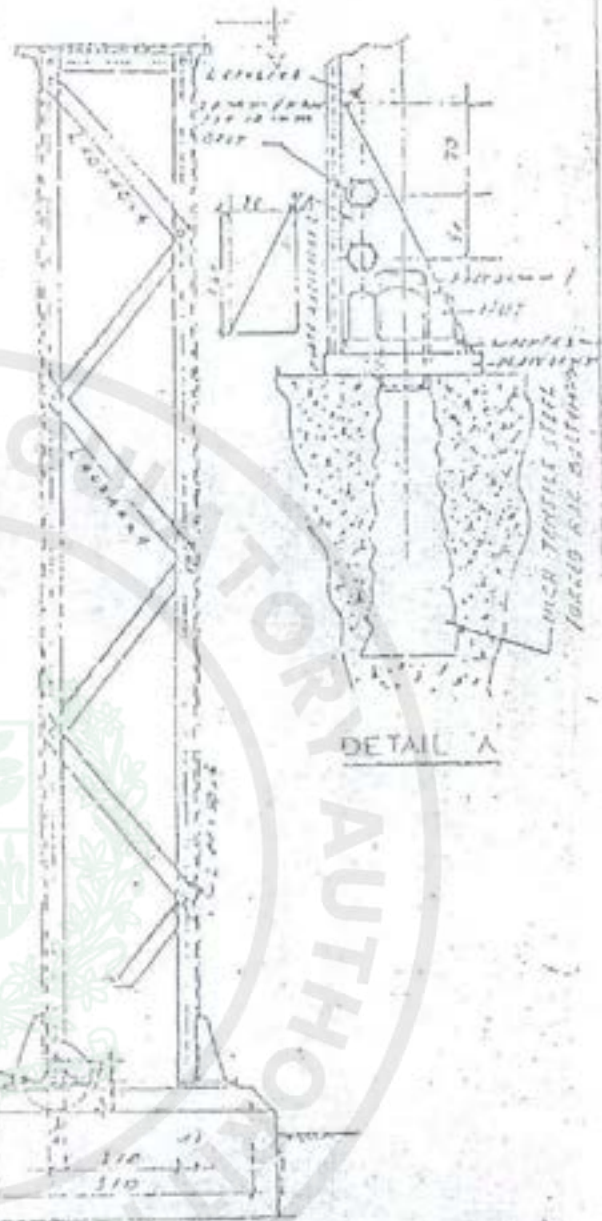
DETAIL B

NOTES

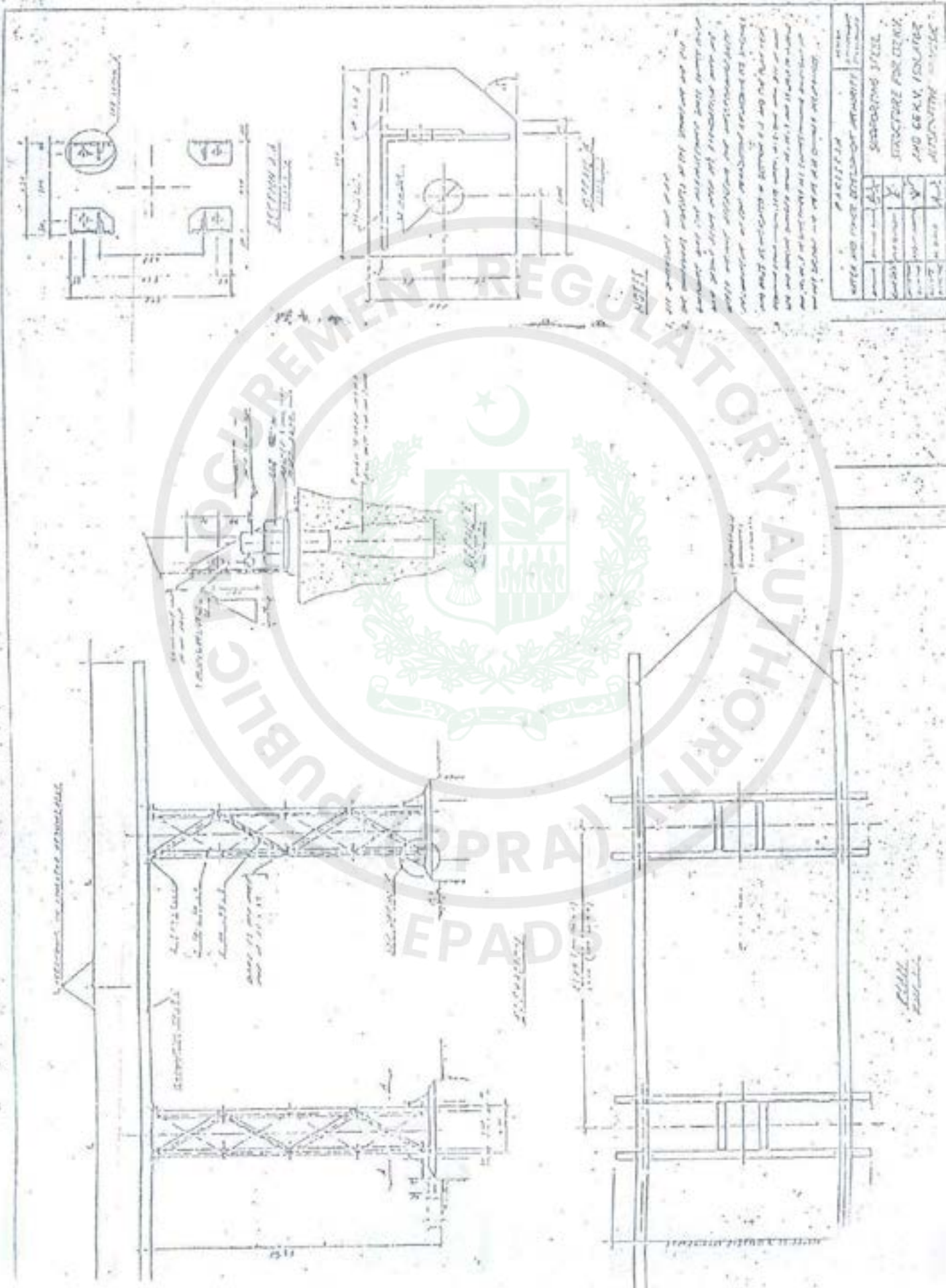
1. ALL DIMENSIONS ARE IN MM.
2. THE DIMENSIONS INDICATED ON THE STRUCTURE ARE FOR GUIDANCE ONLY. THE MANUFACTURER SHALL INTERFERE WITH THE FOUNDATION DESIGN WITHIN THE LIMITS WITHOUT AFFECTING THE INTERFERABILITY REQUIREMENT OF THE FOUNDATION BASE AS INDICATED IN THE DRAWING.
3. GENERAL PROVISIONS SHALL BE AS PER THE REQUIREMENTS OF THE SPECIFICATION.



DETAIL A



PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY				DESIGN DEPARTMENT (IT & G) POWER
DRAWN	APPROVED	DATE	SUPPORTING STEEL STRUCTURE FOR LIGHTING ARRESTER	
CHECKED	MAINTENANCE	DATE		
ASSISTANT ENGINEER	MANAGER	DATE		
DUTY OFFICER	IN CHARGE	DATE		
1/10/86	REDRAWN AS PER NOTE 3	DIRECTOR	IN CHARGE	SCALE: N.T.S.
NO. DATE	REVISIONS	BY		DATE: 28.1.86
				DWG. NO. PBH/TS. 3205



PART 1.1		PART 1.2	
WATER AND POWER DEVELOPMENT AUTHORITY		STRUCTURE FOR DRAINAGE AND GROUND ISOLATION	
Item No.	1.1.1	Item No.	1.2.1
Description	Water and Power Development Authority	Description	Structure for Drainage and Ground Isolation
Quantity	1.00	Quantity	1.00
Unit	1.00	Unit	1.00
Rate	1.00	Rate	1.00
Total	1.00	Total	1.00



NOTES

1. The structure is to be erected on a concrete foundation.
2. The structure is to be erected on a concrete foundation.
3. The structure is to be erected on a concrete foundation.
4. The structure is to be erected on a concrete foundation.
5. The structure is to be erected on a concrete foundation.
6. The structure is to be erected on a concrete foundation.
7. The structure is to be erected on a concrete foundation.
8. The structure is to be erected on a concrete foundation.
9. The structure is to be erected on a concrete foundation.
10. The structure is to be erected on a concrete foundation.



PROJECT		REVISION		DATE	
NO.	DESCRIPTION	NO.	DESCRIPTION	NO.	DESCRIPTION
1	STRUCTURE FOR 132KV	1	STRUCTURE FOR 132KV	1	STRUCTURE FOR 132KV
2	STRUCTURE FOR 132KV	2	STRUCTURE FOR 132KV	2	STRUCTURE FOR 132KV
3	STRUCTURE FOR 132KV	3	STRUCTURE FOR 132KV	3	STRUCTURE FOR 132KV
4	STRUCTURE FOR 132KV	4	STRUCTURE FOR 132KV	4	STRUCTURE FOR 132KV
5	STRUCTURE FOR 132KV	5	STRUCTURE FOR 132KV	5	STRUCTURE FOR 132KV
6	STRUCTURE FOR 132KV	6	STRUCTURE FOR 132KV	6	STRUCTURE FOR 132KV
7	STRUCTURE FOR 132KV	7	STRUCTURE FOR 132KV	7	STRUCTURE FOR 132KV
8	STRUCTURE FOR 132KV	8	STRUCTURE FOR 132KV	8	STRUCTURE FOR 132KV
9	STRUCTURE FOR 132KV	9	STRUCTURE FOR 132KV	9	STRUCTURE FOR 132KV
10	STRUCTURE FOR 132KV	10	STRUCTURE FOR 132KV	10	STRUCTURE FOR 132KV

SPECIFICATION P-82: 81
(UDC NO. 669, 586.5)

ZINC COATINGS



PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY
DESIGN DEPARTMENT, NTDC

C O N T E N T S

0. Foreword
1. Scope
2. Materials
3. Weight and Thickness of Zinc Coatings
4. Test Methods
5. Tests
6. Test Samples, Acceptance and Rejection
7. Passivation Treatment

PRINTING HISTROY

First Edition March, 1971

Second Edition August, 1980

Third Edition July, 1981

SPECIFICATION P-82: 81
(UDC No. 669.586.5)

Z I N C C O A T I N G S

0. **FOREWORD**

- 0.1 This specification has been prepared by the Design Department (T&G) of Power Wing, WAPDA and lays down specification for protective zinc coatings applied on iron and steel.
- 0.2 This standard is intended only for the purpose of procurement of materials and does not include the provisions of a contract.
- 0.3 This standard is subject to periodical revisions as and when required.
- 0.4 This specification is mainly based on ASTM A.90 and A.219, A.153.68, A-164.55, A.525.67, A.121.66, B.261-63, BS.443 : 1961.

1. **SCOPE**

- 1.1 The specification lays down test for the zinc coatings which has been deposited either by Hot Dip Method or by Electrodeposit Method on the articles as classified below. It also covers the weight of zinc coatings which shall be required per square meter of the surface area or its thickness.

Classification	Description of Articles
Class A-Fabricated products	Fabricated products from rolled, pressed and forged steel shapes, channels, angle iron, T shapes, plates, bars and strips e.g. structural poles, tubular poles, pipes channels and angle iron for platforms of pole mounting transformers, capacitors and voltage regulators, lattice steel cross bracket etc.
Class B-Castings	Castings; iron, malleable iron and steel.
Class C-Rolled pressed and forged articles	Rolled, pressed and forged articles such as insulator pins, anchor-shackle, eye-nuts, clamps, cotter pins, thimbles, covers, deadend clamps etc.
Class D-Nuts and Bolts etc.	Nuts, bolts, washers, nails, rivets, screws and similar articles.
Class E-Steel Wires	Steel structural strands, steel wire strands for overhead transmission lines, guys, messengers, spur wires, tie wires and barbed wires.
Class F-Steel Sheets	Steel sheets of all types and sizes.

2. MATERIAL

- 2.1 The zinc used in electro-depositing and not dip galvanizing shall be slab and shall conform to the following chemical composition:

Lead Max	1.6	%
Iron Max	0.05	%
Cadmium Max	0.50	%
Zinc Min	98.0	%

3. WEIGHT AND THICKNESS OF ZINC COATINGS

- 3.1 The weight of zinc coatings by hot dip method on various articles shall be as per Table-I below or otherwise specified in the relevant standards.

TABLE-1 WEIGHT OF ZINC COATINGS

Classification	Description of Articles	Wt. of Zinc Coatings	
		Individual Samples gm/sqm.	Average of 3 Samples gm/sqm.
Class A Fabricated Products	Fabricated products from rolled pressed and forged steel shapes, channels and angle iron, T-shapes, plates bars and strips e.g. structural poles, tubular poles, pipes, channel and angle iron for platform of pole mounting transformers, capacitors and voltage regulators, lattice steel cross arm bracket etc.		
	i) When the thickness of steel is 3mm to 6mm	550	610
	ii) 6mm and heavier material	610	700
	iii) Pipe for service-mast only	350	400
	iv) Distribution transformer station hardware & cross arm braces	450	500
Class B Castings	Castings, cast iron malleable iron and steel	550	610

Classification	Description of Articles	Wt. of Zinc Coatings	
		Individual Samples gm/sqm.	Average of 3 Sample gm/sqm.
Class C Rolled, pressed and forged articles	Rolled, pressed and forged articles such as anchor shackle eye- nuts, clamps cotter pings, thimbles, covers dead-end clamps etc.		
	i) 4.75mm and over in thickness and over 200mm in length	550	610
	ii) Under 4.75mm in thickness and over 200mm in length	380	460
	iii) 200mm and under in length and any thickness	330	400
	iv) Hardware of service- mast other than pipe, insulator pins & D- shackle assembly	450	500
Class D Nuts and Bolts etc			
	i) Bolts, nuts and drive screws (over 9.5mm in diameter) and similar articles, transmission tower bolts, washers 5mm and over in thickness	305	380
	ii) Screws and bolts (9.5mm and under in diameter) rivets, nails and similar articles, washers under 5mm in thickness	260	305

Class E

Steel Wires

The weight of zinc coating on steel structural strand, steel wire stand for overhead transmission lines, guys, messengers, spur wires and tie wires for similar purposes shall be as under:

<u>Stranded Wire dia mm</u>			<u>Weight of Zinc coating (gm/sqm)</u>
0.20	to	0.30	45
0.31	to	0.39	60
0.40	to	0.50	90
0.50	to	0.79	120
0.75	to	1.00	150
1.00	to	1.50	170
1.50	to	2.00	200
2.01	to	2.50	225
2.50	to	3.00	250
3.01	to	5.00	275
5.01	and larger		300

- i) The minimum weight of zinc coating in gm/sqm on barbed wires shall be as under

<u>dia mm</u>		
2.5	Including and above	250.00
2.0	to 2.4 mm	200.00
1.5	to 1.9 mm	1500.00

Class F

Steel Sheets

The minimum weight of zinc coating in gm/sqm on galvanized steel sheets shall be as under:

Coating Class	Average of Triple Spot Test	Min. Single Spot Test
2.75	716.00	610.00
2.5	640.00	550.00
2.25	564.0	490.00
2.00	503.00	427.00
1.75	427.00	366.00
1.50	350.00	305.00
1.25 commercial	274.00	244.00

3.2 Thickness of Zinc Coating by Electrodeposit Method

- 3.2.1 The minimum and average thickness of zinc coating, except threaded parts, by electrodepositing on steel articles shall be as under:

Coating Class	Local Thickness (mm)	Average Thickness (mm)	Application Conditions
Class G	.025	.038	Outdoor
Class H	.008	.013	Indoor

- 3.2.2 The minimum and average thickness of zinc coating on threaded parts of steel articles shall be as under:

Diameter (mm)			Average thickness minimum (mm)	Average thickness maximum (mm)
1.50	to	6.00	0.005	0.0065
6.01	to	12.00	0.0065	0.008
12.01	to	20.00	0.008	0.010

- 3.3 One gram of zinc per square meter of surface, based upon mathematical calculation, shall correspond to a coating thickness of 0.00014 mm.

4. TEST METHOD

4.1 Weight of Zinc Coating on Galvanized Sheets

4.1.1 Test Samples

Test specimens shall be (50 ± 0.25) mm square, except for material narrower than 50mm wide, in which case test specimens shall be of such a length that the area of the specimen is 2500 sq mm. When it is not possible to secure a specimen of 2500 sq mm in area, a smaller size may be used but it is recommended that a specimen of not less than 1,300 sq mm be used.

- 4.1.1.2 The specimens shall be clean, they shall be washed with solvent naphtha or other suitable solvent, then with alcohol and dried thoroughly.

4.1.2 Test Method

4.1.2.1 Reagents

- i) Antimony chloride solution:

Dissolve 20 grams of Sb_2O_3 or 32 gm of $SbCl_3$ in 1000 ml of HCl (sp.g. 1.19)

- 4.1.2.2 Weigh the specimens obtained in accordance with 4.1.1 to the nearest 0.01 g. After weighing immerse each specimen singly in a solution made by adding 5 ml of antimony chloride to 100 ml of HCl (specific gravity 1.19) to cover the specimen and allow to remain therein until the violent evolution of Hydrogen has ceased and only a few bubbles are being evolved. This requires about 15 to 30 sec. The same solution may be used repeatedly until the time required for stripping becomes inconveniently long. The temperature of the stripping solution shall at no time exceed 38 °C. After stripping, wash the specimen by scrubbing them under running water, dip in hot water and wipe or blow dry. Again weigh the specimen to the nearest 0.01 g.

4.1.2.3 Calculations

- i) The loss in weight represents the weight of zinc coating in grams on the samples, to find the weight of zinc coating per sq meter proceed as follows:

$$\text{Wt of coating in grams per meter of steel surface} = \frac{\text{Loss in Wt. in grams} \times 10^6}{A}$$

Where A – Area of stripped sample in sq mm.

4.2 Weight of Zinc Coating on Galvanized Wire

4.2.1 Test Sample

- 4.2.1.1 The specimens of galvanized wire may be of any length over 300 mm, but preferably about 600 mm. Where a continuous length is not available, shorter specimens totaling 300mm but preferably 600 mm shall be used.

- 4.2.1.2 The specimen shall be cleaned by washing with solvent naphtha or other suitable solvent, then rinsed with Alcohol and dried thoroughly.

4.2.2 Test Method

- 4.2.2.1 Test method shall be the same as described in clause 4.1.2.

4.2.3 Test Results

- 4.2.3.1 Calculate the weight of zinc coating as follow:

$$C = \frac{W1 - W2}{W2} \times d \times M$$

Where	C	=	Wt. of zinc coating in grams per sqm
	W1	=	Original weight of specimen in grams
	W2	=	Weight of stripped specimen in grams
	M	=	a constant = 1958
	d	=	diameter of stripped wire in mm

4.3 Weight of Zinc Coating on Articles Covered under Class A, B, C & D

4.3.1 Test Samples

- i) Samples for weight of coating determination, shall be selected in accordance with clause 6.4 or as specified in the relevant specification.
- ii) In the case of threaded articles, such as bolts and screws, the determination shall be made on a portion of the article that does not include any thread.
- iii) The specimens shall be cleaned by washing with solvent naphtha or other suitable solvent, then rinsed with Alcohol and dried.

4.3.2 Test Procedure

The procedure shall be the same as described in clause 4.1.2.

4.3.3 Test Results

- 4.3.3.1 Determine the total coated area of the specimen to the nearest 5 sq mm, alternatively for specimens of uniform thickness of base metal, such as piece of plate or pipe, determine the average thickness of the specimen to the nearest 0.25 mm.

4.3.3.2 Calculation

Calculate the weight of zinc coating by using the formula:

$$C = \frac{W1 + W2}{A} \times N$$

Where

C	=	Wt of zinc coating in gm/sqm of surface
W1	=	Original wt of specimen in grams
W2	=	Weight of stripped specimen in grams
A	=	Coated area of the specimen in sq mm.
N	=	A constant = (1000/400)

- (b) If the specimen has a uniform thickness of base metal, the weight of the zinc coating may be calculated using the following formula:

$$C = \frac{W1 - W2}{W2} \times G \times Z$$

Where

C	=	Wt of zinc coating in gm/sqm of the surface
W1	=	Original weight of the specimen in grams
W2	=	Weight of stripped specimen in grams
G	=	Thickness of stripped specimens in mm
Z	=	A constant = 3935

4.4 Test for Thickness of Electrodeposit Coating

4.4.1 Microscopic Test

The thickness of coating shall be determined on cross-sections taken perpendicular to the significant surfaces by the microscopic method described in the methods given below:

4.4.2 Test Specimens

4.4.2.1 To determine compliance with a specified minimum thickness of electrodeposited zinc, section the specimen at one or more significant surface where such a minimum may be expected.

4.4.3 Test Method

4.4.3.1 Hold the specimen rigidly and in such a position that the surface to be tested is perpendicular to the flat surface that is to be ground and polished (A deviation of 10 degrees from normal introduces an error of about 2% in thickness). The pieces may be plated first with a relatively thick coating of copper to protect the edges during grinding and polishing. On zinc deposit the first layer of copper from a cyanide solution after which, if desired, an acid copper solution may be used.

4.4.3.2 Grind and polish the section to be examined by regular metallographic methods, using successively finer abrasives the last being no coarser than 500 mesh. Polish zinc coating with minimum pressure in the direction from the hard basis metal to the soft coating, and alternatively at 45° and 135° angle to the plated surface.

4.4.3.3 Then treat the surface in such a manner as to obtain the maximum contrast between the coatings and the adjacent metals. Obtain such contrast by etching either the coating or the adjacent metal by an appropriate reagent. Suitable etching is desirable even when a contrast exists, since it will remove any soft metal that may have spread over a harder metal.

4.4.3.4 The following typical reagents are suitable for etching plated coatings:

Chromic Acid (H ₂ CrO ₄)	200	g/litre
Sodium Sulphate Na ₂ SO ₄	15	g/litre

4.4.3.5 Measure the thickness of coating at any desired point on the exposed section by either of the methods described below:

- i) Measure the thickness with a filer micrometer ocular that has been calibrated in order to determine the value of the unit scale division against a scale graduated so accurately that the error will not exceed 2% for example: the scale may be graduated to 0.01 mm.

- ii) Project the image of the specimen especially of those specimens having very thin coating, at a known and properly calibrated magnification on the ground glass focusing plane of the camera of a metallographic microscope. Measure the width of the projected line of deposit with a graduated linear scale, the reading divided by the magnification shall give the thickness of the coating.

4.5 Adherence of the Coating Tests

4.5.1 Galvanized Sheets

4.5.1.1 Galvanized steel sheets shall withstand a bend through 180° in any direction without flaking of coating on the outside surface.

4.5.1.2 The sample under test shall be gripped in a hand operated vice with smooth jaws and shall be bent through 180° over a mandrel twice as thick as the sample if weight of zinc coating is equal or more than 525 grams/sq.m. The sample shall be folded over a mandrel equal to the thickness of sample if the weight of zinc coating is less than 525 grams/sq.m.

4.5.2 Galvanized Wire

4.5.2.1 Zinc coated wire shall be capable of being wrapped at a rate not exceeding 15 turns per minute in a close helices of at least two turns around a cylindrical mandrel equal to three times the nominal diameter of wire under test, without cracking or flaking the zinc coating to such an extent that any zinc can be removed by rubbing with the bare fingers.

4.5.3 Articles Covered under Class A, Class B and C Heavy Materials

4.5.3.1 The pivoted hammer may be used to determine adherence of zinc coating on steel products 8 mm thick and heavier covered under class A, B & C. This test is applicable to flat surfaces only and shall not be used on round and curved surfaces. The hammer used shall conform to fig 4. The hammer blow shall be controlled by clamping or holding the pivoted base of the handle firmly on a horizontal surface of the galvanized member and allowing the hammer head to swing freely through an arc from vertical position to strike the horizontal surface. As illustrated in fig 2 the test shall consist of two or more standard blows forming parallel impressions with 6.5 mm spacing along a common axis so located that no part of an impression shall be closer than 13.0 mm to the edge of the member. Removal or lifting of the coating in the area between the impressions shall constitute failure. An extruded ridge less than 3 mm wide shall be disregarded. The specimen shall be tested in several places throughout its length.

4.5.4 Articles Covered under Class A, Class B & Class C Small and Light Materials

4.5.4.1 Small and light materials which are liable to deflect or deform under the hammer blow and curved or round articles which cannot be hammered properly should be tested by this method.

4.5.4.2 The adherence of zinc coating to the surface of the base metal shall be determined by cutting or prying with a stout knife, applied with considerable pressure in a manner tending to remove a portion of the coating. It shall only be possible to remove small particles of the coating by paring or whittling and it shall not be possible to peel any portion of the coating so as to expose the base metal.

4.6 Uniformity of Coating Test

4.6.1 Test Solution

4.6.1.1 The copper sulphate solution shall be made by dissolving approximately 36 parts by weight of commercial copper sulphate crystals in 100 parts by weight of distilled water. Heat may be used to complete the solution of copper sulphate crystals. If heated, the solution shall be allowed to cool. The solution shall then be agitated with an excess of powdered cupric hydroxide $\text{Cu}(\text{OH})_2$ about 0.81 gms/litre of solution. The presence of an excess of cupric hydroxide will be shown by the sediment of this reagent at the bottom of the vessel. The neutralized solution shall be allowed to stand for 24 hours and then filtered or decanted.

4.6.1.2 The test solution shall have a specific gravity of 1.186 at 18°C. To adjust a solution of improper specific gravity, add distilled water when the specific gravity is high, and add a copper sulphate solution of a higher specific gravity when the test solution is low in specific gravity.

4.6.1.3 Wire specimens shall be tested in a glass container at least 50mm in inside diameter for 2.5 mm dia wire and smaller, and at least 75.0mm in inside diameter for wire larger in diameter than 2.5 mm dia. The container shall be filled with fresh test solution to a depth of at least 100.0 mm. This quantity of solution shall be used for the simultaneous testing of one to seven test specimens. The solution shall be discarded after completion of the test and fresh solution used for any additional tests.

4.6.1.4 For testing articles other than wire, the quantity of copper sulphate solution required for each test will depend on the superficial area of the test specimen and the weight of coating. The quantity should not be less than 40 ml per gm of zinc coating on the specimen and shall be sufficient to cover the specimen so that the top surface of the solution is at least 13 mm above the top of the section of the specimen under test. The solution shall be discarded after completion of the test and fresh solution used for any additional tests.

4.6.2 Test Samples

4.6.2.1 The specimens selected for test shall be free from abrasion or cuts in the zinc coating, except those which may occur during manufacture or the preparation of the specimen for testing. Specimens of wire may be hand straightened.

4.6.2.2 The specimens shall be cleaned with a volatile organic solvent such as carbon tetrachloride, gasoline, or benzene, then rinsed with alcohol, and finally, thoroughly washed with clean water and wiped dry with clean cotton cloth. Test specimens shall be brought to a temperature of 15° to 21°C prior to beginning of the test.

4.6.2.3 Abnormal cases may arise when, by reason of unusual surface conditions, the copper sulphate solution will not act normally on the zinc coating. If there is any question of abnormality of performance of test specimens, the specimens shall be discarded and new ones selected. The new specimen shall be cleaned in alcohol, rinsed and wiped dry and then immersed for 3 minutes in a solution consisting of 1 part by volume of ammonium hydroxide (sp. Gravity 0.90) and nine parts of water. The specimens may be scrubbed with cotton cloth during this immersion. After cleaning the specimens shall be washed and wiped dry and then tested in accordance with the procedure laid down below.

4.6.3 Test Method

4.6.3.1 The test specimen shall be immersed in the copper sulphate solution, which shall be maintained at a temperature of 16 to 20 °C. The specimens shall remain in a fixed position in the solution for exact 1 minute. If a ½ minute dip is specified, it shall be given to the specimens after completion of all of the 1 min dip. There shall be no agitation of the solution during the immersion period and the specimen shall not be allowed to touch each other or the sides of the container. After each dip, the specimens shall be washed immediately in the rinsed water, and a fiber bristle brush shall be used to remove any copper deposit that may have formed on the zinc coating. Before returning the specimens to the test solution they shall be well drained of excess rinse water and wiped dry with a clean cloth.

4.6.3.2 Successive dips of 1 min. each shall be continued, with washing and wiping of the test specimens after each dip, until the specimens have withstood the required number of dips specified in Table-II or until the end point has been reacted.

TABLE-II: WEIGHT OF COATING AND NUMBER OF DIPS

<u>Weight of Coating</u> gm/sqm			<u>No. of Dip</u> 1 minute half minute	
300	and	above	4	-
270	to	299	3	1
240	to	269	3	-
180	to	239	2	-
140	to	179	1	1
90	to	139	1	-
75	to	89	-	1

- 4.6.3.3 A recommended device for holding test specimens of wire in a fixed position is shown in fig 1. A similar device may be used for holding specimens of other small articles that are not required to be fully immersed in the test solution. Specimens that are completely immersed may be suspended by a string.

4.7 Visual Inspection

- 4.7.1 The galvanized surface shall be free from such imperfection as lumps, uneven coatings, blisters, gritty areas, uncoated spots, ash and flux inclusions, globules or heavy deposits of zinc which will interfere with the intended use of the material will not be permitted.

- 4.7.2 Following is the list of defects, their significance and possible remedies:

Condition	Causes	Recommended Actions	Ground for Rejection
Bare Spots	Paint, grease or oil residues	Check cleaning particles	Materials may be Accepted where bare spots are in accordance with clause 4.7.2
	Scale or rust residues	Check pickling particles	
	Residual welding slag	Blast-clean welds. Avoid coated rods.	
	Breakdown of preflux coating	Check preflux and drying conditions	
	Aluminum content of bath too high	Regulate aluminum additions	
	Rolling defects in basis steel	Check steel supply	
General Roughness	Articles in contact during galvanizing	Keep articles separated	Material may be accepted provided adhesion is good and degree of roughness is not too critical.
	Analysis or original surface condition of steel	Check steel supply	
	Over pickling	Reduce pickling use inhibitor	
	High galvanizing temperature and / or long immersion time	Adjust galvanizing conditions	

Pimples	Entrapped dross particles	Avoid agitation of dross layer check carry over of pickle salts	Material with finally disposed Pimples covering not more than 0.5% of the area may be accepted.
Lumpiness and Runs	Withdrawal speed too high "Cold" galvanizing bath	Remove work slowly Increase temperature	Materials of class ABC may be accepted whereas of class D, E, F rejected
	Delayed run-off from seams, joint bolt holes, etc.	Remove work slowly	
	Articles in contact during withdrawal	Keep articles separated	
Flux Inclusion	Steel flux burnt on during dipping Surface residues on steel Flux picked up from top of bath	Refresh or renew flux blanket Check steel preparation Skim before withdrawal	Materials shall not be accepted

4.7.3 Articles covered under class E & F shall be completely free from uncoated sports. However, small localized uncoated sports on fabricated pressed, forged and casted articles covered under class A, B & C may be ignored upto maximum of 0.25% of the total area. The area of such individual sports shall not exceed 0.5 square mm. Uncoated spots shall be patched with galvanizing repair paint.

4.8 Embrittlement Tests

4.8.1 Galvanized Angle Test (for Angle Irons only)

4.8.1.1 Test Requirements

- i) The elongation measured in accordance with clause 4.8.1.2 (i) shall not be less than 5 percent except as specified in para 4.8.1.2 (ii).
- ii) When the specimen does not show 5 percent elongation, the reduction in thickness shall be measured in accordance with clause 4.8.1.2 (ii). The sum of the percentage of elongation plus the average percentage reduction of thickness shall not be less than 10.

- i) For determining the elongation after fracture, a 51 mm gauge length (Fig 2) shall be prick punched in the middle of the edge of the vertical leg of the angle along a line parallel to its length and centered directly under the hole. After the test, the sum of the distance along this line from each punch mark to the corresponding edge of the fracture shall be measured to 0.25 mm with a flexible scale, and the percentage of elongation calculated. For specimens under 13.0 mm in thickness or those in which the distance from the edge of the hole to the edge of the angle is less than 10 mm, the elongation shall be measured over a 25 mm gauge length.
- ii) For determining the percentage reduction of thickness after fracture, the reduction shall be measured with a ball point micrometer at the 3 locations indicated in fig 3; namely (a) outer side of hole, (b) inner side of hole, (c) middle of leg. The percentage reduction of thickness shall be calculated on the basis of the original thickness of the angle and the average of the three values at a, b and c.
- iii) The length of the test specimen and the distance between the supports are shown in the following tables.

Length of angle L (mm)		Length between supports L ₁ (mm)	Minimum length L ₂ (mm)
Upto	100 mm incl.	356.0	457.0
Over	100 mm to 150mm incl.	508.0	610.0
Over	150 mm to 200mm incl.	762.0	915.0

- iv) The kind of hole, punched, sub punched and reamed, or drilled, shall be that employed in the fabricated material which the specimen represents. The dimensional values, diameter, and location of hole, shall be not less than those employed in the structural details. Care shall be taken not to place the hole near stamped or rolled _____ in identification marks.
- v) The test shall be made upon galvanized specimens having a temperature not below 60° and not over 90 °F when tested.
- vi) The test may be made in a universal testing machine, or by other means such as a press or bulldozer with the load applied slowly.

4.8.2 Embrittlement Tests for Materials Covered under Class B, C & D

4.8.2.1 The test is suitable for galvanized steel hardware of such shape and size that permit bending such as bolts, tower steps, insulator clevises, braces, rods etc. Clamp one end of the article in a vice and bend the other end through an angle of 90 degree of about a diameter equal to the dia or thickness of the article under test. A suitable length of pipe may be used as a lever to assist bending. The article after bending shall show no cracks on the outside surface of bend. If such a test is made on threaded articles, it shall be made on un-threaded portion. In case of completely threaded articles, the threads shall be removed and the 90 degrees bend shall be about a diameter equal to the reduced diameter of the article.

4.8.2.2 Castings and steel hardware of such or size that they do not permit bending, may be struck a sharp blow with a hammer of suitable weight. If the material is not embrittled, it should not crack under such a blow. However, if the article is tested to destruction, a white lustrous, coarse grain appearance of the resulting fracture is indicative of embrittlement and shall be cause for rejection.

5. TESTS

5.1 Tests on galvanizing shall be carried out as per table-III below or otherwise specified in the relevant standard. Tests were applicable are marked 'O'.

TABLE-III, TESTS ON GALVANIZING

Test	Class A	Class B	Class C	Class D	Class E	Class F	Articles galvanized by electrodeposit method
Visual Inspection	0	0	0	0	0	0	0
Wt. of zinc coating (on hot dip articles)	0	0	0	0	0	0	X
Thickness of zinc coatings	X	X	X	X	X	X	0
Uniformity of coating test	0	0	0	0	0	0	X
Adherence Of coating Test	0	0	0	X	0	0	0
Embrittlement test	0	0	0	0	X	X	X

6. TEST SAMPLES – ACCEPTANCE AND REJECTION

- 6.1 The manufacturer shall provide all necessary facilities including testing equipment for carrying out tests free of cost to WAPDA. The cost of test samples destroyed during tests shall be borne by the manufacturer.
- 6.2 The WAPDA representatives shall have access at all times while work on WAPDA's contract is being performed. The manufacturer shall afford the WAPDA representative all reasonable facilities to satisfy him that the galvanizing is being furnished in accordance with the specification.
- 6.3 For visual inspection, articles shall be grouped into lots and test specimens shall be selected from a lot at random in accordance with table-IV. If the number of defective units does not exceed one, the lot shall be accepted. If the number of defective units exceeds two, the entire lot shall be rejected. In case the defective being two, another sample of double the quantity given in table-IV shall be selected at random and the test repeated. In case of any failure from the second selection, the entire lot shall be rejected.
- 6.4 Test specimens from each sample for determination of compliance to the tests specified in clause 8.2, 8.3, 8.4 & 8.5 shall be taken from each lot. The lot shall consist of a quantity as specified in table-IV, below or as otherwise specified in the relevant specification. If any sample fails to comply with the requirements laid down in this standard, another set of samples as per table-IV shall be taken from the remaining lot and test repeated. In case of any failure in the second set of samples, the whole lot shall be rejected.
- 6.5 Test samples from sheets or coils (Class E,F) for determination of weight of zinc coating shall be obtained as follows:
- i) When cut from coil, one sample from the centre and two samples from both ends of coil shall be taken.
 - ii) When cut from sheet, one sample from the centre and two samples from diagonally opposite corners shall be taken.
- 6.6 Test specimens from each sample sheets and coils for determination of adherent and uniformity of coating shall be obtained as follows:
- i) When cut from coil, sample shall be selected from one end of the coil.
 - ii) When cut from sheet, sample shall be taken from one corner of the sheet.

7. PASSIVATION TREATMENT

- 7.1 Zinc coatings applied by electrodeposit method shall be given full passivation treatment for maximum protection from corrosion by the following process.

7.2

The zinc plated components shall be well rinsed, then immersed for 5 to 10 seconds in a passivation solution of following composition:

Sodium dichromate	182	g/litre
Free sulfuric acid	6	ml/litre

After pasivation the components shall be well rinsed in running water and then dired in warm air.

7.3

Passivation process other than one specified above, may be used subject to prior approval by WAPDA.

Encls:

Figures 1,2,3,4 & table-IV.

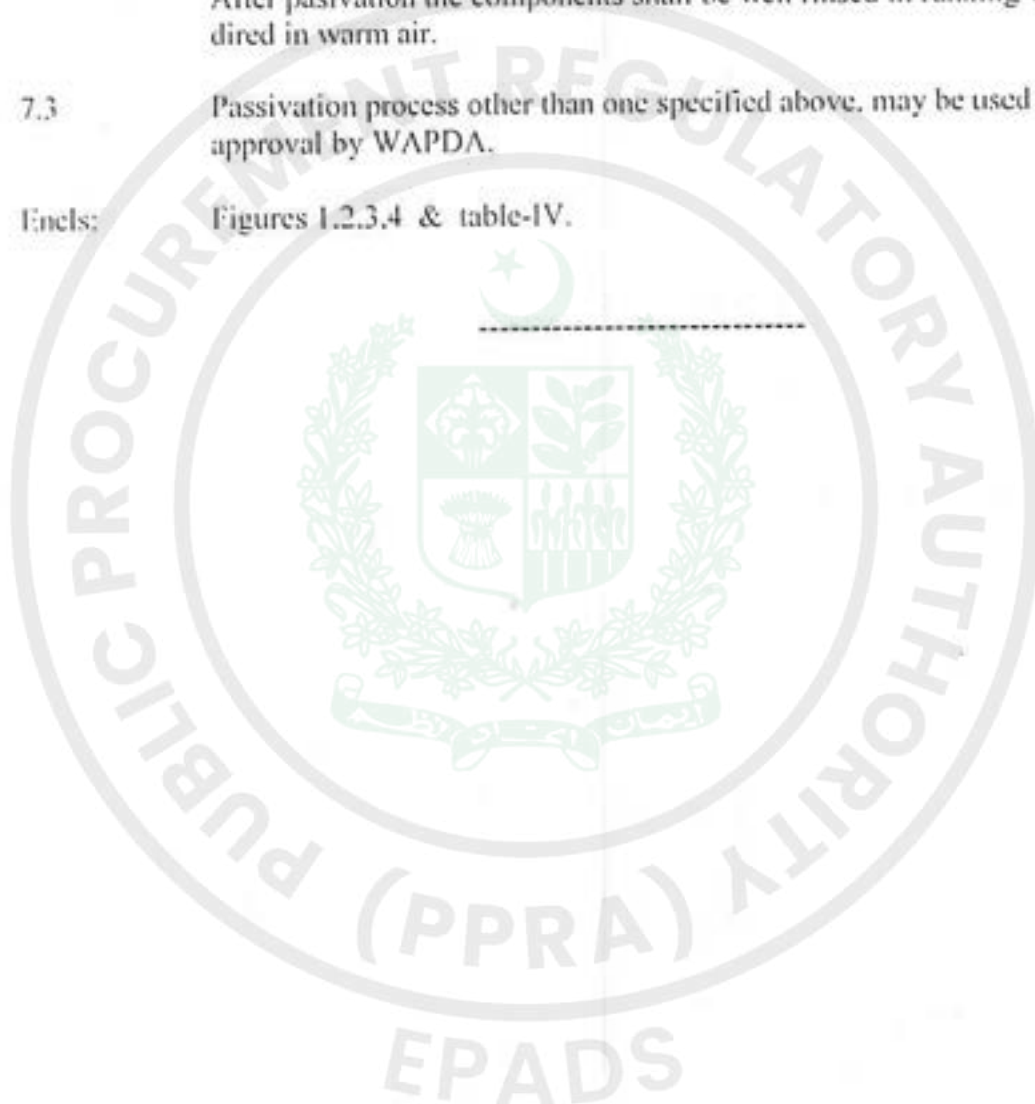
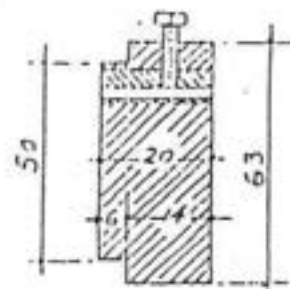
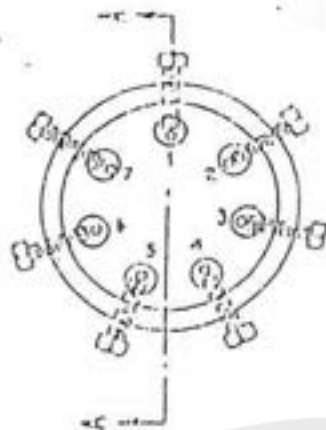


TABLE - IV

Material Description	Lot	No. OF S A M P L E S			
		Visual Inspection	Wt. of galvanizing Test or thickness of Zinc coatings	Uniformity and adherence of coating test	Embrittlement
1. Class A,B,C&D					
i) Fabricated, rolled, pressed, forged and cast articles covered under class A,B,C&D not more than 300 mm in length	1000 unit	100 units	3 units	3 units	3 units
ii) Fabricated, rolled, pressed, forged and cast articles covered under class A,B, C&D more than 300 mm in length	500 unit	100 units	3 units	3 units	3 units
2. Class E					
Galvanized steel wires, barbed wires binding wires etc.	100 coils or 10 km in length of wire of same size in form of coils whichever is less	10 coils	3 sample coils shall be selected from each lot and test specimens shall be cut from each coil as per clause 6.5 of this specification	3 sample coils shall be selected from each lot : test specimen shall be cut from each coil as per 6.6. of this specification.	
3. Class F					
Galvanized steel sheets	500 sheets of same size or 1000 kg in wt, whichever is less	25 sheets	3 sample sheets shall be selected from each lot and test specimens shall be cut from each coil as per clause 6.5 of this specification	3 sample coils shall be selected from each lot and test specimen shall be cut from each coil as per clause 6.6. of this specification	
4 Class G & H					
Galvanized articles by electrodeposit method	The procedure for sampling shall be the same as described above for hot dip galvanized articles				



SECTION A-A

Fig. 1

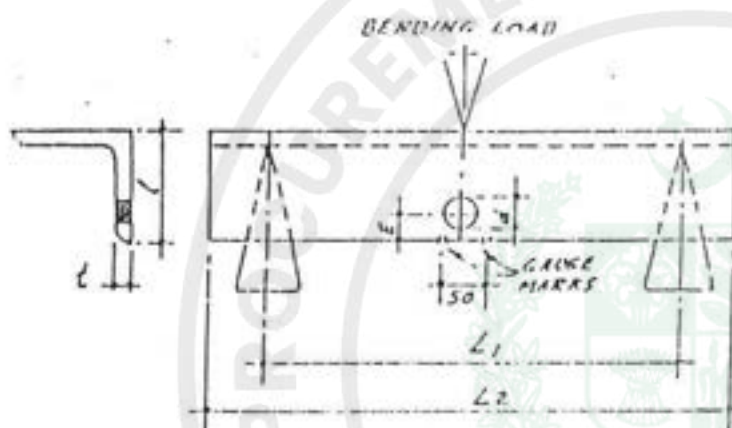


Fig. 2

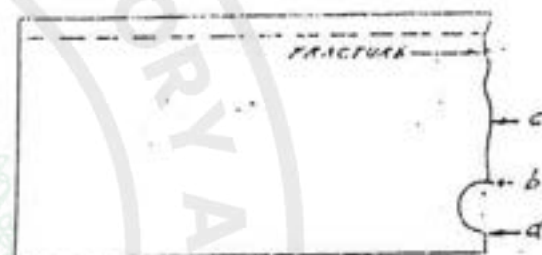


Fig. 3

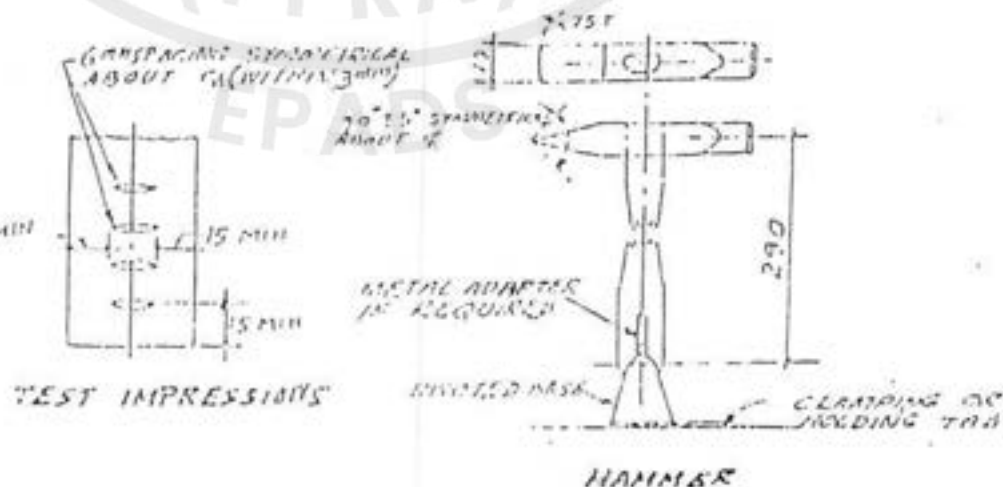


Fig. 4

PRICE SCHEDULE TENDER NO. PMU-216/26-27

Tender No.	Item No.	Description of Stores	Unit	Qty Req	FCS/DDP unit rate in PKR without GST	Applicable GST	FCS/DDP unit rate in PKR with GST	Total Amount in PKR
		1	2	3	4	5	6	7=3*6
PMU-216/26-27	1	11KV Post Insulator (4-Bolt for Capacitor Rack)	No.	100				
	2	132KV BEAMS 11.4 Meters	No.	16				
	3	132KV COLUMN 13.1 Meters	No.	43				
	4	Aluminium Pipe 75mm dia	No.	9				
	5	Aluminium Pipe 40mm dia	No.	12				
		*Grand Total						

(IN WORDS: _____)

Note: The ***Grand Total Price** must be same as the Bid Quoted Price

Stamp & Sign: _____ Date: _____

Past Experience and Completed Contracts

Contractual Experience

Bidder/Manufacturer shall have successfully completed at least two (02) number of contracts of same nature/type. "Same nature/type" means material/equipment having comparable characteristics/features same rating or higher rating not lower rating within last 07 years. In this context, complete set of copies of the contract agreements/Purchase Orders along-with copy of GRN/ completion certificate (must be issued by the end user client) for the equipment indicated in the supply record pertaining to the specified and comparable equipment during the bid evaluation.

The bidders/JV, who are not manufacturers themselves, shall furnish a valid and fresh authorization from the concerned manufacturer to submit a bid from supply of their goods to Pakistan against the tender.

Manufacturing Experience

The manufacturer shall demonstrate designing and manufacturing experience of similar or higher rated equipment /material for at least five year and Two-year satisfactory operation performance of offered equipment.

Performance Criteria

The material manufactured/supplied by the manufacturer/ bidder must have satisfactory operational experience. The bidder / manufacturer shall submit at least two (2) operational certificate with the bid from the end user from Pakistan or from outside the country of offered equipment /goods to establish satisfactory operation for a continuous period of at least two years prior to deadline for submission of bids within the period of last 10 years.

Supply Capacity

The manufacturer shall provide the following information with the Bid to establish its capacity/capability to execute the order.

- Manufacturing Capacity
- Orders in hand

Past Experience / Contracts

Contracts over <i>[insert amount]</i> during the last three years:				
Procuring Agency	Value	Year	Goods/Services Supplied	Country of Destination



Historical Contract Non-Performance, and Pending Litigation and Litigation History

[The following table shall be filled in for the Applicant and for each member of a Joint Venture]

Applicant's Name: *[insert full name]*

Date: *[insert day, month, year]*

Joint Venture Member Name: *[insert full name]*

IFP No. and title: *[insert IFP number and title]*

Page *[insert page number]* of *[insert total number]* pages

☐ Not debarred due to deviation from commitment of Bid Securing Declaration- ☐ Not debarred due to non-performance			
Year	Non-performed portion of contract	Contract Identification	Total Contract Amount (current value, currency, exchange rate and PKR equivalent)
<i>[insert year]</i>	<i>[insert amount and percentage]</i>	Contract Identification: <i>[indicate complete contract name/ number, and any other identification]</i> Name of Procuring Agency: <i>[insert full name]</i> Address of Procuring Agency: <i>[insert street/city/country]</i> Reason(s) for nonperformance: <i>[indicate main reason(s)]</i>	<i>[insert amount]</i>
Pending Litigation, in accordance with Section III, Qualification Criteria and Requirements			
☐ Pending litigation in accordance with Section III, Qualification Criteria and Requirements, Sub-Factor 2.3 as indicated below.			
Year of dispute	Amount in dispute (currency)	Contract Identification	Total Contract Amount (currency), US\$ PKR Equivalent (exchange rate)

<i>[insert year]</i>	<i>[insert amount]</i>	Contract Identification: [indicate complete contract name, number, and any other identification] Name of Procuring Agency: <i>[insert full name]</i> Address of Procuring Agency: <i>[insert street/city/country]</i> Matter in dispute: <i>[indicate main issues in dispute]</i> Party who initiated the dispute: <i>[indicate "Procuring Agency" or "Supplier"]</i> Status of dispute: <i>[Indicate if it is being treated by the Adjudicator, under Arbitration or being dealt with by the Judiciary]</i>	<i>[insert amount]</i>
☐ No consistent history of court/arbitral award decisions in accordance with Section III, Qualification Criteria and Requirements, Sub-Factor 2.4. ☐ Consistent history of court/arbitral award decisions in accordance with Section III, Qualification Criteria and Requirements, Sub-Factor 2.4 as indicated below.			
Year of award	Outcome as percentage of Net Worth	Contract Identification	Total Contract Amount (currency), PKR Equivalent (exchange rate)
<i>[insert year]</i>	<i>[insert percentage]</i>	Contract Identification: [indicate complete contract name, number, and any other identification] Name of Procuring Agency: <i>[insert full name]</i> Address of Procuring Agency: <i>[insert street/city/country]</i> Matter in dispute: <i>[indicate main issues in dispute]</i> Party who initiated the dispute: <i>[indicate "Procuring Agency" or "Supplier"]</i> Court/ arbitral award decision: <i>[Indicate if the award decision was against the Applicant or any member of a joint venture.]y]</i>	<i>[insert amount]</i>

Financial Situation and Performance

[The following table shall be filled in for the Applicant and for each member of a Joint Venture]

Applicant's Name: [insert full name]

Date: [insert day, month, year]

Joint Venture Member Name: [insert full name]

IFP No. and title: [insert IFP number and title]

Page [insert page number] of [insert total number] pages

1. Financial data

Type of Financial information in (currency)	Historic information for previous [insert number] years, [insert in words] (amount in currency, currency, exchange rate*, PKR equivalent)				
	Year 1	Year 2	Year 3		
Statement of Financial Position (Information from Balance Sheet)					
Total Assets (TA)					
Total Liabilities (TL)					
Total Equity/Net Worth (NW)					
Current Assets (CA)					
Current Liabilities (CL)					
Working Capital (WC)					
Information from Income Statement					
Total Revenue (TR)					
Profits Before Taxes (PBT)					
Cash Flow Information					
Cash Flow from Operating Activities					

* Refer ITA 14 for the exchange rate

3. Financial documents

The Applicant and in case of JV, members of JV shall provide copies of financial statements for *[number]* years pursuant Section III, Qualifications Criteria and Requirements. The financial statements shall:

- (a) reflect the financial situation of the Applicant or in case of JV member, and not an affiliated entity (such as parent company or group member).
 - (b) be independently audited or certified in accordance with local legislation.
 - (c) be complete, including all notes to the financial statements.
 - (d) correspond to accounting periods already completed and audited.
- ☐ Attached are copies of financial statements¹ for the *[number]* years required above; and complying with the requirements.

¹ If the most recent set of financial statements is for a period earlier than 12 months from the date of Application, the reason for this should be justified.

Average Annual Turnover (Annual Sales Value)

[The following table shall be filled in for the Applicant and for each member of a Joint Venture]

Applicant's Name: *[insert full name]*

Date: *[insert day, month, year]*

Joint Venture Member Name: *[insert full name]*

IFP No. and title: *[insert IFP number and title]*

Page *[insert page number]* of *[insert total number]* pages

Annual Turnover Data			
Year	Amount Currency	Exchange rate* (If applicable)	PKR equivalent
<i>[indicate calendar year]</i>	<i>[insert amount and indicate currency]</i>		
		Average Annual Turnover **	

* Refer ITA for date and source of exchange rate.

** Total PKR equivalent for all years divided by the total number of years. See Section III, Qualification Criteria and Requirements, ITA.