MATERIAL AND EQUIPMENT STANDARD

FOR

POWER FACTOR IMPROVEMENT CAPACITOR

ORIGINAL EDITION

AUG. 1993

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APPENDICES:

ATTACHMENTS (GENERAL):

*** Note:**

See Attachments at the end of standard.

1. SCOPE

This Standard specification covers the minimum technical requirements for design, manufacture quality control, testing and finishing of low voltage power factor correction equipment, to be connected to a 400 volt 3 phase 50 Hz power system. It covers capacities upto 400 Kvar per unit.

Only the general requirements of power factor correction device are given in this standard specification, the specific requirements of individual equipment will be given in pertinent data sheet, and or requisition.

The standard specification shall be used for preparation of requisitions and purchase order and subsequently a guideline for the manufacturers of the equipment described.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

IEC (INTERNATIONAL ELECTROTECHNICAL COMMISSION)

IEC 27	"Letters, Symbols to be Used in Electrical Technology"
IEC 50	"International Electronical Vocabulary"
IEC 51	"Recommendations for Indicating, Electrical Measuring Instrument and their Accessories"
IEC 70	"Power Capacitors"
IEC 70A	"Supplement to Publication 70, Power Capacitors Self Healing Metallized Power Capacitor"
IEC 71	"Insulation Coordination"
IEC 144	"Degrees of Protection of Enclosure for Low Voltage Switchgear and Controlgear"
IEC 157	"Low Voltage Switchgear and Controlgear, Part 1 Circuit Breaker"
IEC 158	"Low Voltage Controlgear, Part 1 Contactor"
IEC 269	"Low Voltage Fuse"
IEC 439	"Low Voltage Switchgear and Controlgear Assemblies"
IEC 831	"Shunt Power Capacitors of Self Healing Type for a.c. System Having a Rated Voltage upto and Including 660 Volt"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

ISO 9000	"Quality System"

Note:

When standards other than IEC or ISO are used manufacturer/supplier shall submit the applied equivalent standard and state the pertinent deviation from IEC or ISO.

3. UNITS

Dimensions shall be metric to international system of units (SI).

4. SERVICE CONDITIONS

4.1 Environmental Conditions

See Attachment No. 1.

5. BASIC DESIGN AND CONSTRUCTION

5.1 General

The control units shall contain a power factor relay to measure the reactive power in the incoming feeder. In the event of the actual value differing from preset value, the relay shall activate contactors to switch capacitors in and out in steps required. The capacitor rating shall be chosen so that on average the required power is attained.

5.2 Mechanical Design

All live parts shall be enclosed in a sheet metal enclosure factory assembled. Free standing heavy duty, dustproof, having access from front and suitable for extension. The enclosure shall be made of sheet steel not less than 2 mm thick.

The assembly shall be provided with a power entrance compartment. The incoming cable shall enter the power compartment from below.

Auxiliary compartment when required shall be completely barriered from the power compartment and from capacitor compartment.

5.3 Capacitor Modules

Capacitor module shall consist of but not be limited to the following:

5.3.1 HRC fuse

HRC fuse for short circuit protection.

5.3.2 Over current protection device

Over current protection device shall be provided in each unearthed conductor for each capacitor bank. The rating of device shall be suitable for continuous operation at an rms line current not exceeding 1.30 times the current which occurs at rated sinusoidal voltage and rated frequency excluding transients.

5.3.3 Contactors

Contactors for switching the sections of capacitor banks shall comply with the requirement of IEC 158.1.

5.3.4 High speed discharge device

The residual voltage of the capacitor shall be discharged into the reactor and to be reduced to 50 volt nominal or less within one minute after the capacitor is disconnected from the source of supply.

The discharge circuit shall be permanently connected to the terminals of the capacitor or capacitor bank(s).

Manual means of connecting the discharge circuit shall not be used.

5.3.5 Terminal blocks

Terminal blocks for the connection of control leads.

5.3.6 Manual - off - automatic selector

For manual or automatic operation of unit.

5.3.7 Switches with indicator lights for contactor activation in the manual mode.

5.4 The Regulation Modules

The regulation modules shall include the following:

5.4.1 The regulation module shall be of modular design, easily maintainable, plug in structure with L.E.D indication and shall include the following:

- Control circuit fuses.
- Contactor relay to prevent manual operation in the automatic mode.

5.5 Ampacity of Conductor

The ampacity of capacitor circuit conductor shall not be less than 135 percent of the rated current of the capacitor.

5.6 Disconnecting Means

A disconnecting means shall be provided in each unearthed conductor for each capacitor bank.

The rating of disconnecting means shall be not less than 135 percent rated current of capacitor.

5.7 Earthing

Capacitor cases shall be Earthed.

5.8 Enclosure

For ingress protection of enclosure see data sheet in Appendix A.

5.9 Name Plate (s)

5.9.1 The following information shall be given on the name plate(s) of each capacitor unit.

a) Purchaser's name and order number
b) Manufacturer's name
c) Identification number
d) Rated output in Kilovars
e) Rated voltage in volt or kilovolts
f) Rated frequency in hertz
g) Temperature category
h) Connection symbol
i) Insulation level

j) Discharge device

k) Capacitance

Further information which is of importance for the safety of persons or equipment shall be stated either on the nameplate or in an instruction sheet. In the latter case, the nameplate shall bear a reference to this instruction sheet.

Note:

For small units where it is impracticable to indicate all the above items on the nameplate, the item numbers h, i, j may be stated in an instruction sheet. The nameplate shall bear a reference to this sheet.

6. INSPECTION, QUALITY CONTROL AND QUALITY RECORD

See Attachment No. 2.

7. TEST AND CERTIFICATION

Routine tests and type tests shall be carried out on capacitors in compliance with requirements of IEC 70 and IEC 70 A as follows:

7.1 Routine Tests

- Capacitance
- Capacitor losses
- d.c. or a.c. voltage test between terminals
- a.c. voltage test between terminals and container dry test
- Tests between terminals and earth for capacitor bank

Note:

In addition, the following checks shall also be carried out:

Functional tests on all relevant components of the power factor improvement equipment such as isolators, contactors relays control units discharge unit, meter(s), fuses and earthing, to ensure proper functioning of the device.

7.2 Type Tests

Type tests shall be verified in compliance with IEC 70 and IEC 70 A.

8. FINISH

8.1 Manufacturer's standard finish is acceptable provided that it is compatible with specified environment conditions mentioned in Attachment No. 1 unless otherwise stated.

9. INFORMATION FOR MANUFACTURER/SUPPLIER

See data sheet in Appendix A.

10. DOCUMENTATION/LITERATURE TO BE SUBMITTED BY MANUFACTURER (SUPPLIER)

10.1 At Quotation Stage

10.1.1 Supplier shall submit the following:

10.1.1.1 Report of experience background, major clients and annual sale for the similar equipment.

10.1.1.2 Reference list showing the successful operation of equipment offered in major oil industries.

10.1.1.3 Typical type tests certificate of similar equipment.

10.1.2 Declaration of confirmation with the set standards and or clear indication of deviations from the standards and the specification.

10.1.3 Drawings and documents ticked under column "required with quotation" in Appendix B.

10.2 At Ordering Stage

Information ticked under heading of "certified information with order" in Appendix B.

11. PACKING

For general requirements see Attachment No. 4.

12. SHIPMENT

For general requirements see Attachment No. 5.

13. GUARANTEE

See Attachment No. 6.

14. SPARE PARTS

See Attachment No. 7.

15. LANGUAGE

See Attachment No. 8.

16. COORDINATION RESPONSIBILITY WITH OTHERS

See Attachment No. 9.

APPENDICES

APPENDIX A

EXAMPLE OF DATA SHEET FOR POWER FACTOR CORRECTION EQUIPMENT

- **PROJECT NAME:** .....
- **SPECIFICATION No. :** .....
- **AREA CLASSIFICATION TO IEC 79:**.....
- **POWER FACTOR CORRECTION DEVICE FOR:** .....
- **PRESENT KVA OF EQUIPMENT:** .....
- **PRESENT POWER FACTOR:** .....
- **REQUIRED POWER FACTOR:** .....
- **RATED OUTPUT OF CAPACITORS IN KVAR:** .....
- **TYPE OF COMPENSATION:** .....
- **INDIVIDUAL COMPENSTATION:** .....
- **GROUP COMPENSATION:** .....
- **CENTRALIZED COMPENSATION:** .....
- **DEGREE OF PROTECTION:** .....

  INDOOR .....

  OUTDOOR.....
- **COLOR OF EQUIPMENT:** .....
- **SUPPLY VOLTAGE:**..... **PHASE**..... **FREQUENCY**..... **WIRE** .....
- **SYSTEM NEUTRAL EARTHING:** ……
- **DISCHARGE DEVICES:** .....
- **TERMINATION FOR:** .....
- **CABLE ENTRY:** .....

(to be continued)

APPENDIX A (continued)

- **FUSES ISOLATOR RATING:** .....
- **CONTACTOR RATING:** .....
- **CUBICLE / CASE MATERIAL AND THICKNESS:** .....
- **CAPACITOR CONTAINER:** .....
- **RATING PLATE:** .....
- **ACCESSORIES:**.....
- **LIFTING EYE:** .....
- **EARTHING BOLT:**.....
- **METERS:** .....
- **P. F. METER:** .....
- **VOLT METER:** .....
- **CHANGE OVER SWITCH :** .....
- **MANUAL / AUTOMATIC:** .....
- **NUMBER AND STEPS FOR CONTROL UNIT:** .....
- **LIMIT OF INTERNAL LOSSES OF CAPACITOR:**.....**W/KVAR** .....

APPENDIX B

LIST OF DRAWING, DOCUMENTS, MANUALS AND CERTIFICATES TO BE SUBMITTED BY MANUFACTURER, SUPPLIER IN NUMBER

	DESCRIPTION	REQUIRED WITH QUATATION	CERTIFIED INFORM. REQ. WITH ORDER			NUMBER OF WEEKS BEFORE DELIVERY
			N0. OF COPIES		NUMBER OF WEEKS AFTER ORDER	
			REPRO-DICIBLES	PRINTED MATTER		
A	**DRAWING AND OTHER DOCUMENTS:**					
	a) ELECTRICAL EQUIPMENT:					
	1. DIMENSIONED OUTLINES AND FOUNDATION DETAILS					
	INCLUDING: CABLE ENTRIES AND CLEARANCES					
	2. DETAILS AND CROSS-SECTIONAL ARRANGEMENT					
	3. MOUNTING DETAILS					
	4. PERFORMANCE DATA (TYPICAL)					
	5. PARTS / MATERIAL LIST					
	6. RELEVANT CATALOGUES					
	7. NAME PLATES					
	8. LIST OF FINAL LABELS					
	b) TERMINATION:					
	1. CONNECTION DIAGRAM					
	2. TERMINAL BOX ARRANGEMENT					
	3. CONNECTION AND TERMINAL DESIGNATION					
	c) ELECTRICAL REFERENCE DOCUMENTS:					
	1. GENERAL DESCRIPTION					
	2. EQUIPMENT SPECIFICATION					
	3. PERFORMANCE DATA (ACTUAL)					
	4. DRAWINGS / PARTS / MATERIALS LIST					
B	**INSTRUCTION MANUALS : (FOR ALL REQUIRED** ITEMS)					
	1. INSTALLATION, COMMISSIONING AND INSPECTION					
	2. OPERATION AND MAINTENANCE					
C	**SPARE PARTS REQUIREMENTS:**					
	1. ILLUSTRATED SPARE PARTS					
	2. RECOMMENDED COMMISSIONING SPARE LIST					
	3. RECOMMENDED SPARES FOR THREE YEARS OPARATION					
D	**CERTIFICATION:**					
	1. PERFORMANCE TEST, MATERIALS CERTIFICATES AND					
	CURVES					

ATTACHMENTS

GENERAL

ATTACHMENT 1

ENVIRONMENTAL CONDITIONS

1.1 Site elevation : **----------** meters above sea level.

1.2 Maximum ambient air temperature : ---------- degree centigrade. Bare metal directly exposed to the sun can at times reach a surface temperature of ---------- degree centigrade.

1.3 Minimum air temperature : ---------- degree centigrade.

1.4 Relative humidity : ---------- percent.

1.5 atmosphere : saliferrous, dusty corrosive and subject to dust storms with concentration of 70-1412 mg/cubic meter, H_2S may be present, unless otherwise specified.

1.6 Lightning storm isoceraunic level : ---------- storm days/year.

1.7 Maximum intensity of earthquake ---------- richters.

Note:

Blanks to be filled by client.

ATTACHMENT 2

INSPECTION, QUALITY CONTROL, AND QUALITY RECORDS

2.1 Inspection, Quality Control

2.1.1 The purchaser's inspector, or his authorised representative shall have free access to the manufacturing plant engaged in the manufacture of the equipment, to carry out necessary inspection at any stage of work.

2.1.2 Inspection may include the visit to quality control laboratories, work shops, testing bay etc.

2.1.3 The supplier shall make available technical data, test pieces and samples that the purchaser's representative may require for verification in conjunction with pertinent equipment.

If required the supplier shall forward the same to any person or location that the purchaser's representative may direct.

2.2 Quality Records

2.2.1 The supplier shall maintain appropriate inspection and test records to substantiate conformance with specified requirements.

2.2.2 Quality record shall be legible and relevant to the product involved.

2.2.3 Quality records that substantiate conformance with the specified requirements, shall be retained by manufacturer and made available on request by purchaser.

2.2.4 The supplier shall establish and maintain procedure for identification collection, indexing, filing, storage, maintenance and disposition of quality records.

2.2.5 Supplier shall submit to purchaser: reports, test schedules, and test certificates (in ---------- copies) on completion of tests.

Note:

Blanks to be filled by client.

ATTACHMENT 3

TESTS AND CERTIFICATION

3.1 General Requirements

3.1.1 Test procedure as proposed by the supplier shall be agreed upon, and approved by the purchaser before any test is carried out.

3.1.2 Purchaser may require witnessed tests to be carried out in the presence of his nominated representative who should be informed at least ---------- weeks in advance of the date of the tests and confirmed ---------- weeks before the tests.

3.1.3 Test certificates and test reports shall refer to the serial No. of the equipment tested and must bear the purchaser's name, order No. and manufacturer's name and seal.

The certificates shall be approved by the purchaser before shipment instruction are given.

3.1.4 Approval by the purchaser's inspector or representative shall not relieve the vendor of his commitments under the terms of this specification or any associated order.

3.1.5 The equipment may be rejected if measurement and inspection reveal any discrepancies between quoted figures resulting in purchase order and those measured actually.

3.1.6 Any charges incurred by the tests quoted under heading of specific requirements for tests to be quoted as a separate item and are not to be included in the cost of the equipment.

Note:

Blanks to be filled by client.

PACKING

4.1 Equipment must be carefully packed to provide necessary protection during transit to destination and shall be in accordance with any special provision contained in the order.

4.2 Special attention must be given to protection against corrosion during transit, and silica gel or similar dehydrating compound shall be enclosed.

4.3 The method of cleaning preserving and the details of packing including moisture elimination, cushioning, blocking and crating shall be such that to protect the product against all damages or defects which may occur during handling, sea shipment to the port and rough road haulage to site and extended tropical open air storage generally as client general conditions of purchase see Attachment 10.

4.4 All bright and machined parts must be given the protection against corrosion.

4.5 Ancillary items forming an integral part of the equipment should be packed preferably in a separate container if the equipment is normally cased or crated.

Alternatively the ancillary items should be fixed securely to the equipment and adequate precautions taken to ensure that the item do not come loose in transit or be otherwise damaged.

4.6 The supplier shall provide methods of handling to prevent damage and or deterioration during transit.

4.7 Where deemed necessary each shipping section shall be furnished with removable steel angles.

4.8 The requirements of above items shall not relieve the supplier of any of his responsibilities and his obligations for delivery of equipment in a sound undamaged and operable conditions at site.

4.9 Identification for Shipment

The marking and labels of products should be legible, durable and in accordance to specification.

Identification should remain intact from the time of initial dispatch at work to the final destination.

Marking shall be adequate for identifying a particular equipment in the event that a recall or inspection becomes necessary.

ATTACHMENT 5

SHIPMENT

5.1 Motor remote control stations package shall be provided with a permanently attached readily visible identification tag(s) bearing the equipment number of the remote control station to which it belongs.

5.2 The greatest care must be taken to ensure that shipping and associated documents with exact description for custom release are accompanied with the shipment.

ATTACHMENT 6
GUARANTEE

6.1 Clearance of Defects

The supplier shall guarantee his equipment during commissioning and for one year operation starting from the completion of seven days continuous service test in site at full load against the following defects:

- All operational defects.
- All material defects.
- All constructional and design defects.

6.2 Replacement of Defective Parts

All defective parts shall be replaced by the supplier in the shortest possible time free of charge including dismanteling resembling at site and all transportation cost. The above mentioned period shall not however be longer than 18 months from the date of dispatch from the manufacturer's works.

6.3 Supply of Spare Parts

Further more the supplier shall guarantee the provision of spare parts to the purchaser for a minimum period of ----- years from the date of dispatch.

6.4 After Sale Technical Services

6.4.1 Commissioning

6.4.1.1 The supplier shall quote if required for the services of competent engineer(s) and or technician(s) to assist in installation commissioning and testing of the equipment at site on a per diem basis.

6.4.1.2 The quoted rates shall be irrespective of duration and frequency and the supplier shall guarantee the services of the engineer(s) and technician(s) on the specified date within a minimum of ---------- weeks advance notice by the purchaser.

6.4.2 Training

6.4.2.1 The purchaser may require the supplier to arrange for training of his personnel in the manufacturing plant and or in site for the operation and maintenance of the equipment offered.

6.4.2.2 The supplier shall quote (if required) for the cost of any of above mentioned services on a per person per diem basis. The program for the training shall be prepared by mutual agreement. An advance notice of----------weeks minimum, is required by purchaser for the commencement of training program.

Note:

Blanks to be filled by client.

ATTACHMENT 7

SPARE PARTS

7.1 All spare parts shall comply with the same standards, specification and tests of the original equipment and shall be fully interchangeable with the original parts without any modification at site.

7.2 They shall be correctly marked in accordance with client reference and manufacturer part numbers, giving also the purchaser's order number.

7.3 Spare parts shall be preserved to prevent deterioration during shipment and storage in humid tropical climate.

7.4 List of recommended spare parts and interchangeability with spare parts of similar equipment shall be submitted by supplier.

ATTACHMENT 8

LANGUAGE

8.1 All correspondence drawings, documents, certificates, including testing operation and maintenance manuals and spare part lists etc. shall be in English.

8.2 Offers in other languages will not be considered.

ATTACHMENT 9

COORDINATION RESPONSIBILITY WITH OTHERS

9.1 In case the equipment ordered should be mounted on, aligned, connected, adjusted, or tested with the equipment of other manufacturer (s) the supplier shall contact directly the said manufacturer(s) and supply and obtain all dimensional and technical informations and arrange for any interconnecting equipment and combined test that may be required.

9.2 The supplier shall be responsible for correct and timely communication with the said manufacturer(s) and for any delay and/or cost claims arising from such communications.

9.3 Copies of all correspondence should be sent to purchaser.

9.4 The name and address of the manufacturer(s) will be given as soon as their orders have been confirmed.

ATTACHMENT 10

GENERAL CONDITIONS OF PURCHASE

This document will be submitted by purchaser at the time of ordering.

ATTACHMENT 11

SAMPLES OF PURCHASER'S DRAWING TITLE BLOCK

TYPICAL DRAWING TITLE BLOCK

DRAWING NO.	**DESCRIP TION**

REFERENCE DRAWINGS					
D					
C					
B					
A					
REV	**DATE**	**DESCRIP TION**	**REF**	**CHK**	**APP**

THE NAME OF RELEVANT COMPANY

DRAWING TITLE:

DRN.BY	**SCALE**	**MICRO FILM CODE**	**PROJECT NO.**	**CHK.BY**	**APP.BY**

JOB NO.	**AREA CODE**	**DWG NO.**	**SHEET**	**REV.**

Note:

Appropriate Nomenclature and Registered mark shall be used for quotation and order.

ATTACHMENT 12

INSTRUCTIONS OF PURCHASER ABOUT PERTINENT DRAWINGS

12.1 Purchaser's drawing title block, "the sample of which is given in Attachment 11 shall be shown in the right lower corner of the drawings.

12.2 Drawings are to be protected and packed. Negatives must be dispatched in a strong card board cylinder.

12.3 Drawings must be rolled and not folded.

12.4 All drawings, documents and literatures shall be forwarded under cover of a fully detailed letter to purchaser whose addresses are given in Attachment 14.

Note:

Blank to be filled by client.

ATTACHMENT 13

MATERIAL, LAYOUT AND LETTERING OF LABELS

Label material to be "Traffolite" 5 mm. Thick having two outer layers. Letter to be engraved into the white layer to give black lettering on a white background.

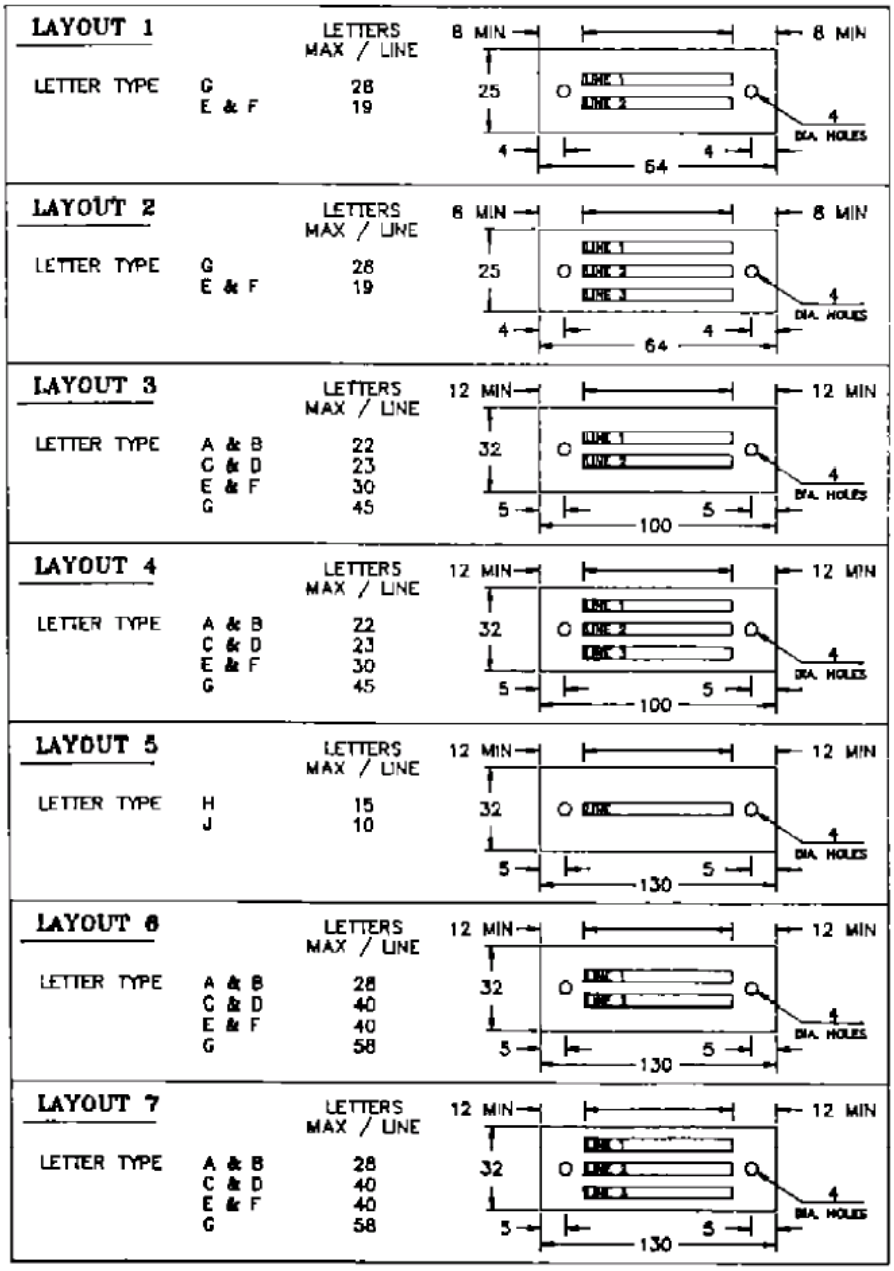
TYPE	HEIGHT	WIDTH mm	STROKE	CASE		LETTERS / 25 mm	SAMPLE
A	5	WIDE	LIGHT	UPPER	CASE	7½ ± 1.2mm. TOL	ABCDEFGHIJKLM
B	5	WIDE	HEAVY	"	"	7½ ± 1.2mm. TOL	
C	5	NARROW	LIGHT	"	"	11 ± 1.2mm. TOL	
D	5	NARROW	HEAVY	"	"	11 ± 1.2mm. TOL	
E	3	WIDE	LIGHT	"	"	10 ± 1.2mm. TOL	
F	3	WIDE	HEAVY	"	"	10 ± 1.2mm. TOL	
G	3	NARROW	LIGHT	"	"	15 ± 1.2mm. TOL	
H	10	WIDE	HEAVY	"	"	3½	
j	12	WIDE	HEAVY	"	"	2½	

Note:

Height is in milli meters.

(to be continued)

ATTACHMENT 13 (continued)



Note:

All dimensions are given in mm.

min = minimum

ATTACHMENT 14

FULL ADDRESS OF PURCHASER:

.....

.....

.....

.....

P. O. BOX No. ..... **CODE No.** .....

TELEPHONE No. .....

TELEX No. .....

FACSIMILE No. .....

Note:

Blank to be filled by client.