

**Ministry of Electricity  
Power Distribution Office  
Baghdad – Iraq**

**Specification No.**

**D-22**

**TECHNICAL SPECIFICATION  
OF  
TUBULAR STEEL POLES FOR SUSPENSION**

**REVISION**

**YEAR 2001**

**YEAR 2009**

**YEAR 2012**

**YEAR 2019**

## **1- Scope of supply**

This specification covers the provision of tubular steel poles, cross arms, fittings and accessories suitable for 11kV overhead lines with maximum conductor size 120/20 ACSR and LV lines with maximum conductor size 120mm<sup>2</sup> AAC on distribution networks. Suppliers are called upon to deliver tubular steel poles to MoE which are required for the installation of medium voltage (11 kV) and low voltage (0.4kv) Electricity Distribution Network.

## **2- General Requirements**

The materials shall be of first class quality and designed for continuous satisfactory operation as continuity of supply is of prime importance and to operate satisfactorily under variation of load, voltage and short circuit or other conditions which may occur on the system provided that these variations are within the assigned rating of the apparatus. The materials used shall be suitable for the following climatic conditions.

### **2 -1-Ambient temperatures**

Lowest minimum (-10) °C

Highest maximum (in the shade) 55 °C for about 6 hours a day

Maximum yearly average (+30) °C

Maximum daily average (+40) °C

### **2-2- Sun Shine temperature**

Black objects under direct sunshine attain a temperature of 80°C

### **2-3- Air humidity**

Maximum 92% at 40 °C

Minimum 12%

Yearly average 44%

### **2-4- Altitudes**

From sea level up to (1000m).

### **2-5- Sand storm**

The equipment's shall be suitable for outdoor installations and subjected to frequent sand storms and heavily polluted atmosphere.

### **2-6- Wind Velocity**

Max velocity (for design purpose) (140 km/ hr) or 39m/sec.

### **2-7- Composition of Soil**

The soil consists mainly of hard clay containing deposit gravel.

### 3- Technical Requirement

3-1 System Data: - Shall be according to Table below:

**Table 1**

a.11 KV System	
Nominal voltage	11000 volts
Highest system voltage	12000 volts
System	3-phase, 3wire neutral earthed through resistance of 21.1 Ohm
Short circuit breaking current	limiting the earth fault current to 300A
b. 0.416 KV System	
Nominal voltage	400 Volts
System	3phases, 6 wires (4 wires with neutral solidly grounded + 1 wire light + 1 wire grounded system
Frequency	50 Hz

### 4- Materials and Process:

The poles shall be made from longitudinally welded tube sections of hot rolled structural carbon steel in accordance with JIS-G-3444 ( ST-51 ) or in accordance with BS-4360 or in accordance with any international equivalent standards like DIN 17100 ( ST-52 ) with considering the design factor of safety for design of the poles shall be considered (1.5).

### 5- Construction and Fittings:

#### 5-1-Tubular Steel Supports:

Tubular steel poles shall be of the following two types:

#### a) Stepped Poles: -

Stepped poles shall be made from one length of tube, seamless or welded, the diameter being reduced in parallel steps by passing the tubes through series of dies. Where welded tubes are used they shall have one longitudinal weld seam only, Stepped poles shall have the same wall thickness at any section of its whole length.

#### b) Swaged Poles: -

Swaged poles shall be made of seamless or welded tubes of suitable lengths swaged and joined together. No circumferential joints shall be permitted in the individual tube lengths of the poles. If welded tubes are used they shall have one longitudinal weld seam only; and the longitudinal welds shall be staggered at each swaged joint. Swaged poles shall be manufactured from tubes brought together when hot. A swaged pole shall consist of three-tube section with diminishing diameters, the bottom Section being the biggest in size , The length of the overlap shall be at least 3 times The diameter of the smaller tube , See Drawing (No.1) and Drawing (No.2).The upper edge of tube at the joint shall be chamfered off at an angle of 45.

The top end of all poles shall be rounded off and sealed completely. Welded type poles made out of three- sections similar to the design but jointed together via reducers welded to the pole section shall also be accepted subject that the mechanical characteristics and tests are the same as for swaged or stepped poles.

### **5-2-Scheduled Equipment:**

a- The pole design shall be in accordance with Table below:-

**Table 2**

	Medium Voltage Pole	Low Voltage Pole
Effective length (m)	11.00	9.00
<b>Top Section</b>		
Length x outside diameter (mm)	3000 x 114.3	2000 x 89.1
Minimum wall thickness (mm)	3.5	3.5
<b>Middle Section</b>		
Length x outside diameter (mm)	3000 x 139.7	2300 x 114.3
Minimum wall thickness (mm)	4.5	4.5
<b>Bottom Section</b>		
Length x outside diameter (mm)	5000 x 165.2	4700 x 139.7
Minimum wall thickness (mm)	5.0	5.0
Sinking Depth (m)	2	1.5
Working Load (kgf)	285	210
Point of load application from top(m)	1.2	0.6
Factor of Safety	1.5	1.5
yield strength (N/mm <sup>2</sup> )	355	355

b - All (11 m) pole shall be fitted with (A) shaped clamped welded to the poles top and having an approximate height of (25 cm) . The clamp which shall be fixing the upper (11kv) pin insulator, is to be made of plate steel having of chemical and mechanical properties similar to that of the tubular poles.

The plate shall have a width of (75 mm) and (6 mm) thickness with two holes (25mm) diameter of steel (ST-41) or (ST-42), each drilled at center coincident with the centerline of the pole.

The extra length of ((A)) clamp shall not be considered in the effective length of the (11 m) pole.

c- six nos.(17.5mm) dia. through holes shall be drilled at the top sections of poles for the purpose of fixing low tension shackle insulators. The upper-most hole shall be located (120cm) below the top of the (11 m) pole, the rest spaced (30 cm) between centers vertically downwards according to the dimensions in Drawing (No. 1).

The same number of holes shall be drilled through the (9 m) poles but the upper-most hole shall be drilled (15cm) below the top, according to the dimensions in Drawing (No. 2).

For earthing purposes a (20mm) dia. hole shall be drilled at the bottom of each pole at a distance of (15cm) there from, and a suitable length (M-18) galvanized bolt, nut & washer shall be supplied with each pole.

### **5-3 Galvanization:**

The poles shall be hot-dip galvanized thoroughly internally and externally as per according to ISO 1461 or (BS 729). Poles and other hollow items shall be galvanized both inside and out.

The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath that could have a detrimental effect on the durability of the zinc coating. Before pickling, all welding, drilling, cutting and grinding shall be completed and all grease, paint, varnish, oil and welding slag shall be completely removed. All protuberances which could affect the life of galvanizing shall also be removed. To avoid the formation of white rust all galvanized material shall be packaged in such a way to ensure adequate ventilation between parts during shipping and storage.

#### **5-4- Drillings:**

Poles shall be drilled according to the dimensions given in Drawing (No.1) and Drawing (No.2). All holes shall be drilled prior to the galvanizing process and have smooth uniform finish after galvanizing.

#### **5-5- Pole Cap:**

Each pole shall be supplied with a pole cap, to seal the aperture at the top of the pole. The cap shall be manufactured according to the dimensions given in Drawing (No.1) and Drawing (No.2).

#### **5-6- 'A' Clamps:**

Medium Voltage pole shall have welded to the top an 'A' clamp for the purpose of supporting the pin stalk of a top phase insulator. The additional height due to the attachment of the clamp shall not be considered as part of the effective length of the pole and, where measurements are quoted "from the pole top", they refer to the top of the main pole structure. The A shaped clamp shall be manufactured according to the dimensions in Drawing (No.1) and the completed clamp shall be welded to the pole before galvanizing. All welding and drilling involved in the manufacture of the 'A' Clamp will be carried out prior to the galvanizing process.

#### **5-7-Identification Marks:**

A line of dimension (5x150) mm shall be engraved/punched/embossed on each pole. The line shall be perpendicular to the longitudinal axis at a distance of 3m from bottom edge of the pole before galvanizing. The following text shall be engraved/punched/embossed (20) mm below the line: -

- 1- Manufacturers name/Trade mark,
- 2- Year of manufacturing,
- 3- Batch or Order Number.

The text shall be at least (10) mm in height and the depth of engraving/height of embossing shall be such that the text remains legible after galvanizing.

#### **5-8- Cross arm (Strain):**

Each Medium Voltage pole shall be supplied with a cross arm and its associated clamp according to the dimensions in Drawing (No. 1). The cross-arm is intended to be fixed to the pole by means of the clamp at a distance of 600mm below the pole top. Every set shall include the following:

- One galvanized steel channel cross arm (100x50x6 mm) with length of (1250 mm) according to the dimensions given in Drawing (No. 1) and manufactured from steel (ST-41) or (ST-42).
- One galvanized steel clamp according to the dimensions given in Drawing (No.1) and manufactured from steel (ST-41) or (ST-42).
- Two galvanized high-tensile steel ( M16 x 60) bolts with a minimum threaded length of (50 mm). Each bolt shall be supplied complete with a galvanized nut, plain washer and spring washer.

#### **5-9 D-iron Bracket:**

galvanized steel D-iron bracket for porcelain shackle insulator according to the dimensions given in Drawing (No.2) and manufactured from steel (ST-41) or (ST-42), with galvanized high-tensile steel bolt (M-16) of a suitable length, Each bolt shall be supplied complete with a galvanized nut, plain washer and spring washer.

**5-10- Bolts, Nuts & Washers:**

All bolts and nuts supplied under this series of Specifications shall comply with the following: The bolts and nuts shall comply with ISO 4016. Mechanical properties shall be in accordance with ISO 898.

The dimensions and characteristics in this specification are intended to describe typical ISO metric bolts, nuts, and washers, such as are commonly used in the construction of electrical distribution lines, plant and equipment.

The safe working shear stress of bolts is taken as 120MPa, with the area of the bolt measured at the root of the thread. The table 3 below shows the ultimate tensile strength, the tensile stress areas, the safe working tensile loads and the safe working shear loads for the bolts covered by this specification. The ultimate shear strength has been assumed to be 75% of the ultimate tensile load and a factor of safety of 2.5 has been applied:

**Table 3:**

Bolt Size	Ultimate Tensile Stress (N/mm <sup>2</sup> )	Tensile Stress Area (mm <sup>2</sup> )	Ultimate Tensile Strength (kN)	Working Tensile Load (kN)	Safe Working Shear Load (kN)
M16	400	157.0	62.80	25.12	18.84
M18	400	204.0	81.6	32.64	24.48
M20	400	245.0	98.00	39.20	29.40

Screw threads shall be parallel throughout their length. They shall be so formed that, after galvanizing, the nut can be easily screwed by hand over the whole length of thread, without excessive play. Before dispatch from the works, one washer shall be fitted to each bolt and a nut shall be screwed on the whole threaded length and left in that position. Washers shall be round, flat, of mild steel, unless where otherwise specified. Spare bolts, nuts and washers to the amount of 5% of the total, shall be supplied. In addition, each pole shall be supplied with one M18 galvanized steel bolt, (60mm) long, with a threaded length of (50mm), complete with a suitable nut, washer and lock washer

**6- Quality Control:**

The supplier shall submit evidence of ISO 9001 accreditation with his tender. The supplier shall also submit detailed quality control procedures with his tender. Any potential supplier that does not submit these documents shall be disqualified from the evaluation process. All materials under contract shall be tested at the manufacturing works to verify compliance to our specifications. The MoE shall appoint an inspector for this purpose and paid accordingly, but the manufacturer shall supply all equipment and facilities to our inspector necessary for conducting all such tests without extra charge

Random samples from each batch shall be inspected by the purchaser’s engineers or the purchaser’s nominated inspector. The minimum quantities for sampling from each batch are listed in the table below

- a- Number of poles selected for conducting tensile test and chemical analysis shall be as given Table below.

**Table 4:**

Batch Size	Number of Poles
up to 500	1
501 – 1000	2
1001 – 2000	3
2001 – 3000	4
3001 and above	5

b- Number of poles selected for conducting the deflection, permanent set, Dimensions tests, Galvanization tests and drop tests specified in Table below:

**Table 5:**

<b>Batch Size</b>	<b>Number of Poles</b>
<b>up to 500</b>	<b>5</b>
<b>501 – 1000</b>	<b>8</b>
<b>1001 – 2000</b>	<b>13</b>
<b>2001 – 3000</b>	<b>18</b>
<b>3001 and above</b>	<b>20</b>

The Supplier shall aid the work of the Purchaser’s inspector by providing copies of all relevant standards, and allowing the inspector full use of the necessary tools, instruments and laboratory equipment, together with ample space and assistance in the handling of poles for inspection. Any costs incurred in assisting with the inspections shall be borne by the supplier.

The following parameters shall be examined: -

- a. General appearance
- b. Finishing
- c. Dimensions
- d. Tensile test
- e. Chemical analysis test
- f. Sweep
- g. Thickness and appearance of galvanizing

As a minimum requirement, the following dimensional checks for Poles shall be witnessed by the inspector shall be as given below Table: -

**Table 6:**

<b>Dimension</b>	<b>Tolerance</b>
<b>Length</b>	<b>+0.25%</b>
<b>Bottom diameter and circumference</b>	<b>+2.5%</b>
<b>Top diameter and circumference</b>	<b>+2.5%</b>
<b>Wall thickness</b>	<b>+10%</b>
<b>Concentricity</b>	<b>±1%</b>
<b>Accuracy of drillings</b>	<b>±0.5%</b>
<b>Sweep, where appropriate</b>	<b>±1%</b>

Cross arms, clamps and fittings shall have the following parameters examined: -

- h.General appearance
- i. Finishing
- j. Dimensions
- k.Tensile test
- l. Chemical analysis test
- m. Straightness
- n.Appropriate markings
- o.Accuracy of drillings
- p.Thickness and appearance of galvanizing

As a minimum requirement the following dimensional checks for Fitting and accessories shall be witnessed by the inspector shall be as given Table below: -

**Table 7:**

Dimension	Tolerance
Length	+0.25%
Cross section of cross arm	+10%
Dimensions of clamp	+2.5%
Position and size of suspension holes	±0.5%
Verticality of all through holes	±0.5%

The group of poles or fittings offered at any one time shall constitute a batch. Within a batch, poles and fittings presented for inspection shall be segregated on a size basis. If the inspected items have damage or deviations on a quantity greater than 5% of the batch, then the entire batch shall be unconditionally rejected without further sorting. Poles delivered to stores or sites shall be free of all damage to protective zinc coating, and shall not be out of straight by more than one thousandth of the length of the pole.

**7- Testing and inspection:**

Test frequency shall conform to the inspection frequency listed in table 5. Testing shall be conducted by the supplier as follows: -

**- Drop Test (type test):**

The pole shall be dropped vertically from a height of 3m above arm surface. The test will be deemed successful if no welds crack or break.

(Load Test):

**Table 8**

Load	Type of Load	Acceptance Criteria
Ps	Working load	No deflection
Pb	Ps x 1.5	Destruction

Where: -

Ps = Specified working load.

Pb = Breaking load.

All test loads shall be applied at a distance 600mm from the pole top with the direction of force being perpendicular to the longitudinal axis of the pole. The bottom of the pole shall be securely fixed during testing at a distance equal to the sinking depth as shown in table 2. Loads shall be applied gradually and held constant at the final value for a period of 2 minutes after which the load will be released gradually. The purchaser reserves the right to witness the testing at the expense of the supplier.

**8- Handling:**

Poles and cross arms shall be handled with due care. Specifically, poles shall not be dragged along the ground and care shall be taken not to cause damage to the protective coating.

## **9- Packing:**

### **9-1-Protection**

All poles shall be packed suitably to provide full protection during multiple loading/offloading and storage, as the poles will be redistributed several times to various destinations.

### **9-2-Bundle Size:**

Poles shall be packed in bundles on wooden supports placed at right angles to the pole axis with a ledge for each layer of poles with one on top. The number of poles in each bundle shall be limited to the following:

- a) **Tubular Steel Poles 9m:** Maximum 12 poles per bundle.
- b) **Tubular Steel Poles 11m:** Maximum 9 poles per bundle.

a minimum cross section of (100 x 100) mm and adequate length. These ledges shall be carved on top and bottom faces to suit the outside diameter of the pole at the plane of contact. The minimum thickness of wood after carving shall not be less than (75 mm).

Each Wooden support/ledge shall be strapped around by a tight steel band fixed to the ledges at least at two points on each

There shall be a minimum of three evenly distributed sets of cross supports/ledges, having side to prevent slipping. Metal staples or similar devices, which do not weaken the steel band, shall be used for fixing. The steel band shall not come in contact with the poles. Two or more additional tight bands made of nylon or similar material, strong enough for the application shall be provided between two wooden ledges.

The bundle shall be placed on wooden supports of minimum cross section of (150x100) mm running along the entire length of the bundle. These wooden supports shall be fixed to the bottom most ledges so that they become integral part of the bundle.

Both the ends of the bundle shall be covered using waterproof plywood sheets of minimum (6mm) thickness to protect the pole ends and A-clamps. All markings shall be indelibly made on one of these plywood end shields.

The center of gravity of the bundle shall be clearly marked to facilitate safe handling of the bundle. The packing arrangement is typically illustrated in the sketch in Drawing (No. 3).

Cross-arms and accessories shall be packed in sea-worthy wooden packing cases

### **Note:**

- a. All drawings of the pole and its accessories subjected to our approval before start manufacturing.
- b. The type of poles (galvanized) will be fixed by the tenderer.

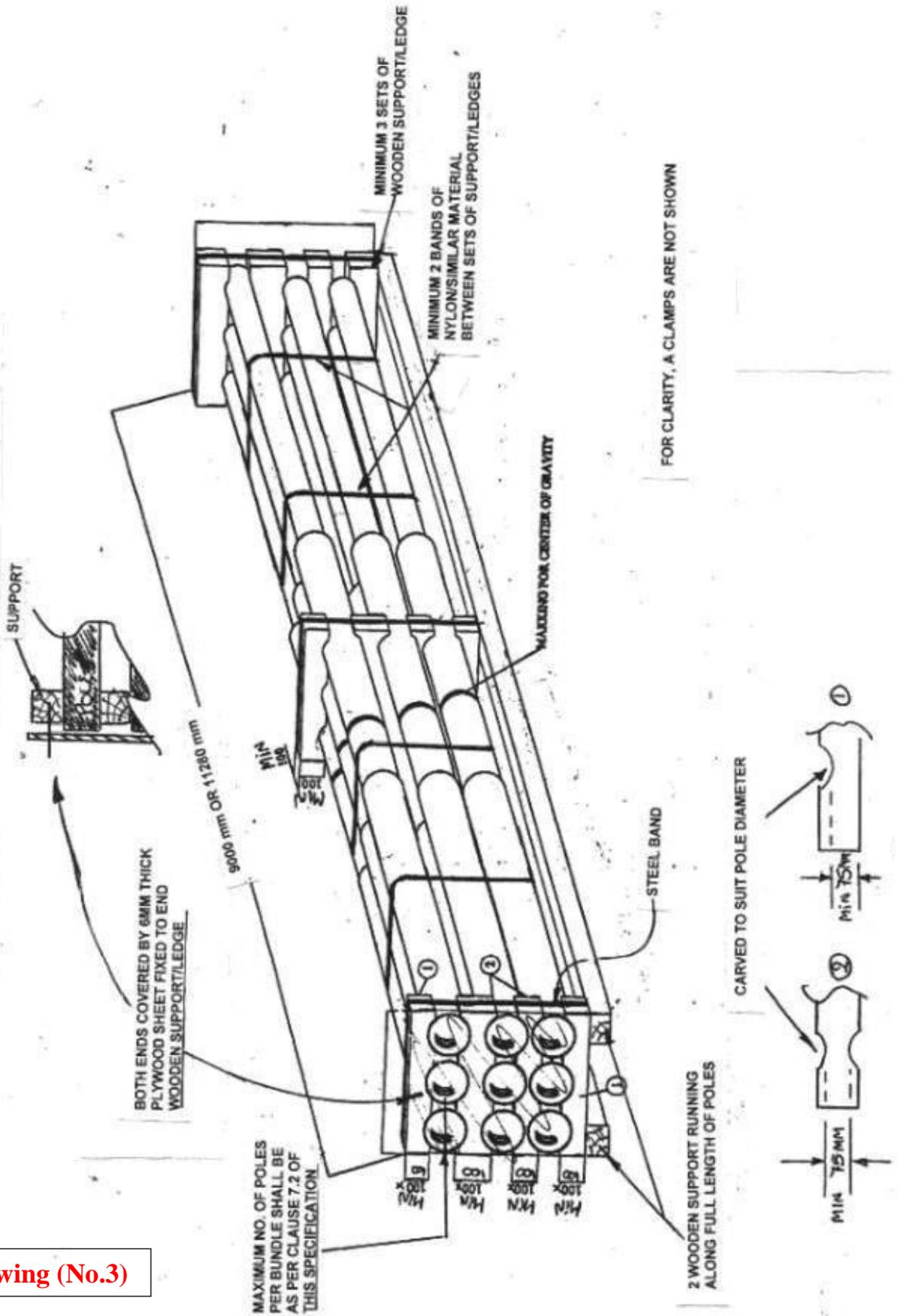




### 11-Typical Packaging Arrangement

#### ANNEXURE-1 TO SPECIFICATION L-01

#### TYPICAL ILLUSTRATION OF PACKING ARRANGEMENT FOR STEEL POLES



Drawing (No.3)