

**MATERIAL AND EQUIPMENT STANDARD**

**FOR**

**TRANSFORMER RECTIFIERS**

**FOR**

**CATHODIC PROTECTION**

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## **0. INTRODUCTION**

This Standard is based on the combined experience of oil industry specialists in engineering, design, purchase, construction, operation, maintenance and inspection of electrical installations in process and utility plants, and may be applied at every oil refinery, gas establishment and petrochemical plant, thus a large measure of uniformity throughout the procurement will be achieved with all its economic and harmonization advantages.

This standard may not cover every requirement or diversity of conditions at each locality, but this is recognized and the write up is sufficiently flexible to allow individual companies in oil, gas, and petrochemical industries of Iran to exercise their own judgment in these situations, with due consideration to the existing electrical installations of oil, gas and petrochemical industries in Iran and the pertinent prevailing hazards.

It is necessary to mention also that this standard is written mainly for the purchase of transformer rectifier to be installed in non hazardous atmospheres, and their installation shall be avoided in hazardous locations.

## 1. SCOPE

This Standard specification covers the minimum technical requirements for design, manufacture, quality control, finishing and testing of indoor or outdoor transformer rectifiers which shall be installed in oil, gas and petrochemical industries in Iran under the service conditions stated in clause 4 of this Standard specification.

Only the general requirements of transformer rectifiers are given in this standard specification, the specific requirements of individual transformer rectifiers will be given in pertinent data sheets and or requisitions.

This standard specification shall be used for preparation of requisitions and purchase orders and subsequently as a guideline for the manufacturer of the equipment described.

## 2. REFERENCES

The edition of the following standards and Codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the vendor consultant.

### IEC (INTERNATIONAL ELECTROTECHNICAL COMMISSION)

IEC 51	"Recommendations for Indicating Electrical Measuring Instruments and their Accessories"
IEC 76	"Power Transformers"
IEC 99.1	"Surge Diverters (BS 2914)"
IEC 144	"Degree of Protection of Enclosures for Low Voltage Switchgear and Controlgear"
IEC 146	"Semiconductor Convertors"
IEC 185	"Current Transformer (where applicable)"
IEC 269	"Low Voltage Fuses"
IEC 296	"Unused Mineral Insulating Oils for Transformer and Switchgear"
IEC 391	"Marking of insulated conductors"
IEC 445	"Identification of Apparatus Terminal and General Rules for a Uniform System of Terminal Marking using An Alphanumeric Notation"
IEC 464	"Specification for Insulating Varnishes Containing Solvent"

#### Notes:

1) Where standards other than "IEC" are used, manufacturer/supplier shall submit the pertinent deviations from IEC standards specified.

2) The testing and certification by the following authorities are acceptable where relevant:

- a) European Organization for Testing and Certification under CENELEC (EOTC).
- b) Electrical Equipment Certification Services (EECS).

## 3. UNITS

International system of units (SI) in accordance with IPS-E-GN-100 shall be used.

## **4. SERVICE CONDITIONS**

### **4.1 Environmental Conditions**

See Attachment 1.

### **4.2 Electricity Supply**

For power supply in site see data sheet in Appendix A.

## **5. BASIC DESIGN AND CONSTRUCTION**

### **5.1 General**

The transformer rectifier units shall comprise a main transformer and a rectifier with manual output regulation equipment. They shall all be installed either:

In a welded weatherproof steel tank for oil filled type; (with transformer, rectifier and regulating equipment all below oil level) or:

In a standard cast iron pillar / weather proof steel cabinet, in case of dry type transformers.

The unit shall be suitable for plinth mounting.

The degree of ingress protection of enclosure of equipment shall comply with requirement in data sheet in Appendix A.

### **5.2 Main Transformer**

The main transformer shall be a double wound type in accordance with IEC publication No. 76, suitable for connection to a supply system rated at voltage and current given in data sheet and for environmental conditions specified in Attachment 1.

An earthed shield shall be placed between primary and secondary winding.

### **5.3 Rectifier**

The rectifier shall be of the silicon or selenium type, connected for full wave rectification in accordance with the requirements of IEC 146.

Suitable surge protection shall be provided for:

- Input to transformer
- Input to rectifier and,
- Rectifier output

Unless otherwise specified.

### **5.4 Insulating Materials**

All varnishes, insulated films, tapes and boards shall be compatible with environmental conditions specified in Attachment 1.

The use of wood in equipment is not permitted.

## 5.5 Electrical Components

**5.5.1** All coils for transformer, chokes, wire wound resistors etc., shall be fully impregnated with suitable oil resistant insulating varnish, either by vacuum application or by preheating to a minimum 100°C, fully immersing the coil in varnish while still hot, allowing the coil to cool in the varnish and then over drying all in accordance with the varnish manufacturer's instructions.

**5.5.2** All assembled electrical components which are not oil immersed shall be protected with fungicide materials when required.

## 5.6 Output Regulation Device

The transformer shall be equipped with rotary selector switches for adjusting the output in 63 steps unless otherwise specified.

## 5.7 a.c. Isolating Means

A suitably rated switch fuse or molded case circuit breaker shall be mounted on the side of tank and shall be suitable for bottom cable entry.

Provision shall be included to lock the switch fuse or m.c.b in closed or open position, unless they are located in a lockable box, in which case this feature is not necessary.

The bottom entry on the switch fuse shall be provided with a cable gland suitable for a 4 core 10 mm PVC/SWA/PVC cable.

## 5.8 Time Switch

**5.8.1** When required a single phase adjustable time switch complete with suitable contactor to IEC 158 capable of switching the unit at full output on a "3" minute on "2" minute off cycle shall be fitted.

**5.8.2** A double pole selector switch shall be provided to enable a selection to be made for either continuous operation or time switch controlled operation of the unit.

## 5.9 Control Box

**5.9.1** A control box shall be installed on the outside of the tank and shall be provided with a hinged lockable door, suitably stiffened to prevent distortion and provided with a reinforced glass for viewing the meters.

**5.9.2** The control box shall house the followings:

- The manual control of the output regulation device, and the time/continuous supply control switch, where applicable.
- Suitable d.c. voltmeter and d.c. ammeter.

The instrument cases shall be earthed unless manufactured of insulating materials.

The voltmeter shall be protected by a fuse in each lead of the instrument.

- There shall be a schematic circuit diagram on the inside of control box door of the transformer rectifier.

This diagram shall be engraved on non corrosive and non deteriorating material.

- Three positive and three negative output terminals shall be provided in a suitable location for easy access and cable connections.

## 5.10 Transformer Oil

Oil cooled transformer rectifier shall be supplied with the first complete filling of oil which shall comply with the requirements of IEC 296.

## 5.11 Miscellaneous Fittings

The transformer-rectifier shall be supplied fitted with the followings:

- Lifting lugs of suitable size and location to facilitate lifting of the unit when full of oil.
- An approved oil sight-gage consisting of a flat durable glass window in front of a rigid white plastic plate.
- An oil drain cock in the bottom of the tank suitably protected from damage, and provided with a blocking plug.
- A removable dial type thermometer fitted through a gland into the side of the oil tank, graduated in degrees centigrade with a red mark on the scale at the maximum operating temperature.
- A silica gel breather and spare cartridge.
- Steel channel underbase for plinth mounting.
- An earthing terminal comprising:  
A "M10" coarse threaded stud complete with washer nuts and locknuts suitable for 3 x 25 mm earth strip.
- Gland plate below terminal enclosure.

## 5.12 Nameplates and Labels

The nameplates, labels and their fixing materials shall be proven durable under the service conditions specified for the transformer rectifier in Attachment 1.

They shall be corrosion and moisture resistant and provided with indelible inscription in the language specified in Attachment 8.

Stainless nameplates and traffolite labels are acceptable.

Holes for fixing of nameplate or labels shall not influence in any way the degree of ingress protection of enclosure.

### Note:

**For material layout and lettering of labels (see Attachment 13).**

## 5.13 Marking

Each transformer rectifier shall bear the following marking:

- 1) Purchaser's name, order number and date of order.
- 2) The manufacturer's name and trade mark.
- 3) Identification reference/serial No.
- 4) Number of input phases and neutral.
- 5) Rectifier materials.
- 6) Rated input voltage, current and frequency.
- 7) Rated output direct current, and voltage.
- 8) Range of output voltage.
- 9) Number of tapping for voltage control.
- 10) IEC standard publications Number(s).
- 11) Dimensions:

Weight with oil.....kg., weight without oil.....kg. In case of oil immersed type.

## 6. INSPECTION, QUALITY CONTROL AND QUALITY RECORD

See Attachment 2.

## 7. TESTS AND CERTIFICATION

### 7.1 General Requirements for Tests

See Attachment 3.

### 7.2 Specific Requirement for Tests

The tests shall comprise but shall not be restricted to:

#### 7.2.1 Type tests

a) Measurement of inherent voltage regulation	IEC 146 Sub-clause	480.1
b) Insulation Test	" "	492.1
c) Power loss measurement	" "	480.2
d) Power factor measurement	" "	480.3
e) Temperature rise test	" "	480.4
f) Load Test	IEC 146 sub-clause	492.7
g) Ratio and polarity tests		
h) Lightning impulse voltage test		

#### 7.2.2 Routine tests

a) Insulation test	IEC 146 Sub-clause	492.1
b) Ratio and polarity Tests		
c) Efficiency test at 100% of maximum current output into a fixed load of 1 ohm		
d) Functional tests		
e) Any other test deemed necessary by purchaser's representative/inspector		

## 8. FINISH

**8.1** The equipment shall be cleaned primed with two layers of antirust undercoat and one final layer of durable paint suitable for environmental conditions given in Attachment 1.

**8.2** The color of final layer shall be:

- a) light grey color No. 631 to BS 381C or;
- b) as specified in requisition.

## 9. INFORMATION FOR MANUFACTURER/SUPPLIER

For information to be given to manufacturer/supplier (see data sheet in Appendix A).

## 10. DOCUMENTATION TO BE SUPPLIED BY MANUFACTURER/SUPPLIER

For list of drawings, documents manuals and certificates to be submitted by manufacturer/supplier.

See Appendix B.

**11. PACKING**

For general requirements for packing:

See Attachment 4.

**12. SHIPMENT**

For general requirements for shipment:

See Attachment 5.

**13. GUARANTEE**

See Attachment 6.

**14. SPARE PARTS**

See Attachment 7.

**15. LANGUAGE**

See Attachment 8.

**16. COORDINATION RESPONSIBILITY WITH OTHERS**

See Attachment 9.

APPENDICES

APPENDIX A

EXAMPLE OF \*TYPICAL DATA SHEET FOR TRANSFORMER RECTIFIER

PROJECT NAME .....

AREA CLASSIFICATION .....

ENVIRONMENTAL CONDITIONS (see Attachment 1).....

LOCATION

Indoor.....Degree of ingress protection (IP) required.....

Outdoor.....Degree of ingress protection (IP) required.....

STANDARD SPECIFICATION No.....

TRANSFORMER DATA :

DryType.....Oilimmersed.....

Typeofcooling.....

Primary input: phase.....volt..... ± .....%.....Hz..... ± .....%

Primary input current.....AMPS ± ....%

Neutrlearthing.....

Output d.c. voltage: volt, Ripple voltage < mv, output current.....AMP

Transformerrating.....kVA,vectorgroup.....

Continuous fine adjustment of output voltage

Required.....

Notrequired.....

\* Tick or explain the applicable data.

(to be continued)

**APPENDIX A (continued)**

FITTINGS REQUIRED :

- Lifting lugs.....
- Oil level site gage.....
- Oil drain cock with blocking plug.....
- Dial type thermometer.....
- Oil breather..... Required..... Not required..... Sealed
- Sun shade..... Required..... Not required
- Provision for remote alarm.....
- Schematic circuit diagram plate.....
- Rating plate.....
- Padlock for isolating means.....
- Maximum permissible noise level.....db(A)

OPERATION :

- Continuous operation.....
- Time controlled operation.....

MEASURING INSTRUMENT :

- Input "a.c." voltmeter scaled from.....to.....volts
- output "d.c." voltmeter scaled from.....to.....volts
- output "d.c." ammeter scaled from.....to.....AMPS

CABLES/CONDUIT TYPE AND SIZE :

- a.c. incoming side.....
- d.c. outgoing side.....

**APPENDIX B**

**LIST OF DRAWINGS, DOCUMENTS, MANUALS AND CERTIFICATES TO BE SUBMITTED BY MANUFACTURER/SUPPLIER IN NUMBERS AND THE TIMES**

DESCRIPTION	REQUIRED WITH QUATATION	CERTIFIED INFORM. REQ. WITH ORDER			NUMBER OF WEEKS BEFORE DELIVERY
		NO. OF COPIES		NUMBER OF WEEKS AFTER ORDER	
		REPRO-DICIBLES	PRINTED MATTER		
<b>A DRAWING AND OTHER DOCUMENTS:</b>					
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>B INSTRUCTION MANUALS : (FOR ALL REQUIRED ITEMS)</b>					
1. INSTALLATION, COMMISSIONING AND INSPECTION					
2. OPERATION AND MAINTENANCE					
<b>C SPARE PARTS REQUIREMENTS:</b>					
1. ILLUSTRATED SPARE PARTS					
2. RECOMMENDED COMMISSIONING SPARE LIST					
3. RECOMMENDED SPARES FOR THREE YEARS OPARATION					
<b>D CERTIFICATION:</b>					
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 temperature : ----- degrees centigrade. (Bare metal directly exposed to the sun can at times reach a surface temperature of ----- degrees centigrade.

**1.3** Minimum air temperature : ----- degrees centigrade.

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

**1.5** Atmosphere : saliferous, dusty corrosive and subject to dust storms with concentration of 70 - 1412 mg/cubic meter, H<sub>2</sub>S may be present, unless otherwise specified in data sheet .

**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 authorized 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.**

## ATTACHMENT 4 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 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** According to manufacturer standard practice the transformer rectifier shall be oil filled in case of immersed type and all associated equipment shall be prepared for transportation for road or sea shipment.
- 5.2** Transformer rectifier package shall be provided with a permanently attached readily visible identification tag(s) bearing the equipment number of the motor starter(s) to which it belongs.
- 5.3** 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 dismantling reassembling 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**

<b>DRAWING NO.</b>	<b>DESCRIPTION</b>				
<b>REFERENCE DRAWINGS</b>					
<b>D</b>					
<b>C</b>					
<b>B</b>					
<b>A</b>					
<b>REV</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>REF</b>	<b>CHK</b>	<b>APP</b>
<b>THE NAME OF RELEVANT COMPANY</b>					
<b>DRAWING TITLE :</b>          					
<b>DRN. BY</b>	<b>SCALE</b>	<b>MICRO FILM CODE</b>	<b>PROJECT NO.</b>	<b>CHK. BY</b>	<b>APP. BY</b>
<b>JOB NO.</b>	<b>AREA CODE</b>	<b>DWG. NO.</b>	<b>SHEET</b>	<b>REV.</b>	

**Note:**

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

**ATTACHMENT 12  
INSTRUCTIONS OF PURCHASER ABOUT 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 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 letter to be engraved into the white layer to give black lettering on a white background.

**LETTER TYPE**

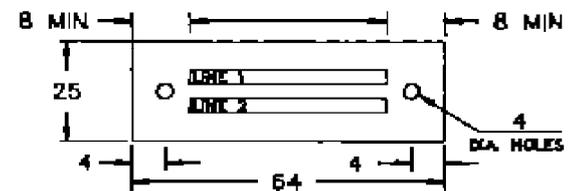
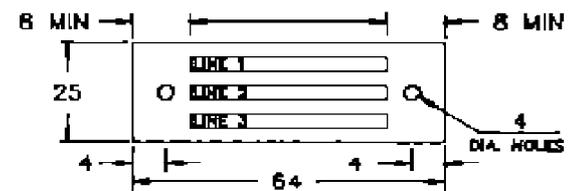
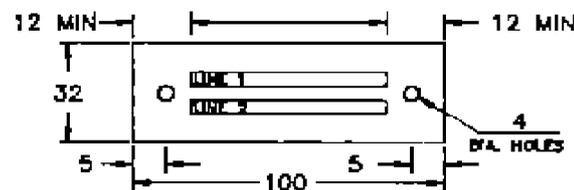
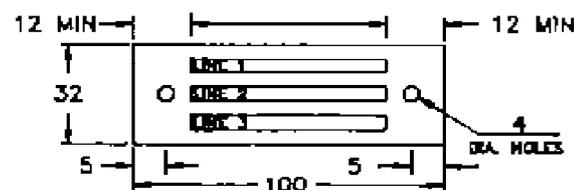
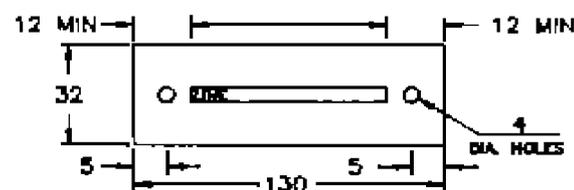
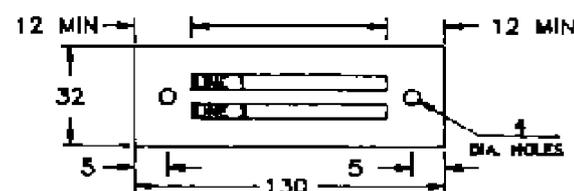
<b>TYPE</b>	<b>HEIGHT</b>	<b>WIDTH</b> <b>mm</b>	<b>STROKE</b>	<b>CASE</b>		<b>LETTERS / 25 mm</b>	<b>SAMPLE</b>
A	5	WIDE	LIGHT	UPPER	CASE	7½ ± 1.2mm. TOL	ABCDEFGHIJKLM
B	5	WIDE	HEAVY	"	"	7½ ± 1.2mm. TOL	
C	5	NARROW	LIGHT	"	"	11 ± 2.5mm. TOL	
D	5	NARROW	HEAVY	"	"	11 ± 2.5mm. TOL	
E	3	WIDE	LIGHT	"	"	10 ± 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 millimeters.

(to be continued)

ATTACHMENT 13 (continued)

<b>LAYOUT 1</b>		LETTERS MAX / LINE	8 MIN		8 MIN
LETTER TYPE	G E & F	28 19	25		4 DIA HOLES
<b>LAYOUT 2</b>		LETTERS MAX / LINE	8 MIN		8 MIN
LETTER TYPE	G E & F	28 19	25		4 DIA HOLES
<b>LAYOUT 3</b>		LETTERS MAX / LINE	12 MIN		12 MIN
LETTER TYPE	A & B C & D E & F G	22 23 30 45	32		4 DIA HOLES
<b>LAYOUT 4</b>		LETTERS MAX / LINE	12 MIN		12 MIN
LETTER TYPE	A & B C & D E & F G	22 23 30 45	32		4 DIA HOLES
<b>LAYOUT 5</b>		LETTERS MAX / LINE	12 MIN		12 MIN
LETTER TYPE	H J	15 10	32		4 DIA HOLES
<b>LAYOUT 6</b>		LETTERS MAX / LINE	12 MIN		12 MIN
LETTER TYPE	A & B C & D E & F G	28 40 40 58	32		4 DIA HOLES
<b>LAYOUT 7</b>		LETTERS MAX / LINE	12 MIN		12 MIN
LETTER TYPE	A & B C & D E & F G	28 40 40 58	32		4 DIA HOLES

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.**