JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE SOCIALIST REPUBLIC OF VIET NAM
THE MINISTRY OF ENERGY

REHABILITATION OF DA NHIM POWER SYSTEM IN THE SOCIALIST REPUBLIC OF VIET NAM

DRAFT TECHNICAL SPECIFICATIONS

Volume III of III

JUNE 1995

NIPPON KOEI CO., LTD.
TOKYO, JAPAN

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DRAFT TECHNICAL SPECIFICATION

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SECTION 1 GENERAL

1.1 Scope of Work

The Contract is covering the designing, manufacturing, supplying, testing before shipment, finishing, painting, packing for transport, insuring and shipping of :

(a) Aluminium cable steel reinforced, 410 mm^2 and 336.4 MCM
(b) Galvanized steel stranded wire, 90 mm^2 and 22 mm^2
(c) Insulators and insulator sets for 230 kV and 110 kV use
(d) Accessories for conductors and overhead earthwires
(e) Galvanized steel materials for repair of towers
(f) Galvanized steel tubular poles with crossarms and guy wires
(g) Tools, appliance and materials for maintenance use

All works shall be in accordance with these specifications, the accompanying drawings and tender schedules, and shall be compatible with the existing facilities.

1.2 General Description of the Project

The materials, tools and others to be supplied under this contract will be used for the restoration works of the 230 kV single circuit transmission line between the Da Nhim No.1 power station and the Saigon substation, and 110 kV single circuit transmission lines in the Da Nhim power system. The restoration works at site will be implemented by the Employer.

1.3 Climate

The annual climatic cycle is composed of a dry and wet season. The dry season is from mid-October to mid-May and remaining months are wet.

Shade temperature will normally vary between 10°C and 40°C according to the past records. In the wet season, heavy rain and storm winds are expected.

IN choosing materials and their finishes, due regard shall be given to the humid tropical conditions under which the plant will be called upon to work.

1.4 Transportation

All sea cargoes destined for the site are landed at the port of Saigon. The landing, customs clearance and handling of cargoes at the port of Saigon will be carried out by the Employer.

In no case, materials and others shall be touched with sea water during loading, transshipment and unloading and shipped with fertilizer or such chemical products as may give corrosive atmosphere on the galvanized surface.

1.5 Program and Progress

A contract schedule for the whole works of the project has been prepared by the Employer, and is attached at the end of this Specifications. This schedule will assist Tenderers and the Contractor in preparing their detailed schedules of delivering materials.

The following dates shall be considered critical and shall be included in all programs prepared by the Contractor.

(a)	Design calculation and drawings	by
(b)	Shipping of tower materials and poles	by
(c)	Shipping of conductors and overhead earthwire with accessories	by
(d)	Shipping of tools and appliances	by

Within one week after the verification of the Contract by OECF, the estimated program shall be prepared in a bar chart form, covering the design, manufacture, testing and shipment, by the Contractor and shall be submitted for approval to the Engineer. Upon approval of the program by the Engineer, it shall thereafter be referred to as the approved program and shall become a part of the Contract.

1.6 Working Drawings

Working drawings of the materials and tools shall be submitted to the Employer and the Engineer for approval before the work is put in hand and at an early stage of the Contract.

It shall be understood, however, that approval of the drawings will not exonerate the Contractor from any responsibility in connection with the work.

After approval of drawings by the Engineer, the Contractor shall supply the approved drawings in the following copies. Further copies of particular drawings are to be provided if requested by the Employer.

	Employer	Engineer
Drawings for approval :	1 set	3 sets
Approved drawings :	10 sets	4 sets

All drawings submitted for approval to the Employer and the Engineer for any other reason shall be sent by the registered airmail.

1.7 Standard and Workmanship

All materials and tools shall be new, the best of the respective kinds and of such as are usual and suitable for work of like character. All materials shall comply with the latest IEC or Japanese standards unless otherwise specified or permitted by the Engineer.

All workmanship shall be of the highest class throughout to ensure smooth and vibration free operation under all possible operating conditions, and the design, dimensions, and materials of all parts shall be such that the stresses to which they may be subjected shall not render them liable to distortion, undue wear, or damage under the most severe conditions encountered in service.

All corresponding parts shall be made to gauge, shall be interchangeable wherever possible and shall be such as will facilitate the fitting of replacement parts.

All bolts and nuts shall conform to the latest standards of the International Organization for Standardization covering these components and shall all conform to the standards for metric sizes. The Contractor shall use exclusively the standards and size system presented in his Tender and accepted and incorporated in this Contract.

(1) Standard Specifications

IEC standards and Japanese Standards shall be applied for all materials and tools. Other national or international standards may be accepted provided the requirements therein are, in the opinion of the Engineer, equivalent to the current issue of IEC or the Japanese standards.

If the Contract Documents conflict in any way with any or all of the above standards or codes, the Contract Documents shall have precedence.

(2) Galvanizing

Unless specifically mentioned to the contrary, all iron and steel shall be galvanized in the factory after hop fabrication is completed. The zinc coating is to be uniform, clean, smooth and as free from spangle as possible. Galvanizing shall be applied by the hot dip process for all parts other than steel wires. All steel wires shall be galvanized by a recognized trade standard.

The minimum quantities of zinc coating shall be 350 gram/m^2 for bolt and nuts and 550 gram/m^2 for all other parts except steel wires, unless otherwise specified in the Contract Documents. The uniformity of zinc coating, tested by dipping the sample into a solution of copper sulfate, shall be such that no iron or steel surface shall be exposed until the surface has been dipped four times for bolts and nuts, and six times for all other parts.

The preparation for galvanizing and the galvanizing itself shall not distortion or adversely affect the mechanical properties of the materials.

Special treatment during galvanizing to prevent the formation of "white rust" during shipment or storage is required. The Tenderer shall state in his Tender the treatment to be used.

(3) Casting

Casting shall be true to pattern, of workmanlike finish and of uniform quality and condition, free blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, and shall be satisfactorily cleaned for their intended purpose.

Major defect on castings shall not be repaired, plugged, or welded without permission of the Engineer. Distinction of major defect and minor defect shall be proposed by the

Contractor. Such permission will be given only when the defects are small and do not adversely affect the strength, use, or machinability of the castings. Excessive segregation of impurities or alloys at critical points in a casting will be a cause for its rejection. The largest fillets compatible with the design shall be incorporated wherever a change in section occurs. All castings shall be stressed-relieved before machining and again after repair by welding.

(4) Welding

Wherever welding is specified or permitted, a welding process, including stress relieve treatment as required if necessary, conforming to an appropriate and widely recognized professional standard shall be used. All welders and welding operators shall be fully qualified by such a standard.

After the welding process has been approved by the Engineer, the Contractor shall record it on a special drawing that shall thereupon become one of the drawings of the Contract.

Radiograph inspection shall be carried out by the Contractor when required by the standards, these Specifications or the design criteria employed. All welds that, in the opinion of the Engineer, may be subject to the full stress induced in the adjacent plate, or which in the opinion of the Engineer, do not appear to conform to the welding standard shall be radiographed when required by the Engineer.

All defects in welds shall be chipped out to sound metal and such areas shall be magnetically or ultrasonically tested to ensure that the defect has been completely removed before repair welding.

Plates to be joined by welding shall be accurately cut to size and rolled by pressure to the proper curvature which correction by blows will not be allowed. The dimensions and shape of the edges to be joined shall be such as to allow through fusion and complete penetration, and the edges of plates shall be properly formed to accommodate the various welding conditions.

The surfaces of the plates adjacent to the edge to be welded shall be thoroughly cleaned of all rust, grease and scale to bright metal. All important weldings shall be stress-relieved by heat treatment before machining.

(5) Marking

(a) All tower members are to be stamped with distinguishing the quality and size corresponding to those on the approved drawings or material list. These marks shall also be impressed before galvanizing and are to be clearly readable afterwards.

(b) All insulator units shall have impressed on them, before firing the glaze, the name, initials or trade mark on the manufacturer, the year of manufacture and the mechanical strength.

(c) Individual items of hardware and fittings shall preferably carry identification marks to facilitate assembly and sorting in stores.

(6) Packing

The materials and tools shall be packed in an approved manner, properly or protected for shipment from the Contractor's premises to the port of Saigon. Each crate or package shall contain a packing list in a water-proof envelope, unless otherwise approved.

All cases, package, etc., shall be clearly marked on the outside to indicate the total weight, net weight, correct rolling direction with an arrow on drums for the conductors and overhead earthwires and shall bear identification marks relating them to the appropriate shipping documents.

1.8 Inspection and Test

The Contractor's attention is drawn to the provisions for the inspection and test specified in each section.

The Contractor shall carry out the commercial routine test in the presence of the Engineer during fabrication of materials and tools in accordance with the applied standard, and submit the test data for the Engineer's review. The Contractor shall inform in writing the scheduled date of performing such test at least one week before, otherwise the Engineer reserves the right of ordering to perform such test on the date decided by the Engineer.

Immediately after performing tests, the Contractor shall prepare and submit test data and reports in six copies to the Employer and two copies to the Engineer. The Engineer reserves the right of holding in abeyance the issue of Inspection Certificate until the Contractor submits the said test data and reports.

The Engineer may require to inspect the packing before the materials and tools are shipped.

SECTION 2 CONDUCTORS, OVERHEAD EARTHWIRES AND FITTINGS

2.1 Conductors and Overhead Earthwires

2.1.1 Power Conductors

The power conductors used for the existing transmission lines are the following Aluminium Conductor Steel Reinforced (ACSR).

For 230 kV transmission line : ACSR 410 mm^2
For 110 kV transmission lines : ACSR 336.4 MCM and ACSR 185 mm^2

The power conductors to be supplied under the Contract are ACSR 410 mm^2 and ACSR 336.4 MCM. ACSR 410 mm^2 shall comply with Japanese Industrial Standard (JIS) C-3110 ,while ACSR 336.4 MCM shall comply with the standards for American Society for Testing and Materials (ASTM B 232-92).

The characteristics of the conductors shall be as summarized hereunder.

	ACSR 410 mm^2	ACSR 336.4 MCM
Nominal sectional area	410 mm^2	336.4 MCM
Calculated section	Aluminium : 413.40mm^2	Aluminium : 170.56 mm^2
	Steel : 67.35mm^2	Steel : 27.86 mm^2
	Total : 480.75mm^2	Total : 198.42 mm^2
Stranding (nos./diameter)	Aluminium : 26/4.5 mm	Aluminium : 26/2.888 mm
	Steel : 7/3.5 mm	Steel : 7/2.245 mm
Outside diameter	Aluminium : 28.5 mm	Aluminium : 18.28 mm
	Steel : 10.5 mm	Steel : 6.735 mm
Electr. resistance (20°C)	less than 0.0702 /km	less than 0.1612 /km
Min. tensile strength	13,890 kgf	6,110 kgf

The outermost layer of the power conductors shall be right handed (Z-lay). The aluminium shall be of the highest purity commercially obtainable that shall not be less than 99.5%. The steel wires shall be galvanized in an approved manner before stranding and the zinc coat shall be smooth, clean, of uniform thickness and free from defects. Minimum coating of zinc shall be 230 g/m^2.

Characteristics of the individual wires shall be as follows:

	Al 4.5mm	St 3.5 mm	Al 2.888 mm	St 2.245 mm
Tolerance of diameter	± 0.04 mm	± 0.07 mm	± 1.00 %	+ 0.04 & - 0.03 mm
Min. tensile strength	16.17 kg/mm^2	130 kg/mm^2	25.5 ksi	1,450 MPa
Minimum elongation (%)	2.0	4.5	1.7	3.0
Uniformity of galvaniz. (min.)	-	4 times	-	4 times

The conductors shall be supplied on impregnated drums of approved materials constructed so as to enable the conductors to run smoothly. Arrow mark and other particulars to be instructed by the Engineer during the Contract shall be stenciled on the drums.

Length of the power conductors per drum shall be 1,000 meters for easy transportation in the field.

2.1.2 Overhead Earthwires

The overhead earthwires used for the existing transmission lines are the following galvanized steel stranding wires (GSW).

For 230 kV transmission line : GSW 90 mm^2
For 110 kV transmission lines : GSW 22 mm^2

The overhead earthwires to be supplied under the Contract are GSW 90 mm^2 and GSW 22 mm^2 shall comply with Japanese Industrial Standard (JIS) G-3537 (1988) or equivalent.

The characteristics of the earthwires shall be as summarized hereunder.

	GSW 90 mm^2	GSW 22 mm^2
Nominal sectional area	90 mm^2	22 mm^2
Calculated section	88.00mm^2	21.99 mm^2
Stranding (nos./diameter)	7/4.0 mm	7/2.0 mm
Outside diameter	12.0 mm	6.0 mm
Grade of min. strength	90 kg/mm^2	90 kg/mm^2
Min. tensile strength	7,280 kgf	1,820 kgf

The outermost layer of the earthwires shall be right-handed (Z-lay). The steel wires shall be galvanized in an approved manner before stranding and the zinc coat shall be

smooth, clean, of uniform thickness and free from defects. Minimum coating of zinc shall be 230 g/m^2.

Characteristics of the individual wires shall be as follows:

	4.0 mm	2.0 mm
Tolerance of diameter (mm)	± 0.10	± 0.06
Min. tensile strength (kg/mm^2)	90.0	90.0
Minimum elongation (%)	5.0	4.0
Minimum number of torsion	10 times	12 times

The earthwires shall be supplied on impregnated drums of approved materials constructed so as to enable the earthwires to run smoothly. Arrow mark and other particulars to be instructed during the Contract shall be stenciled on the drums.

Length of the earthwires per drum shall be 1,000 meters for easy transportation in the field.

2.2 Midspan Joints and Repair Sleeves

2.2.1 Midspan Joints

Midspan joints to be supplied under the Contract shall be for the undermentioned power conductors and overhead earthwires.

Power Conductor and	Outside Diameter	
Overhead Earthwire	Aluminium	Steel
ACSR 410 mm^2 (JIS)	28.5 mm	10.5 mm
ACSR 336.4 MCM (ASTM)	18.28 mm	6.735 mm
ACSR 2K 185/29 (Russian Standard)	18.8 mm	6.9 mm
GSW 90 mm^2 (JIS)	-	12.0 mm
GSW 22 mm^2 (JIS)	-	6.0 mm
GSW TK-50 (Russian Standard)	-	9.2 mm

Midspan joints of the conductors and earthwires shall be of compression type and shall be free from slipping off, damage to or failure of the complete conductors, earthwires or any parts thereof at load less than 95 per cent of the ultimate breaking strength of the conductors and earthwires.

Electrical conductivity and current carrying capacity of the midspan joints for the power conductors shall not be less than those of equivalent length of the conductors.

The cut ends of steel wires and steel component inside the joint shall be protected from the weather in an effective and permanent manner.

Aluminium sleeves shall have plug holes for injecting filling compound.

All midspan joints shall be supplied with aluminium fool-proof gauges or anti-displacement pins for correct positioning, adequate quantity of filling compound in injectors, and aluminium collars for gap filling.

Full detail of the joints, including an illustration of practices for filling the air gap between sleeves, method of correct positioning of steel sleeves, gauges for ascertaining the compressed size, etc., shall be submitted with the Tender.

2.2.2 Repair Sleeves

Repair sleeves for the power conductors shall be of compression type and the conditions stated above for the tension joints shall apply to the repair sleeves where applicable. Repair sleeves to be supplied are those for ACSR 410 mm^2, ACSR 336.4

MCM and ACSR 2K 185/29. Outside diameters of the conductors are as shown in the table above.

2.3 Vibration Dampers

Vibration dampers for power conductors shall be of galvanized Stockbridge type. The dampers shall be designed to be attached to the conductors in a manner that will prevent damage thereto and free drop of the weight in service. Clamping bolts shall be provided with domed self-locking nuts designed to prevent corrosion to the thread.
The nominal weight of damper shall be 6.5 kg for ACSR 410 mm^2 and 5 kg for ACSR 336.4 MCM.

2.4 Armour Rods

Armour rods are used for all suspension points of ACSR 410 mm^2. The armour rods shall be of preformed type and consist of 10 pieces of rods for one set.

2.5 Corona and Radio Interference

The design of all power conductor fittings shall avoid sharp corners or projections that would produce high electrical stress in normal working. The design of adjacent metal parts and matching surfaces shall be such as to maintain good electrical contact under service conditions. Particular care shall be taken during manufacture of conductors and fittings and during subsequent handling to ensure smooth surfaces free from abrasion.

2.6 Inspection and Test

The following tests shall be carried out at the manufacturer's works. Unless otherwise specified in this Contract, selection of test samples, number of specimen and acceptance of the results shall be in accordance with the terms of the relevant standards or as instructed by the Engineer.

Where no applicable terms, the Engineer is to instruct details in advance of the inspections and tests in response to request of the Contractor.

2.6.1 Conductor

(1) Aluminium wire

- (a) Outside view and construction
- (b) Tensile strength and elongation

(2) Steel wire

- (a) Outside view and construction
- (b) Tensile strength and elongation
- (c) Galvanizing (quantity and torsion)

(3) Stranded conductor

- (a) Outside view and construction
- (b) Resistivity
- (c) Tensile strength
- (d) Weight

2.6.2 Overhead Earthwires

(1) Steel wire

(a) Outside view and construction
(b) Tensile strength and elongation

(2) Stranded earthwire

(a) Outside view and construction
(b) Tensile strength
(c) Weight

2.6.3 Midspan Joint

(1) Conductor joint

(a) Outside view and dimension
(b) Compression and tensile strength
(c) Electrical resistance
(d) Galvanizing (Quantity of zinc on steel sleeve)

(2) Earthwire joint

(a) Outside view and construction
(b) Tensile strength
(c) Galvanizing (quantity of zinc)

2.6.4 Repair Sleeve

(a) Outside view and construction
(b) Electrical resistance

2.6.5 Vibration Damper

(a) Outside view and construction
(b) Weight of damper
(c) Galvanizing (quantity of zinc)

2.6.6 Armour Rods

(a) Outside view and construction

(b) Tensile strength

(c) Assembly on conductor

SECTION 3 INSULATORS AND FITTINGS

3.1 Insulators

Suspension and tension insulator sets for both 230 kV and 110 kV lines shall consist of porcelain or toughened glass insulator units of the cap and pin type with ball and socket couplings and shall comply with IEC 305 in all respect.

The colour of the porcelain insulator units shall be grey and that for the glass insulator units shall be colourless or skyblue. The insulator surface shall be free from bulges, hair line cracks and other defects. The glaze shall be uniform throughout the surface.

Both standard suspension and fog type insulators shall be supplied.

The dimension of insulator units shall be 254 mm in diameter and 146 mm in spacing. The dimension of ball and socket shall comply with the IEC Recommendation, Publication 120, 16 mm ball and socket.

Electrical and mechanical characteristics of each unit shall be as under-mentioned.

	Standard	Fog
Withstand voltage		
Power frequency, dry	70 kV	70 kV
Power frequency, wet	40 kV	41 kV
Impulse, 1.2x50 micro-sec.	105 kV	120 kV
Power frequency puncture voltage	140 kV	140 kV
Minimum leakage distance	280 mm	430 mm
Minimum electromechanical strength	12,000 kg	12,000 kg

Retaining pins shall be of stainless steel or phosphor bronze and so made and shaped that when set and under any condition of handling and service nothing but extreme deformation of the retaining pin shall allow separation of insulator units or fittings or shall cause any risk of the retaining pins being displaced. The design shall be such as to allow easy removal for replacing of insulator units or fittings.

3.2 Insulator Sets

Suspension and tension insulator sets shall consist of the following strings of units. Construction of the existing insulator sets is shown on the attached Figure Nos. TL-230-01 and TL-110-01. Insulator sets supplied under the Contract shall be same as or equivalent to the existing insulator sets.

3.2.1 Insulator Sets for 230 kV Line

Following insulator sets are used for the 230 kV transmission line.

	No. of String per Set	No. of Units per String
Standard suspension insulator set	1	14
Double suspension insulator set	2	14
Standard tension insulator set	2	14
Uplift tension insulator set	2	14

Electrical and mechanical characteristics of insulator sets complete with all fittings shall be as specified below:

	Suspension Set		Tension Set	
	Standard	Double	Standard	Uplift
Withstand voltage				
Power frequency, dry	600 kV	600 kV	600 kV	600 kV
Power frequency, wet	480 kV	480 kV	480 kV	480 kV
Impulse, positive 1.2x50 μ-sec.	1,100 kV	1,100 kV	1,100 kV	1,100 kV
Minimum mechanical strength	12 tons	12 tons	22 tons	22 tons

(except clamp)

3.2.2 Insulator Sets for 110 kV Line

Following insulator sets are used for the 110 kV transmission line.

	No. of String per Set	No. of Units per String
Single suspension insulator set	1	8
Special single suspension insulator set	1	8
Double suspension insulator set	2	8
Special double suspension insulator set	2	8
Single tension insulator set	1	8
Special single tension insulator set	1	8
Double tension insulator set	2	8
Reversible light duty tension set	1	8

Electrical and mechanical characteristics of insulator sets complete with all fittings shall be as specified below:

	Suspension Set		Tension Set	
	Standard	Double	Standard	Uplift
Minimum withstand voltage				
Power frequency, dry	375 kV	375 kV	375 kV	375 kV
Power frequency, wet	295 kV	295 kV	295 kV	295 kV
50% flashover voltage, impulse positive 1.2x50 μ-sec.	630 kV	630 kV	630 kV	630 kV
Minimum mechanical strength	7 tons	12 tons	7 tons	12 tons
				(including clamp)

3.3 Dead End Clamp for 230 kV Line

The dead end clamp shall be of Asahi Electric Works' model or equivalent. The model is shown on the attached Figure No. TL-230-02. The conditions stated for the joints of conductors shall also be applied to the clamps where applicable. The clamp shall consist of a galvanized steel clamp, an aluminium dead end body with an aluminium jumper connector and a jumper lug. All necessary bolts, nuts and washers shall be supplied at the unit rate of the clamp.

3.4 Fittings of Insulator Sets for 110 kV Line

All fittings to make each insulator set complete for effective use shall be supplied in accordance with the technical specifications shown the attached drawings or equivalent.

Such bolts, nuts, washers, split pins and retaining pins in 5 % excess quantities as may be required as spares shall be deemed to be included in the appropriate items.

All ferrous fittings shall be made of drop forged steel or malleable iron and hot dip galvanized. Split pins shall be made of non-ferrous metal or stainless steel and designed as the self-locked type.

3.4.1 Suspension Clamp for Conductors

The suspension clamp for ACSR 336.4 MCM shall be of model 1H-1075AU of NGK Insulators, Ltd. Japan (hereinafter refer to as NGK) as shown in the attached Figure No. TL-110-02 or equivalent model.

The clamps for ACSR 410 mm^2 shall be of trunnion type as light as possible and are to preferably be of aluminium alloy. The clamps shall be designed to avoid any possibility of deforming the stranded conductors and separating the individual strands, and shall be free to pivot in the vertical plane containing the conductors. The clamp shall permit the complete conductor to slip at a load lower than the maximum working tension of the conductor of 1,500 kg.

3.4.2 Strain Clamp Set for Conductors

The strain clamp for ACSR 336.4 MCM shall be of NGK model 2H-970AU or equivalent model and of bolted type with aluminium alloy body as shown in the attached Figure No. TL-110-03. The conditions stated for the joints of conductors shall also be applied to the strain clamps where applicable. The clamp shall not permit the complete conductor to slip at a load less than the maximum working tension of the conductor of 1,500 kg.

3.4.3 Dead End Clamp for Power Conductor ACSR 336.4 MCM (Linnet)

The clamp for ACSR 336.4 MCM shall be of NGK model 2H-1025-8 or equivalent and of compression type as shown in the attached Figure No. TL-100-04. The conditions stated for the joints of conductors shall also be applied to the strain clamps where applicable. The clamp shall consist of a galvanized steel clamp with eye end, an aluminium dead end body with an aluminium jumper connector and a jumper clamp.

3.4.4 Arcing Horns

Following arcing horns and horn holders shall be supplied for the 110 kV suspension and tension type insulator sets.

(a)	For suspension insulator sets	: NGK model 2H-1810AU or equivalent
(b)	For suspension insulator sets	: NGK model 2H-1810BU or equivalent
(c)	For tension insulator sets	: NGK model 2H-1812AU or equivalent
(d)	For tension insulator sets	: NGK model 2H-1812BU or equivalent
(e)	Ball eye type horn holder	: NGK model 4H-2046A or equivalent
(f)	Socket eye type horn holder	: NGK model 4H-20496L or equivalent

The horns and holders shall be manufactured referring to the attached Figure Nos. TL-110-04 and TL-110-05. The arcing horns shall be made of steel and processed by hot dip galvanization. Each arcing horn for the suspension insulator set shall be supplied with a galvanized connecting bolt of 14 mm in diameter, a spring washer and a nut. Each arcing horn for tension insulator set shall be supplied with 2 pieces each of galvanized bolt, nut and spring washer for 14 mm diameter.

3.4.5 Other Insulator Fittings

Following fittings shall be supplied as a composed part of insulator sets referring to the attached drawings.

(a)	U-bolt with 4 nuts	: NGK model 4H-1805BU or equivalent
(b)	Clevis-eye	: NGK model 4H-488-10 or equivalent
(c)	Socket-clevis with pins	: NGK model 4H-20491B or equivalent
(d)	Ball-clevis with a cotter pin	: NGK model 4H-492C or equivalent
(e)	Anchor shackle with a cotter pin	: NGK model 4H-835A or equivalent
(f)	Chain link	: NGK model 3H-7D or equivalent

All fittings shall be manufactured and supplied with necessary accessories as shown on the Figure Nos. TL-110-06 and TL-110-07.

3.5 Overhead Earthwire Sets and Fittings

3.5.1 Fittings for 230 kV Overhead Earthwires

(1) Suspension clip

Suspension clips and complete tension sets for the earthwire of GSW 90 mm^2 shall be supplied referring to the models shown on the attached Figure No. TL-230-03.

The earthwire clip shall be made of steel or malleable iron, hot dip galvanized and designed to permit slipping-off the earthwires at the load of around 1,900 kg. The clips shall also be designed to avoid any possibility of deforming the stranded wires and separating the individual wires.

(2) Complete tension set

The composition of the set is shown on the attached Figure No.TL-230-03. One (1) set shall consist of two (2) tension clamps, two (2) chain links, four (4) shackles and one (1) suspension clip. The tension clamps shall be made of steel or malleable iron, hot dip galvanized and of bolted type. The clamps shall not permit slipping-off the earthwires at a load of less than 95% of the earthwire's ultimate breaking strength.

3.5.2 Fittings for 110 kV Overhead Earthwires

(1) Suspension clamp

The clamp for GSW 22 mm^2 shall be of NGK model 1H-677BU as shown in the attached Figure No. TL-110-08 or equivalent. The model is shown on the attached drawing. The clamps shall be made of malleable iron or drop-forged steel of trunnion type and shall be galvanized. The clamps shall be hung on the top of support with band and provided with an earthing bond. The clamp shall permit the complete earthwire to slip at a load of around 350 kg. The ultimate breaking strength of the clamp shall not be less than that of the earthwire.

(2) Tension clamp for pole

The tension clamp shall be of bolted type of NGK model GNB-4511U shown in the attached Figure No. TL-110-08 or equivalent model. The model is shown on the attached drawing. The clamp shall be of malleable iron or drop-forged steel and shall be galvanized.
The clamps shall not permit slipping-off the earthwires at a load of less than 95% of the earthwire's ultimate breaking strength.

(3) Flexible copper earth bond

The bond shall be of NGK set model 2H-500 as shown in the attached Figure No. TL-110-09 or equivalent. The NGK model is shown on the attached Figure. The bond is used for firm earthing of the suspension clamp for the earthwire. The copper wires of

the bond shall be plated by tin and provided with compressed terminals on its both ends.

(4) Suspension set

The suspension set shall be of NGK set model shown in the attached Figure No. TL-110-09 or equivalent set. The specifications stated in subclause for the suspension clamp shall be applied for the set.

(5) Tension set for the dead end tower

The set shall be of NGK set shown in the attached Figure No. TL-110-09 or equivalent set. The NGK model is shown on the attached drawing. The specifications stated in the subclause for the tension clamp shall be applied for the set. All component shown on the drawing shall be supplied as a set.

(6) Tension set for pole

The set shall be of NGK model 89712 or equivalent model. The NGK model is shown on the attached drawing. The specifications stated in the subclause for the tension clamp shall be applied for the set. All component shown on the drawing shall be supplied as a set.

(7) Tension set for pole

The set shall be of NGK set as shown in the attached Figure No. TL-110-08 or equivalent set. The specifications stated in subclause (b) of this section.

3.6 Interchangeability of Fittings

The fittings shall be so designed as to provide the interchangeability with existing similar fittings such as shackles, ball-eyes, ball-clevises, socket-clevises, etc. for both suspension and tension insulator sets, as far as applicable.

3.7 Inspection and Test

Unless otherwise specified in this Contract Documents, selection of test samples, numbers of specimen and acceptance of the test results shall be in accordance with the terms of the relevant standard where applicable.

Where no applicable terms are specified, the Engineer is to instruct details in advance of the inspections and tests in response to the request of the Contractor,

3.7.1 Tests of Insulators

The rules of IEC publications 383 (1983) shall be applied for the tests of insulators. The test results shall comply with the requirement in Clause 2.1

(1) Type test

The Tenderer shall include with their offers test certificate carried out in accordance with IEC publication 575 that are issued by an approved and internationally acknowledged reputable independent testing laboratory. This means that the laboratory can prove that it has performed testing services for known insulator manufacturer from all over the world and this laboratory shall be outside the country of manufacturer.

The Engineer may call for type tests to be carried out at the manufacturer's works. Such tests would be concluded to random samples at the discretion of the Engineer and failure to meet the conditions of test could result in the rejection of the complete batch of insulators.

When such tests are called for, they will comprise the following:

(a) Impulse withstand voltage test
(b) One minute dry power frequency withstand voltage test
(c) Wet power frequency withstand voltage test

(2) Sample test

The insulators for the sample test shall be selected at random from the batch. The number of test pieces shall be p, or the nearest whole number greater than p given by the following formulae:

$p = 4$, when $n < 500$

$p = 4 + 1.5n/1{,}000$, when $500 \leq n < 20{,}000$

$p = 19 + 0.75n/1{,}000$, when $n > 20{,}000$

where, n = the number of insulators in the batch.

After having passed the routine tests described in (c) hereunder, the test pieces of insulators shall be subject to the following tests:

(a) Verification of dimensions
(b) Temperature cycle test
(c) Puncture test
(d) Porosity test
(e) Galvanizing test

Re-test procedure:

If only one insulator or metal part fails to comply with any of the sample tests, a new quantity equal to twice the quantity originally submitted to that test shall be subject to re-testing.

If two or more insulators or more metal parts fail to comply with any of the sample tests, or if any failure occurs on insulators or metal parts subject to re-testing, the complete batch will be considered as not complying with the specifications and will be rejected.

(3) Routine test:

(a) Visual examination
(b) Mechanical routine test
(c) Electrical routine test
(d) Thermal shock routine test

These tests shall be carried out at the manufacturer's factory.

3.7.2 Test of Sets and Fittings

The following tests shall be carried out at the manufacturer's factory before shipment.

(1) Insulator sets:

(a) Assembly
(b) Mechanical loading and breaking test
(c) Withstand voltage (power frequency and impulse)
(d) 50% impulse flashover voltage (positive and negative)

(2) Suspension clamps:

(a) Outside view and construction
(b) Slipping load
(c) Ultimate breaking strength
(d) Galvanizing

(3) Tension clamps:

(a) Outside view and construction
(b) Electrical resistance measurement
(c) Tensile strength
(d) Galvanizing

(4) Other fittings:

(a) Outside view and construction
(b) Load test
(c) Galvanizing

SECTION 4 TOWER MATERIALS

4.1 General

The Contract includes design, fabrication, galvanizing, tests and inspection, packing for export, insurance and delivering to the specified warehouse in Viet Nam of the following materials for replacement and repair of 230 kV transmission line towers.

(a) Non-fabricated galvanized steel equal angles and flat bars
(b) Galvanized steel plates
(c) Galvanized bolts and nuts with specified washers

Tower materials shall be fabricated in accordance with the standards issued by the latest Japanese Industrial Standards (JIS) or equivalent standards.

4.2 Materials and Galvanization

4.2.1 Quality of Steel Materials

The steel materials shall be of SS-41 and SS-50 of JIS G-3101 (1987) "Rolled Steel for General Structure". The technical specifications of those materials are as below:

Symbol	Thickness (mm)	Minimum Yield Strength	Tensile Strength
SS-41	$t \leq 16$	25 kgf/mm^2	41 - 52 kgf/mm^2
	$16 < t \leq 40$	24 kgf/mm^2	41 - 52 kgf/mm^2
SS-50	$t \leq 16$	29 kgf/mm^2	50 - 62 kgf/mm^2
	$16 < t \leq 40$	28 kgf/mm^2	50 - 62 kgf/mm^2

4.2.2 Non-fabricated Galvanized Steel Equal Angles and Flat Bars

Non-fabricated galvanized materials shall be supplied in the standard length of 6 meters and 8 meters.

Materials supplied under the Contract are as listed below:

Symbol	Size of Steel Member (mm)	Unit Length
Steel angle		
SS-41	L 40 x 40 x 3	6 meters
SS-41	L 45 x 45 x 4	6 meters
SS-41	L 50 x 50 x 4	6 meters
SS-41	L 50 x 50 x 6	6 meters
SS-41	L 60 x 60 x 5	8 meters
SS-41	L 65 x 65 x 6	8 meters
SS-41	L 70 x 70 x 6	6 meters
SS-41	L 80 x 80 x 6	8 meters
SS-41	L 100 x 100 x 7	8 meters
SS-50	L 45 x 45 x 4	6 meters
SS-50	L 50 x 50 x 4	6 meters
SS-50	L 60 x 60 x 5	8 meters
SS-50	L 90 x 90 x 7	8 meters
SS-50	L 100 x 100 x 10	8 meters
SS-50	L 130 x 130 x 9	8 meters
Flat bar		
SS-41	60 mm wide, 6 mm thick	6 meters
SS-41	70 mm wide, 6 mm thick	6 meters
SS-41	120 mm wide, 10 mm thick	6 meters

4.2.3 Galvanized Steel Plates

Non-fabricated SS-41 galvanized steel plates of 4.5 mm, 6.0 mm, 9.0 mm and 12.0 mm thick shall be supplied in the standard size of 1.5 meters and 3.0 meters wide.

4.2.4 Galvanized Bolts, Nuts and Washers

All bolts and nuts shall have enough strength to permit firm gripping of the other members. All nuts shall fit handtight to the bolts.

Following galvanized steel bolts, nuts and washers supplied under the Contract shall be manufactured in accordance with the following JIS or equivalent standards.

Bolts	:	JIS B 1180 (1985)	Hexagon Head Bolts and Hexagon Head Screws
Nuts	:	JIS B 1181 (1993)	Hexagon Nuts and Hexagon Thin Nuts
Washers	:	JIS B 1251 (1984)	Spring Lock Washers
	:	JIS B 1256 (1978)	Plain Washers

Symbol	Diameter and Length	Nut and Washers
SS-41	12 mm x 40 mm long	one nut, a spring and flat washers
SS-41	16 mm x 45 mm long	one nut, a 3 mm thick flat washer
SS-41	16 mm x 120 mm long	one nut, a 3 mm thick flat washer
SS-41	20 mm x 90 mm long	one nut, a 4 mm thick flat washer
SS-50	16 mm x 40 mm long	one nut, a spring and flat washers
SS-50	16 mm x 50 mm long	one nut, a spring and flat washers
SS-50	16 mm x 60 mm long	one nut, a spring and flat washers
SS-50	20 mm x 60 mm long	one nut, a spring and flat washers
SS-50	24 mm x 70 mm long	one nut, a 4 mm thick flat washer

The diameter of each bolt shall be casted on its head surface.

4.2.5 Galvanization

All steel materials required in the Contract shall be galvanized in accordance with the requirements specified in JIS H-0401 (1983).

Hot dip galvanizing treatment shall be applied with the following quantity of zinc.

For bolts, nuts and washers : more than 350 g/m^2
For all other steel materials : more than 550 g/m^2

The Tenderer's special attention shall be given to the special treatment to be carried out for preventing white rust on the surfave of the galvanized materials. The Tenderer is requested to submit his proposal of the preventive method of white rust with his tender.

4.3 Inspection and Tests

The following tests shall be carried out at the manufacturer's works. Unless otherwise specified in this Contract, selection of test samples, number of specimen and acceptance of the results shall be in accordance with the terms of the relevant standards of JIS, equivalent standard or as instructed by the Engineer.

Where no applicable terms in the above standards, the Engineer is to instruct details in advance of the inspections and tests in response to request of the Contractor.

(1) Inspection

Measurement of sizes and packing conditions of the materials shall be carried out in the manufacturer's works.

(2) Material tests

Pulling, bending and galvanizing of specimen taken from steel equal angles, steel plates, bolts, nuts and washers shall be carried out for each shipment.

SECTION 5 STEEL TUBULAR POLES

5.1 General

The Contract includes design, fabrication, galvanizing, tests and inspection, packing for export, insurance and delivering the materials to the specified warehouse in Viet Nam of the following materials for replacement of the existing deteriorated supports of the existing 110 kV steel poles.

(a) Galvanized steel tubular poles for single circuit of ACSR 336.4 MCM
(b) Foundation plates for supports
(c) Attachment of overhead earthwires, staywires, crossarms of power conductors and all other necessary fitings for completing a support.
(d) Grounding materials

Support materials shall be fabricated in accordance with the standards issued by the latest Japanese Standards or equivalent standards.

5.2 Type of Supports

Each support shall consist of a single steel pole for type PA and two steel poles in H-frame construction for PC and PD, reinforced with staywires, complete with steel crossarms and other necessary accessories. The steel pole shall be of galvanized tubular and circular section construction, and shall be separable into sections for easy transportation and erection at the site.

Power conductors shall be arranged in triangle formation for the type PA and horizontal for the types PC and PD with an overhead earthwire at the top of the supports.

Pole supports shall be designed to provide with plus 2 and 5 meters extension where required for maintaining the necessary ground clearance of the power conductors.

The sizes and numbers of the power conductors and overhead earthwire for design of supports shall be as follows:

Power conductor	:	single circuit of ACSR 336.4 MCM
Overhead earthwire	:	one galvanized steel wire of 22 mm^2

All the supports shall be reinforced with necessary staywires as shown on the attached Figure Nos. TL-110-10 and TL-110-11. The Figures show also general construction and other basic dimensions of each support.

The standard types of supports are classified as follows:

Type-PA : Use for straight line section with suspension insulator sets. Staywires will be installed where necessary for reinforcement of the strength of supports.

Type-PC : Use for line horizontal angle points up to 45° reinforced by staywires with tension insulator sets.

Type-PD : Use for straight line section reinforced by staywires with tension insulator sets. This type of support is used for reinforcement of the line.

5.3 Design Conditions

5.3.1 Design Spans

The design wind spans and weight spans of all the types of supports shall be 150 meters and 300 meters, respectively.

The term "wind pan" shall mean half the sum of adjacent horizontal span length supported on any one support.

The term "weight span" shall mean the equivalent span length of the weight of conductor or earthwire supported at any one support at the minimum temperature in still air.

5.3.2 Design Loads

The following design loads for the supports shall be assumed to work simultaneously.

(1) Horizontal loads

(a) wind load (lateral direction to the line route)
(b) horizontal angle effect (longitudinal direction to the line route)
(c) horizontal component of tension of the staywires

(2) Vertical loads

(a) dead weights of supports, power conductors, overhead earthwire, insulator sets and other accessories
(b) vertical component of tension of the staywires
(c) appropriately assumed weight loaded during erection works

The wind load on the projected area of the facilities shall be as follows:

(a) 100 kg/m^2 on power conductors
(b) 110 kg/m^2 on overhead earthwire
(c) 140 kg/m^2 on insulator sets
(d) 80 kg/m^2 on steel tubular poles
(e) 170 kg/m^2 on crossarms

It is noted that no wind pressure may be considered for the staywires.

The maximum working tensions of the power conductor and overhead earthwire shall be assumed as follows:

- ACSR 336.4 MCM : 1,500 kg
- Overhead earthwire of GSW 22 mm^2 : 600 kg

5.3.3 Strength of Supports

Each type of supports shall be designed so that no failure or permanent distortion shall occur when applied with forces equivalent to twice the above-mentioned maximum simultaneous working loading. The ultimate design stress, computed from the working stress times the factor of safety, shall not exceed a figure obtained from an approved formula to be entered in Tender based on the yield strength of the materials used. Computation of loading to supports and strength of the supports shall be submitted together with the Tender.

5.3.4 Crossarm Arrangement

In design of the supports, power conductors shall be maintained with the clearances from any earthed parts of the support as shown on the attached Figure No.TL-110-12.

5.4 Staywires

A staywire shall consist of a stay band, V-shape hangers with thimbles, a galvanized steel staywire, a guy insulator with preformed grips at the both ends, a steel stay rod with a thimble, a washer and a steel anchor plate as sampled on the attached Figure No. TL-110-13. All of the component shall be galvanized and designed to withstand the above mentioned working loads with a factor of safety of more than 2.5.
Minimum coating of zinc on wires shall be 230 kg/mm^2 and uniformity of galvanizing shall not be less than 3 times.

Staywire sets including all necessary fittings shall be supplied as components of a complete set of a support.

5.5 Foundations

The footing depth shall be so designed that overturning load may be supported with a factor of safety of more than 2.0, but in no case shall be lower than 1.5 meters. In the design calculation of footing depth and safety anchors, the soil characteristics shall be assumed as follows:

Ultimate bearing strength	:	40,000 kg/m^2
Weight of soil	:	1,500 kg/m^3
Angle of inverted pyramid of soil	:	15 degrees

The underground portion of the pole shall also be galvanized and finished with bituminous paint at the factory.

The design calculation and drawings of support and staywire foundations shall be submitted in the Tender proposal and for approval during the Contract.

All necessary foundation fittings such as pole foundation plate shall be supplied as accessories of a complete pole.

5.6 Galvanization

All steel materials required in the Contract shall be galvanized in accordance with the requirements specified in JIS H-0401 (1983).

Hot dip galvanizing treatment shall be applied with the following quantity of zinc.

For bolts, nuts and washers	:	more than 350 g/m^2
For all other steel materials	:	more than 550 g/m^2

The Tenderer's special attention shall be give to the special treatment to be carried out for preventing white rust on the galvanization. The Tenderer is requested to submit his proposal of the preventive method with his tender.

5.7 Inspection and Test

Following inspection and tests shall be carried out on steel poles and accessories in the Contractor's factory.

Unless otherwise specified in this Contract, selection of test samples, number of specimen and acceptance of the results shall be in accordance with the terms of the relevant standards of JIS, equivalent standard or as instructed by the Engineer.

Where no applicable terms in the above standard, the Engineer is to instruct details in advance of the inspections and tests in response to request of the Contractor.

Costs for the inspection and tests shall be deemed to be included in the respective rates of materials.

(1) Assembly test

One of each type of supports shall be assembled and the following shall be inspected:

(a) Major dimensions of structure
(b) Numbers and sizes of accessories

(2) Material test

Following tests shall be carried out.

(a) Pulling and bending of specimen taken from steel pole, steel crossarm, steel band and staywire
(b) Pulling of bolts and staywire set
(c) Galvanizing of samples of all materials

(3) Load test

Pole assembly selected by the Engineer shall be assembled with complete accessories including staywires at the manufacturer's works after galvanizing and shall be subject to the load test to prove compliance with the factor of safety of more than 2.0 for 5 minutes without showing any sign of failure or permanent distortion.

(4) Appearance inspection

All accessories shall be subject to the appearance inspection for their dimensions, fitness to other fittings, galvanizing, etc.

SECTION 6 MISCELLANEOUS MATERIALS FOR 110 KV LINES

6.1 General

The Contract includes design, fabrication, galvanizing, tests and inspection, packing for export, insurance and delivering to the specified warehouse in Viet Nam of the materials specified in this section for replacement of the existing deteriorated supports of the existing 110 kV steel poles.

The materials shall be fabricated in accordance with the standards issued by the latest Japanese Standards or equivalent standards.

6.2 Crossarms for Supports

The galvanized and fabricated crossarm sets for the existing pole supports in the Thap Cham-Cam Ranh section and the Thap Cham-Phan Ri-Phan Thiet section shall be supplied with such necessary fittings as galvanized steel band, bolts, nuts, etc.

One set of crossarm shall consist of those for single circuit of power conductors with the necessary fitting.

Crossarm sets for the Thap Cham-Cam Ranh section are shown in the attached Figure No. TL-110-14.

All the materials used for the crossarms shall have quality of JIS SS-41 or equivalent.

One of each type of the crossarms shall be assembled in the manufacturer's works before galvanizing and the following shall be inspected.

(a) Outside view and construction
(b) Major dimensions of assembly of arms
(c) Size of members
(d) Number and size of bolts

6.3 Support Accessories

6.3.1 Pole Caps

Following pole caps shall be supplied in the dimensions specified in the attached Figure No. TL-110-16.

(a) Cap for pole type PA
(b) Cap for pole type PC and PD
(c) Cap for pole type PC and PD fixed with a wire clip for the overhead earthwire of 22 mm^2 diameter

All caps and clips shall be made from mild or forged steel and galvanized.

6.3.2 U-bands and Accessories

Following fittings shall be supplied for fixing materials to the existing steel tubular poles. All materials shall be made from mild steel and galvanized by hot dip coating after fabrication. Dimensions of the fittings shall be those shown in the attached Figures.

	Fittings	Figure to be referred
(a)	U-band for crossarm fixing (types 15-a and 15-b)	TL-110-17
(b)	Crossarm band for type PC and PD supports	TL-110-17
(c)	Crossarm attachment (M-type)	TL-110-18
(d)	Band for overhead earthwire	TL-110-18
(e)	Arm-tie band for type PC and PD supports	TL-110-18

6.3.3 Staywire and Accessories

(1) Staywire

The staywire shall be of galvanized steel stranded wire of 55 mm^2 section and have the following particulars:

Nominal sectional area	:	55 mm^2
Calculated section	:	56.29 mm^2
Stranding (nos./diameter)	:	7/3.2 mm
Outside diameter	:	9.6 mm
Grade of minimum strength	:	90 kgf/ mm^2
Minimum tensile strength of stranded wire	:	4,660 kgf

The wire shall comply with JIS G-3537 (1988) or equivalent standard. The outermost layer of the wire shall be right-handed (Z-lay). The steel wire shall be galvanized in an approved manner before stranding and zinc coat shall be smooth, clean, of uniform thickness and free from defects. Minimum coating of zinc shall be 230 g/m^2.

Characteristics of the individual wire shall be as follows:

Tolerance of diameter	:	± 0.08 mm
Minimum tensile strength	:	724 kgf
Minimum elongation	:	5.0 %
Minimum number of torsion	:	10 times

The staywire shall be supplied on impregnated drums of approved materials constructed so as to enable the wires to run smoothly. Length of the wire per drum shall be 500 meters for easy handling at the site.

(2) Staywire bands

The bands to be supplied are shown in the attached Figure No. TL-110-19. The bands shall be made of mild steel, galvanized by the hot dip coating and have mechanical strength equivalent to that of the staywire of GSW 55 mm^2.

Each band shall be provided with two bolts and nuts with two thimbles as shown in the drawing.

(3) Anchor plate

The anchor plate shown in the attached Figure No. TL-110-20 is used for anchor rod of staywire. The plate shall be fabricated from mild steel and galvanized by hot dip coating after welded.

(4) Anchor rod

The anchor rod shown in the attached Figure No. TL-110-20 shall have strength equivalent to that of the staywire of GSW 55 mm^2. The rod shall have a thimble, a flat washer and double nuts. All the materials shall be galvanized by hot dip coating.

(5) Ball type insulators

The insulator used on the staywire shall be made of porcelain or toughened glass, and the colour shall preferably be grey. General view of the insulator is shown in the Figure No. TL-110-19 and shall comply with the requirements of JIS C 3832 (1975). Mechanical breaking strength of the insulator shall be more than 6,000 kgf, and its power frequency withstand voltage shall be more than 15 kV.

(6) Staywire grips

The grips shall be made of galvanized steel wires and preformed in the left hand lay for gripping the staywire of 55 mm^2. The grips are shown in the attached Figure No. TL-110-21. The thimble type grips will be used at the pole end and the anchor rod end of the staywire, while the insulator type grips will be used at the ball type insulator.

General requirements of the grips shall be as follows:

	Thimble type	Insulator type
Length of grip	750 mm	750 mm
Minimum holding strength	5,100 kg	5,100 kg
Minimum weight of zinc coating	230 g/m^2	230 g/m^2

(7) Anchor shackles

Galvanized anchor shackles will be used for terminating the staywire of GSW 55 mm^2 at its ends. The anchor shackles shall have sufficient strength for terminating the staywire GSW 55 mm^2 specified above and shall be provided with a bolt and a nut of 12 mm diameter with a split pin.

6.4 Grounding Materials

Following materials and fittings shall be supplied for supplementing the existing grounding system.

6.4.1 Counterpoise Grounding Set

The set shall consist of a piece of galvanized steel stranded wire in 50 meter long of 38 mm^2, two compression terminals and two sets of bolt and nut for 12 mm diameter as shown in the attached Figure No. TL-110-22.

The terminals shall be compressed at both ends of the wire at the manufacturer's works. The steel stranded wire shall have the following characteristics;

Nominal sectional area	:	38 mm^2
Calculated section	:	37.16 mm^2
Stranding (nos./diameter)	:	7/2.6 mm
Outside diameter	:	7.8 mm
Grade of minimum strength	:	70 kgf/ mm^2
Minimum tensile strength of stranded wire	:	2,390 kgf

The wire shall comply with JIS G-3537 (1988) or equivalent standard. The outermost layer of the wire shall be right-handed (Z-lay). The steel wire shall be galvanized in an approved manner before stranding and zinc coat shall be smooth, clean, of uniform thickness and free from defects. Minimum coating of zinc shall be 230 g/m^2.

6.4.2 Counterpoise wires

Galvanized steel stranded wire of 90 mm^2 shall also be supplied for use of counterpoise grounding system in other line sections. The wires shall be supplied in 25 meters long per piece and individual wires at its both ends shall be tied up with a binding wire so that the strand will not to dismember.

The steel stranded wire shall have the following characteristics;

Nominal sectional area	:	90 mm^2
Calculated section	:	87.99 mm^2
Stranding (nos./diameter)	:	7/4.0 mm
Outside diameter	:	12.0 mm
Grade of minimum strength	:	70 kgf/ mm^2
Minimum tensile strength of stranded wire	:	5,660 kgf

The wire shall comply with JIS G-3537 (1988) or equivalent standard. The outermost layer of the wire shall be right-handed (Z-lay). The steel wire shall be galvanized in an approved manner before stranding and zinc coat shall be smooth, clean, of uniform thickness and free from defects. Minimum coating of zinc shall be 230 g/m^2.

6.4.3 Galvanized Steel Rod

The rod shall be of mild steel rod of 16 mm diameter and 2.4 meters long and galvanized by hot dip coating. This rod is to be connected with the counterpoise wire of 90 mm^2 specified above at an end of the wire.

6.4.4 Galvanized Steel Terminal for Counterpoise

The terminal shall be compression type terminal for the counterpoise wire (90 mm^2) specified in the above clause (b). The steel terminal shall be provided with a bolt and a nut of 12 mm diameter and a hole for connecting the terminal with the existing provision on the pole.

A set of dies shall be supplied for compression of the terminal to suit the compressor specified in Section 6 hereunder.

6.4.5 Wire Clips

The clips will be made of mild steel and galvanized. They are used for connection of the counterpoise wire of 90 mm^2 specified above with the galvanized steel rod

specified above (c). Size of the clip shall be suitable for connecting both the materials.

6.5 Other Materials

Following miscellaneous fittings shall be supplied for restoring the existing steel tubular poles. All the fittings shall be made of steel equivalent to JIS SS-41 and galvanized after fabrication.

6.5.1 Strain Plates

Attached Figure No. TL-110-22 shows the plates to be supplied under the Contract. The plates will be used for fixing tension type insulator sets to the crossarm for power conductors.

6.5.2 Loop Type Support

The loop type support is such fitting as shown in the attached Figure No. TL-110-23. The support will be installed on PA type pole and used for hanging a suspension clamp of the overhead earthwire.

6.5.3 Eye Bolt for Base Plate

The bolt will be used for fixing an earthing angle at the bottom of pole support. The bolt shall be supplied with a round washer and a nut.

6.6 Galvanization

All steel materials required in the Contract shall be galvanized in accordance with the requirements specified in JIS H-0401.

Hot dip galvanizing treatment shall be applied with the following quantity of zinc.

For bolts, nuts and washers	:	more than 350 g/m^2
For all other steel materials	:	more than 550 g/m^2

The Tenderer's special attention shall be give to the special treatment to be carried out for preventing white rust on the galvanization. The Tenderer is requested to submit his proposal of the preventive method with his tender.

6.7 Inspection and Test

Following inspection and tests shall be carried out on steel materials and accessories in the Contractor's factory.

Unless otherwise specified in this Contract, selection of test samples, number of specimen and acceptance of the results shall be in accordance with the terms of the relevant standards of JIS, equivalent standard or as instructed by the Engineer.

Where no applicable terms in the above standard, the Engineer is to instruct details in advance of the inspections and tests in response to request of the Contractor.

Costs for the inspection and tests shall be deemed to be included in the respective rates of materials.

(1) Assembly test

One of each type of crossarms shall be assembled and the following shall be inspected:

(a) Major dimensions of structure
(b) Numbers and sizes of accessories

(2) Material test

Following tests shall be carried out:

(a) Pulling and bending of specimen taken from steel crossarm, steel band, staywire and fittings
(b) Pulling of steel materials
(c) Galvanizing of samples of all materials

(3) Appearance inspection

All accessories shall be subject to the appearance inspection for their dimensions, fitness to other fittings, galvanizing, etc.

SECTION 7 TOOLS AND APPLIANCE FOR MAINTENANCE USE

7.1 General

The tools and appliance for maintenance use specified hereunder shall be adequate for the line specified in this Contract and comply with the under-mentioned requirements.

The tools and appliance specified hereunder shall be clearly marked with their size and/or item and shall be packed in appropriate boxes with three copies of operation and maintenance instructions.

7.2 Stringing Tools and Appliance

7.2.1 Engine Winch

Following engine winches shall be supplied complying with the specifications under-mentioned.

(1) Skid base type

The winch shall be of Yasuda (Yasuda Seisakusho., Ltd. Japan) model SEW-30 or equivalent and have the following functions.

Approximate dimensions		
Overall length	:	1,435 mm
Overall width	:	1,075 mm
Overall height	:	810 mm
Weight	:	290 kg
Capstan diameter	:	240 mm
Engine		
Exhaust volume	:	618 cc
Maximum horse power	:	15 HPS/3,600 rpm
Maximum torque	:	3.3 kg-m/2,600 rpm
Fuel tank capacity	:	13 liters
Winch with anti-reversal pawl		
Maximum tension		
Transmission (1st stage)	:	2,500 kg
Transmission (2nd stage)	:	800 kg

Normal tension		Continuous rated tension
Transmission (1st stage)	:	2,000 kg
Transmission (2nd stage)	:	550 kg
Wire speed		
Transmission (1st stage)	:	4-10 meter/minute
Transmission (2nd stage)	:	14-33 meter/minute
Reverse (1st stage)	:	3-9 meter/minute
Reverse (2nd stage)	:	12-29 meter/minute

(2) Vehicle type

The winch shall be of Yasuda model SEP-14 mounted on the 4-wheel driving vehicle or equivalent and have the following functions.

Approximate dimensions		
Overall length	:	3,825 mm
Overall width	:	1,750 mm
Overall height	:	1,500 mm
Wheel base	:	2,400 mm
Tread	:	1,400 mm
Weight	:	2,500 mm
Capstan diameter	:	360 mm
Engine		
Total piston displacement	:	3,956 cc
Maximum horse power	:	98 HPS/2,800 rpm
Maximum torque	:	26.8 kg-m/2,000 rpm
Fuel tank capacity	:	70 liters
Winch		Max. tension and wire speed
Two capstans driving		
Transmission (1st stage)	:	7,000 kg x 2, 10 meters/minute
Transmission (2nd stage)	:	7,000 kg x 2, 16 meters/minute
Transmission (3rd stage)	:	5,000 kg x 2, 25 meters/minute
Transmission (4th stage)	:	4,000 kg x 2, 43 meters/minute
Transmission (5th stage)	:	2,500 kg x 2, 69 meters/minute
Reverse 1st stage	:	7,000 kg x 2, 8 meters/minute
One capstan driving		
Transmission (1st stage)	:	7,000 kg x 1, 10 meters/minute
Transmission (2nd stage)	:	7,000 kg x 1, 16 meters/minute
Transmission (3rd stage)	:	7,000 kg x 1, 25 meters/minute

Transmission (4th stage)	:	7,000 kg x 1, 43 meters/minute
Transmission (5th stage)	:	5,000 kg x 1, 69 meters/minute
Reverse (1st stage)	:	7,000 kg x 1, 8 meters/minute

7.2.2 Conductor Tensioner

The conductor tensioner shall be of 1.2 m oil pressure operating shoe chain type for pulling power conductors and overhead earthwires. The tensioner shall give a constant tension to the conductors/earthwires.

The tensioner shall have the following features:

(1) The tensioner shall be provided with a shoe chain sheave, a brake device with a handle, a capstan, a reducer gear, an oil cooler, a guide roller, pressure gauges, etc., on the rigid frame.

(2) Groove diameter of the tensioner's wheel shall be 1.2 meters, and the groove of shoe-chains and the guide roller shall be capable of passing a stringing clamp of conductor up to ACSR 610 mm^2.

(3) The tensioner shall be equipped with an ordinary band brake and an oil-pressure type braking system of the latest model. The oil-pressure type braking system shall maintain a constant tension and running speed. The band brake will be used for an auxiliary and safety.

(4) The oil-pressure braking capacity shall be more than 2,500 kg. Control capacity of the oil-pressure and hand brake shall be more than 3,000 kg.

The tensionser shall be the type equivalent to 1.2 m shoe chain tensioner of Yasuda's model.

7.2.3 Hydraulic Compressor

The hydraulic compressor shall be of portable type, 4 cycle gasoline engine-driven and rated at 100 tons. The compressor shall be consisted of an engine pump, a compressor head and a hydraulic hose with a pressure gauge and others. The head piston shall automatically and immediately go down by operation of the solenoid and the pressure control switch.

Two sets each of dies and gauges for ACSR and GSW specified in the Price Schedule shall be supplied as accessories of the compressor. One remote operation tube of 25 meters in length shall also be supplied for each hydraulic compressor.

7.2.4 Insulator Replacer

The insulator replacer shall be ratchet turnbuckle type with fittings for clamping insulator cap of 250 mm standard and fog type insulator units and applicable for both suspension and tension insulator sets. The minimum rated load of the replacer shall be 3,500 kgf. Accessories for the replacing the end insulator unit shall also supplied for each replacer.

7.2.5 Insulator Lifter

The lifter is used for lifting either the single string set or the double string set to the power conductor crossarms. The lifter shall be for the standard and fog type insulator sets up to 230 kV line. The minimum rated lifting load shall be 1,600 kg.

7.2.6 Aluminium Ladder

The aluminium ladder shall be consisted of a 5 and 7 meter long (12 meters in total) aluminium ladder, a hook and clamping fittings, designed adequately for the stringing work on the towers, as a platform for the insulator sets.

7.2.7 Hydraulic Cutter

The cutter shall be of hand-operated type for cutting bare conductors and as light as possible. The cutter shall be adequately used for the following conductors.

Conductor or wire	Outside diameter
6 x 7 hemp core	up to 22.4 mm
6 x 12 hemp core	up to 28 mm
6 x 19 hemp core	up to 30 mm
Copper wire or bar	up to 32 mm
Aluminium wire or bar	up to 32 mm
Soft steel wire	up to 22 mm
Bare copper wire strands	up to 41.6 mm
Bare aluminium wire strands	up to 46.2 mm
ACSR	up to 39.9 mm
Galvanized steel stranded wire (1 x 7)	up to 15 mm
Galvanized steel stranded wire (1 x 19)	up to 20 mm
Underground cable	up to 41.6 mm

7.2.8 Pulling Grips for Power Conductor and Overhead Earthwire

The pulling grips are used during the stringing operation for temporary connection of power conductors or overhead earthwires. The grips shall be braid or wire net stocking type and suitable for pulling of the following conductors and earthwires.
Following grips shall be supplied under the Contract. Capacities mentioned shall be allowable load and the safety factor of minimum 3.0 shall be considered for the breaking strength.

Gripping range (diameter)	Allowable capacity	Suitable size
8 to 11 mm	600 kgf	GSW 38 mm^2 & TK-50
11 to 13 mm	1,200 kgf	GSW 90 mm^2
16 to 21 mm	1,500 kgf	ACSR 336.4 MCM & AC 185 mm^2
25 to 30 mm	3,000 kgf	ACSR 410 mm^2

7.2.9 Stringing Swivels

The swivel provided with a ball bearing is used for connecting a pilot wire with a power conductor or an overhead earthwire without strand twisting. The swivel supplied under the Contract shall be of clevis type and its rated working strength shall be 2,500 kg and 4,000 kg with the safety factor of 3.0.

7.2.10 Fault Insulator Detector

The detector shall be adequate for use to 110 kV and 230 kV transmission line to detect defective insulator units. The detector shall be preferably of NGK's model "Neon Lamp Type Insulator Tester" or equivalent model. The NGK's tester is gap type and consists of two horns, a condenser, a neon lamp, a parallel resistance and a needle gap.

Technical particulars of the testers shall be as follows:

Applicable line voltage	Dry power frequency test voltage on insulated tube at the full length	between contact horns
110 kV - 187 kV	374 kV (2 minutes)	30 kV (1 minute)
220 kV - 275 kV	550 kV (2 minutes)	30 kV (1 minute)

7.2.11 Aerial Conductor Car

The car shall be for single conductor use and four conductors use. The car shall be equipped with aluminium wheels, a cage for worker, a brake, stoppers and a distance meter. Standard spacing of sub-conductors shall be 450 mm with ± 100 mm spacing adjustment. The car shall be possibly light and easily pass over the aluminium or steel midspan joint or repair sleeves on the conductors or overhead earthwires.

7.2.12 Earthing Roller

The roller is used for earthing the induced current on power conductors or earthwires during the stringing operation. A roller shall consist of two aluminium wheels, counter weights for balancing of the roller and an earthing lead wire with a clamp. The lead wire shall be capable of 100 amperes.

7.2.13 Temporary Earthing Equipment (Rod)

The equipment shall be designed for the voltages of 150 kV and 300 kV lines and equipped with a hook for clamping a conductor, expandable insulation rods (minimum 2,800 mm long) and an earthing copper conductor of minimum 14 mm^2 in section and

5 m long with a clamp on one end. Size of the hook shall be adequate for ACSR up to 410 mm^2.

7.2.14 Conductor Cutter

The cutter is used for cutting aluminium stranding wires only of ACSR 410 mm^2, 336.4 MCM, 397.5 MCM, 200 mm^2 and 185 mm^2. A cutter shall be supplied with 2 sets of dies for those conductors as accessories.

7.2.15 Line Throwing Appliance

The appliance is used for throwing nylon rope over 250 meters. An appliance consists of a launcher, an ignition cord, a rocket, a push rod for the rocket and 320m nylon rope in a box. The launcher shall be equipped with a handle, ignition system (including a firing switch, safety switch, charging switch, ignition plug), a shoulder plate, batteries and other accessories for safety use. Otherwise the Tenderer shall propose other types of the throwing appliance as a spring type for the same function in his Tender proposal. The Contractor shall obtain a necessary permit to export the appliance to Viet Nam at his responsibility.

7.2.16 Tension Meter

Tension meters are used for measurement of tensions of conductors and overhead earthwires during the stringing operation. The meters shall be of spring type or other approved type equipped with eye fittings on its both ends and its accuracy shall be ± 3% at its full scale. Meters to be supplied under the Contract are 1 ton full scale with 20 kg graduation, 3 tons full scale with 50 kg graduation, and 5 tons full scale with 100 kg graduation. Each meter shall be supplied in the leather case.

7.2.17 Come-along Clamp

The come-along clamp shall be of a wedge type and so designed that no slipping off or damage to the conductors and overhead earthwires shall occur at the load less than 40 % of the ultimate breaking tensions of conductors and earthwires.

One set of the wedge of conductors and earthwires shall be supplied for each come-along. Each wedge shall be clearly marked with die for suitable size of conductors and earthwires.

	Type No.2	Type No.3
Applicable ACSR (diameter in mm)	336.4 MCM (18.28mm) & 185 mm^2 (18.80mm)	410mm^2 (28.5mm)
Applicable GSW (diameter in mm)	50 mm^2 (9.2mm)	90mm^2 (12.0mm)
Working load (safety factor of 3.0)	3,500 kg	7,000 kg
Wedges to be supplied with a clamp	ACSR 336.4MCM, ACSR 185 mm^2 and GSW 50 mm^2	ACSR 410 mm^2 and GSW 90mm^2

7.2.18 Wire Grip

The grip for wire ropes (10 mm to 20 mm in diameter) shall be of similar model to that shown in the attached Figure No. TL-230-04. Its allowable tensile strength shall be 4,000 kg with safety factor of 3.0.

7.2.19 Aluminium Pulley Block

The block shall have the clevis type hanger and an aluminium alloy sheave of not less than 309 mm in diameter at the bottom of its groove and bearing shall be of ball or roller type. The groove shall be lined with urethane. The groove width shall be approximately 65 mm.

The support frame shall be provided with a gate for transferring conductors and designed in such rigid construction as will enable to open or close the gate under the load of 800 kg. The mechanical allowable strength shall be more than 3,000 kg with the safety factor of 3.0.

7.2.20 Steel Snatch Block

The blocks shall be side openable type equipped with the hook type hanger and a cast iron pulley of not less than 100 mm or 150 mm in diameter at the bottom of groove. The blocks to be supplied under the Contractor shall be both of single groove, double and three grooves. Ball bearing shall be used for smooth revolution of the wheel.

The diameter of wheel and working load (with safety factor of 3.0) of the blocks shall be as follows. Groove of the wheel shall be capable of passing wires of up to 40 mm in diameter.

Model No.	Dia. of Groove	Dia. of Wheel	Working Load
IS-100	1	100 mm	2,000 kg
IS-150	1	150 mm	5,000 kg
2S-100	2	100 mm	2,000 kg
2S-150	2	150 mm	5,000 kg
3S-150	3	150 mm	5,000 kg

7.2.21 Pressed Steel Plate Block

The blocks shall be side openable type equipped with the hook type hanger and a cast iron wheel of 150 mm in diameter at the bottom of groove with ball bearing. The blocks to be supplied under the Contractor shall be of single groove. Size of the groove shall be for passing wires of up to 40 mm in diameter. Working load of the block shall be more than 1,000 kg with safety factor of 3.0.

7.2.22 Wire Joint Clevis

The joint clevis is used for connecting a pilot wire of 12-14 mm diameter with another pilot wire of 12-14 mm diameter during the stringing operation. The working load of the clevis shall be more than 3,000 kg with the safety factor of 3.0. The attached Figure No. TL-230-04 shows the general feature of the joint clevis.

7.2.23 Stringing Roller

The roller is used for protecting the power conductors and overhead earthwires during paying out from damage due to scrubbing ground or other obstacles. The roller shall be made of cast aluminium alloy and the frame shall be made of mild steel.

General feature and standard dimensions are shown in the attached Figure No. TL-230-05. Main roller and side rollers shall smoothly revolve around their axes.

7.2.24 Hanger of Pulley

The hanger is used for hanging pulleys on support structures. The working load of the hanger shall be more than 3,000 kg with safety factor of 3.0. General feature and standard dimensions are shown in the attached Figure No. TL-230-05.

7.2.25 Conductor Grip

The grip is of lever type for gripping a conductor of 18 mm to 32 mm in diameter with allowable gripping capacity of 1,000 kg. General feature of the grip is shown in the attached Figure No. TL-230-06.

7.2.26 Conductor Hook

The hook is used for shifting a conductor from a pulley to a suspension clamp after conductor sagging and armour rod winding. Attached Figure No. TL-230-06 shows the general feature of the hook. Groove of the hook shall be lined by rubber or equivalent materials to protect conductor or armour rods from unexpected damages.

The hook shall be designed for conductors of ACSR 185 mm^2 to ACSR 410 mm^2 and working load of 4,000 kg with the safety factor of 3.0.

7.2.27 Drum Stand

Attached Figure No. TL-230-07 shows general construction of the drum stand of power conductors and overhead earthwires. Dimensions in the drawing are standard but for information to manufacturers. The stand shall consist of brake drums, brake bands, drum shaft, oil jacks, support frames and other accessories.

The brake drums shall be easily installed with clamps and staples to conductor or earthwire drums. The drum stand shall bear the weight of 4,000 kg with safety factor of 3.0.

7.2.28 Joint Protector

The protector is used for protecting midspan joints of power conductors from bending and scratching when the joint passes through the pulleys. The protector is to be assembled by two covers. Each cover shall be constructed with a semicircled steel body and hard rubber terminal at both ends of the steel body. Length and inside diameter of the protector shall be adequate to cover respective midspan joint.

Protectors to be supplied under the Contract are those for equivalent conductors to ACSR 185 mm^2, ACSR 300 mm^2 and ACSR 500 mm^2.

7.2.29 Stringing Yoke

The yoke is used for connection between a pilot wire and power conductors or overhead earthwire during paying out of conductors and overhead earthwire.

The yoke shall be of auto-passing running board type for single conductor. The yoke shall be in such construction that several links are connected each other by pins or other devices and each part shall sag in only one direction. The yoke shall be equipped with a curved counterweight for preventing overturning of the yoke on the pulley.

7.2.30 Wire Clip

Following galvanized wire clips shall be supplied under the Contract for connecting two wires:

Model No.	Outside Dia. of Wire
MR- 8	6.3 mm - 8.0 mm
MR-10	9.0 mm - 10.0 mm
MR-14	14.0 mm

7.3 Other Tools and Appliance

7.3.1 Hand Winch

The winch is of hand-operated type as shown in the attached Figure No.TL-230-08. The set shall be easily detached and re-assembled at site. It consists of a winding drum, a winch body, frame and other accessories. All parts shall be hot-dip galvanized. Dimensions

mentioned in the drawing are for manufacturers' information, but smaller size is preferable. Direct winding capacity of the winch shall be 4,000 kg and 7,000 kg with safety factor of 3.0 (ultimate capacity of 12,000 kg and 21,000 kg, respectively).

The set shall be installed on a pole or others for operation. The gear brake shall have such function that reverse revolution is prevented automatically. Length of a handle for the winch shall be adjustable for 25 cm and 50 cm.

7.3.2 Lever Block

The block is principally a chain device for lifting loads by manual operation of a lever. Frame, gear case, and cover of brake equipment shall be made of steel. The brake mechanism is fully enclosed by the cover and a seal to prevent dust and other foreign matters. The hook shall be provided with a safety latch.

General feature and specifications of the blocks to be supplied are shown in the attached Figure No. TL-230-09.

7.3.3 Chain Hoist

The hoist is shown in the attached Figure No. TL-230-09. Lifting capacity and standard lift shall be 6,000 kg with safety factor of 2.5 and 3.5 meters.

7.3.4 Universal Pulling and Lifting Machine (Tirfor)

The machines supplied under the Contract shall be the following models.

Model No.	T-13	T-35
Capacity	1,500 kg	3,000 kg
Lift	Unlimited	Unlimited
Speed	3 m/min.	1 to 3 m/min.
Rope Diameter	11.7mm (max.)	16.3mm (max.)
Rope Breaking Load	9,600 kg	18,000 kg
Safety Pin Endurance	3,200 kg	6,000 kg
Lever Ratio	36 : 1	85 : 1
Rope Length Required	20 meters	10 meters

The rope supplied shall be completely hot dip galvanized.

7.3.5 Torque Wrench

The torque wrenches shall be of a spring lever type with a dial for the preset of torque. The wrenches shall be provided with torque preset dial. Wrenches to be supplied shall be as follows:

Model No.	Capacity of Torque	Graduation
225 QL	50-225 kgf-cm	2.5 kgf-cm
900 QL	200-900 kgf-cm	10 kgf-cm

Each wrench shall be provided with sockets for 12mm, 16 mm and 19 mm bolts.

7.3.6 Turnbuckle

The turnbuckle shall be of the hook and clevis type and shall be composed of a pair of hook or clevis and a body with a reversible ratchet handle. Minimum stroke of the device, lever-operating load and holding load shall be as follows:

Model No.	Stroke	Lever-operating Load	Holding Load
No.2	910 mm-1,410 mm	2,000 kgf	3,200 kgf
No.3	1,160 mm-1,790 mm	3,200 kgf	5,000 kgf

Loads specified above shall be working loads with safety factor of 3.0.

7.3.7 Ratchet Spanner

Following spanners shall be supplied with the required sockets for hexagon bolts and nuts.

Model No.	Sockets for Bolts	Standard Length
14x16	14mm & 16 mm dia.	150 mm
16x19	16 mm & 19 mm dia.	250 mm
20x22	20 mm & 22 mm dia.	300 mm

7.3.8 Derrick

General arrangement of the derrick is shown in the attached Figure No. TL-230-10. Total length of the derrick after jointing 3 booms shall be 18 meters. The derrick shall be structured by galvanized steel pipes and provided with a pedestal for fixing the derrick to a member of tower or other structures. The derrick shall be capable of the loads shown in the drawing.

7.3.9 Gin Pole

The pole shall be made of steel tube and jointable for total length in 15 meters. One end of the pole shall be equipped with a device for fixing the pole to structures and another end of the pole provided with a device for connecting stay wires and a steel pulley. The allowable lifting capacity of a jointed 15 m pole shall be 500 kg at its vertical position.

The Tenderer shall submit in his tender proposal his design of the pole with jointing parts of pole element, devices at both ends of the pole and a loading chart for inclination of the pole with staywires.

7.3.10 Hand Drill

The drill shall be capable of drilling steel materials for bolt holes up to 20 mm dia. and be supplied with three sets of drills of 12 mm, 16 mm and 20 mm in diameter with a saddle for fixing the drill to the tower members.

7.3.11 Portable Hydraulic Punching Machine

The machine is used for punching bolt holes up to 19 mm in diameter on steel plates and steel angles up to 9 mm thick at site. The machine shall be operated by hydraulic pressure and designed for the possibly lightest weight.

Each set shall be supplied with a punching head, a hydraulic pump, pressure tubes, other accessories together with three sets of punching devices for 12 mm, 16 mm and 19 mm bolts.

7.3.12 U-type Clevis (Shackle)

Following two kinds of the clevises shall be supplied after hot dip galvanizing. Dimensions specified below are referred to the attached Figure No. TL-230-11.

Model No.	Dimensions				Working Load (kg)
	A (mm)	B (mm)	C (mm)	D (mm)	
UCH-500	80	12	12	13	1,700
UCH-800	95	18	16	16	2,600

The working loads of the clevises mentioned above shall have the safety factor of more than 3.0.

7.3.13 Wire Rope

The steel wire ropes shall be so constructed as to be suitable for paying out of the conductors and overhead earthwires or for lifting of loads. The rope shall be composed of the galvanized steel wires and hemp and shall be stranded in the right-hand (Z) regular lay. Ropes to be supplied shall be as follows and packed in coils containing 200 m each.

Diameter	(mm)	9	12	14	16
Strand (Z lay)		6 x 19	6 x 24	6 x 24	6 x 24
Sectional area	(mm^2)	31.6	50.0	69.1	89.0
Minimum ultimate strength	(kg)	4,110	6,680	9,090	11,900

7.3.14 Nylon Rope

Nylon ropes shall be so constructed as to be for lifting of loads. The rope shall be stranded in the right-hand (Z) regular lay. Ropes to be supplied shall be as follows and packed in coils containing 200 m each.

Diameter	(mm)	12	16
Strand		Z-lay	Z-lay
Minimum ultimate strength	(kg)	2,950	5,050

7.3.15 Safety Belt for Lineman

The safety belt shall consist of a free size belt and an adjustable safety rope in 2 meters long with a fixing clip.

7.3.16 Safety Rope

The rope is used for spare safety rope of the safety belt specified above. Specifications for material and size of the rope shall be those for the safety belts.

7.3.17 Screw Anchor

The screw anchor shall be of about 1,800 mm in length and 250 mm in diameter. Attached Figure No. TL-230-11 shall be referred to supply. Quality of the material shall be equivalent to SS-41 of JIS, and the anchors shall be hot-dip galvanized.

One ratchet handle per five anchors shall be supplied in the rate for the anchors.

7.3.18 Binocular

The binocular shall be of zoom type and satisfied with the following specifications.

Magnification	: 8 - 20
Field of view	: 5° - 3.3°
Diameter of exit pupil	: 5.6 mm - 23 mm
Objective lens diameter	: 45 mm
Brightness	: 31.6 - 5.1
Field at 1,000 m	: 58 m - 87 m
Dimension (approximately)	: 16.2 cm x 18.5 cm x 6 cm
Weight (approximately)	: 1,000 gram

Each binocular shall be supplied in a hard leather case.

7.4 Inspection and Test

Following inspection and tests shall be carried out on tools and appliances in the Contractor's factory.

Unless otherwise specified in this Contract, selection of test samples, number of specimen and acceptance of the results shall be in accordance with the terms of the relevant standards of JIS, equivalent standard or as instructed by the Engineer.

Where no applicable terms in the above standard, the Engineer is to instruct details in advance of the inspections and tests in response to request of the Contractor.

Costs for the inspection and tests including supply of specimen shall be deemed to be included in the respective rates of materials.

(1) Material test

Following tests shall be carried out:

(a) Pulling of specimen taken from ropes or wires and steel made fittings
(b) Galvanizing of samples of all materials

(2) Functional test

Samples taken by the Engineer at random from all the tools and appliances shall be tested on their functions at the Contractor's factory.

(3) Appearance inspection

All accessories shall be subject to the appearance inspection for their dimensions, fitness to other fittings, galvanizing, etc.

SCHEDULE FOR RATES AND PRICES FOR TRANMISSION LINES

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	230kV Transmission Line Materials						
11M-1.1	Galvanized Steel Equal Angles : L40 x 40 x 3 (SS-41)	meter	11,280				
11M-1.2	Galvanized Steel Equal Angles : L45 x 45 x 4 (SS-41)	meter	4,560				
11M-1.3	Galvanized Steel Equal Angles : L45 x 45 x 4 (SS-50)	meter	7,140				
11M-1.4	Galvanized Steel Equal Angles : L50 x 50 x 4 (SS-41)	meter	1,140				
11M-1.5	Galvanized Steel Equal Angles : L50 x 50 x 4 (SS-50)	meter	720				
11M-1.6	Galvanized Steel Equal Angles : L50 x 50 x 6 (SS-41)	meter	288				
11M-1.7	Galvanized Steel Equal Angles : L60 x 60 x 5 (SS-41)	meter	1,920				
11M-1.8	Galvanized Steel Equal Angles : L60 x 60 x 5 (SS-50)	meter	40				
11M-1.9	Galvanized Steel Equal Angles : L65 x 65 x 6 (SS-41)	meter	240				
11M-1.10	Galvanized Steel Equal Angles : L80 x 80 x 6 (SS-41)	meter	88				
11M-1.11	Galvanized Steel Equal Angles : L90 x 90 x 7 (SS-50)	meter	1,000				
11M-1.12	Galvanized Steel Equal Angles : L100 x 100 x 7 (SS-41)	meter	18				
11M-1.13	Galvanized Steel Equal Angles : L100 x 100 x 10 (SS-50)	meter	1,000				
11M-1.14	Galvanized Steel Equal Angles : L130 x 130 x 9 (SS-50)	meter	504				
11M-2.1	Galvanized Steel Plates : 4.5mm thick x 1.5m x 3.0m (SS-41)	sheet	20				
11M-2.2	Galvanized Steel Plates : 6.0mm thick x 1.5m x 3.0m (SS-41)	sheet	6				
11M-2.3	Galvanized Steel Plates : 9.0mm thick x 1.5m x 3.0m (SS-41)	sheet	2				
11M-2.4	Galvanized Steel Plates : 12.0mm thick x 1.5m x 3.0m (SS-41)	sheet	2				
11M-3.1	Galvanized Bolts and Nuts : 12mm dia. x 40mm long (SS-41)	piece	7,500				
11M-3.2	Galvanized Bolts and Nuts : 16mm dia. x 40mm long (SS-50)	piece	7,500				
11M-3.3	Galvanized Bolts and Nuts : 16mm dia. x 50mm long (SS-50)	piece	3,000				
11M-3.4	Galvanized Bolts and Nuts : 16mm dia. x 60mm long (SS-50)	piece	1,000				
11M-3.5	Galvanized Bolts and Nuts : 20mm dia. x 60mm long (SS-50)	piece	500				

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	230kV Transmission Line Materials						
11M-4.1	Insulator Set : Single Suspension Set	set	50				
11M-4.2	Insulator Set : Double Suspension Set	set	50				
11M-4.3	Insulator Set : Single Tension Set	set	40				
11M-4.4	Insulator Set : Double Tension Set	set	40				
11M-4.5	Standdard Insulator Disc	unit	10,000				
11M-4.6	Fog Type Insulator Disc	unit	2,000				
11M-5.1	Preformed Armour Rods for ACSR 410 sq.mm	set	300				
11M-6.1	Midspan Joint for ACSR 410 sq.mm	set	500				
11M-6.2	Midspan Joint for Overhead Earthwire of GSW 90 sq.mm	set	100				
11M-7.1	Repair Sleeve for ACSR 410 sq.mm	set	300				
11M-8.1	Compression Dead-end Clamp for ACSR 410 sq.mm	set	120				
11M-9.1	Vibration Damper for ACSR 410 sq.mm	set	300				
11M-10.1	Suspension Clip for GSW 90 sq.mm	set	100				
11M-10.2	Complete Tension Set for GSW 90 sq.mm	set	50				
11M-11.1	Power Conductor : ACSR 410 sq.mm	meter	60,000				
11M-12.1	Overhead Earthwire : Galvanized Stranding Steel Wire 90 sq.mm	meter	20,000				

SCHEDULE FOR RATES AND PRICES FOR TRANMISSION LINES

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	230kV Transmission Line Tools						
11T-1	Engine Winch mounted on 4 WD Vehicle	set	2				
11T-2	Conductor Tensioner of 1.2 m Shoe-Chain Type	unit	2				
11T-3	Hand Winch for 20-ton Capacity	set	4				
11T-4	Hand Winch for 4-ton Capacity	set	6				
11T-5	Chain Hoist (4.5-6.0 ton Capacity)	set	6				
11T-6	Universal Pulling and Lifting Machine (3-ton Capacity)	set	6				
11T-7	12 meter long Aluminium Ladder	set	6				
11T-8	Insulator Replacer for 254mm x 146 mm unit	set	6				
11T-9	Torque Wrench for 200-900 kgf-cm	set	4				
11T-10	Gin Pole of 15 meter long	set	5				
11T-11	Turnbuckle of 3-5 ton Capacity	set	20				
11T-12	Hydraulic Compressor with dies	set	4				
11T-13	Hydraulic Cutter for ACSR 410 sq.mm	set	4				
11T-14.1	Nylon Rope (12 mm diameter)	km	4				
11T-14.2	Nylon Rope (16 mm diameter)	km	4				
11T-15	Hand Drill	set	6				
11T-16.1	Braid Type Pulling Grip for ACSR 410 sq.mm	set	10				
11T-16.2	Braid Type Pulling Grip for GSW 90 sq.mm	set	10				
11T-17.1	Swivel for 2,500 kg Pulling (Clevis-type)	set	20				
11T-17.2	Swivel for 4,000 kg Pulling (Clevis-type)	set	20				
11T-18	Fault Insulator Detector for 230 kV Line	set	10				
11T-19	Aerial Conductor Car for Single Conductor Use	set	4				
11T-20	Earthing Roller	set	4				
11T-21	Temporary Earthing Equipment for Transmission Line Use	set	30				
11T-22	Conductor Cutter with Dies	set	6				
11T-23	Line Throwing Equipment	set	4				
11T-24	Portable Hydraulic Punch	set	4				

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	230kV Transmission Line Tools						
11T-25.1	Ratchet Spanner for Bolts of 14mm and 16 mm dia.	set	20				
11T-25.2	Ratchet Spanner for Bolts of 16mm and 18 mm dia.	set	20				
11T-25.3	Ratchet Spanner for Bolts of 20mm and 22 mm dia.	set	20				
11T-26.1	Tension Meter for 1-ton Use	set	3				
11T-26.2	Tension Meter for 3-ton Use	set	3				
11T-26.3	Tension Meter for 5-ton Use	set	3				
11T-27	Come-along Clamp for ACSR 410 sq.mm	set	24				
11T-28.1	Wire Rope in 10 mm diameter	km	5				
11T-28.1	Wire Rope in 12 mm diameter	km	5				
11T-28.1	Wire Rope in 14 mm diameter	km	5				
11T-29	Wire Grip	set	16				
11T-30	Pulley Block of 309 mm diameter	set	200				
11T-31.1	Snatch Block : Single Sheeve	set	10				
11T-31.2	Snatch Block : Double Sheaves	set	12				
11T-32.1	Safety Belt for Lineman	set	200				
11T-32.2	Spare Safety Rope	meter	400				

SCHEDULE FOR RATES AND PRICES FOR TRANMISSION LINES

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	110kV Transmission Line Materials						
	Da Nhim - Thap Cham Section						
12M-1.1	Galvanized Steel Pole : Type PA+2	set	2				
12M-1.2	Galvanized Steel Pole : Type PA+5	set	1				
12M-1.3	Galvanized Pole Cap for Type PA	piece	60				
12M-1.4	Galvanized Pole Cap for Type PC	piece	15				
12M-1.5	Galvanized Pole Cap for Type PC &PD	piece	15				
12M-2.1	Crossarm U-band of Type 15a	set	10				
12M-2.2	Crossarm U-band of Type 15b	set	10				
12M-2.3	Crossarm Attachment of Type M	set	60				
12M-2.4	Crossarm Band for Type PC and PD Poles	set	40				
12M-2.5	Guywire Band, 216.7 mm diameter	set	50				
12M-2.6	Guywire Band, 267.4 mm diameter	set	50				
12M-2.7	Band for Overhead Earthwire	set	50				
12M-2.8	Strain Plate - A	piece	50				
12M-2.9	Strain Plate - B	piece	50				
12M-2.10	Loop Type Support	set	50				
12M-2.11	Eye Bolt for Base Plate	piece	100				
12M-2.12	Arm-tie Band	set	100				
12M-2.13	Anchor Rod	set	100				
12M-2.14	Strain Insulator	piece	200				
12M-2.15	Guywire (7/3.2mm)	meter	3,000				
12M-2.16	Guy Grip, Thimble Type	piece	200				
12M-2.17	Guy Grip, Ball Type	piece	200				

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	Da Nhim - Thap Cham Section						
12M-3.1	Insulator Set : Single Suspension Set	set	100				
12M-3.2	Insulator Set : Special Single Suspension Set	set	20				
12M-3.3	Insulator Set : Double Suspension Set	set	20				
12M-3.4	Insulator Set : Special Double Suspension Set	set	20				
12M-3.5	Insulator Set : Single Tension Set	set	50				
12M-3.6	Insulator Set : Special Single Tension Set	set	10				
12M-3.7	Insulator Set : Double Tension Set	set	20				
12M-3.8	Insulator Set : Reversible Light Duty Set	set	10				
12M-3.9	Standard Insulator Disc : 254mm x 146mm Porcelain	unit	1,300				
12M-3.10	Fog Type Insulator Disc : 254mm x 146mm Porcelain	unit	200				
12M-4.1	Suspension Clamp for ACSR 336.4MCM	set	100				
12M-4.2	Ball Type Horn Holder	piece	50				
12M-4.3	Socket Eye Type Horn Holder	piece	50				
12M-4.4	Arcinh Horn-A	piece	50				
12M-4.5	Arcinh Horn-B	piece	50				
12M-4.6	Arcinh Horn-C	piece	50				
12M-4.7	Arcinh Horn-D	piece	50				
12M-4.8	U-bolt with 2 Nuts	piece	200				
12M-4.9	Clevis Eye	piece	50				
12M-4.10	Clevis Socket	piece	50				
12M-4.11	Clevis Ball	piece	50				
12M-4.12	Anchor Shackle	piece	200				
12M-4.13	Chain Link	piece	100				
12M-4.14	Strain Clamp Set for ACSR 336.4MCM	set	100				
12M-4.15	Suspension Clamp for Overhead Earthwire 22 sq.mm	set	100				
12M-4.16	Tension Clamp	set	50				

SCHEDULE FOR RATES AND PRICES FOR TRANMISSION LINES

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	Da Nhim - Thap Cham Section						
12M-5.1	Stockbridge Damper for ACSR 410 sq.mm	piece	50				
12M-5.2	Midspan Joint for ACSR 410 sq.mm	set	200				
12M-5.3	Repair Sleeve for ACSR 410 sq.mm	set	200				
12M-5.4	Flexible Copper Earth Bond	set	500				
12M-5.5	Deadend Clamp for ACSR 410 sq.mm	set	50				
12M-6.1	Midspan Joint for GSW 22 sq.mm	piece	50				
12M-6.2	Suspension Set for GSW 22 sq.mm	piece	5				
12M-6.3	Tension Set for GSW 22 sq.mm on Deadend Tower	set	10				
12M-6.4	Suspension Set for GSW 22 sq.mm on Pole	set	50				
12M-6.5	Tension Set for GSW 22 sq.mm on Pole	set	20				
12M-7.1	Power Conductor, ACSR 336.4 MCM	km	5				
12M-8.1	Overhead Earthwire, GSW 22 sq.mm	km	2				
	Thap Cham - Phan Thiet Section Materials						
12M-9.1	Galvanized Steel Equal Angles : L 70 x 70 x 6 (SS-41) x 6m long	piece	40				
12M-9.2	Galvanized Steel Equal Angles : L 100x100x7(SS-41) x 6m long	piece	20				
12M-9.3	Galvanized Steel Equal Angles : L 50 x 50 x 4 (SS-41) x 6m long	piece	40				
12M-9.4	Galvanized Flat Bar : 120 x 10 mm (SS-41) x 6m long	piece	10				
12M-9.5	Galvanized Flat Bar : 70 x 6 mm (SS-41) x 6m long	piece	20				
12M-9.4	Galvanized Flat Bar : 60 x 6 mm (SS-41) x 6m long	piece	20				
12M-10.1	Galvanized Bolts and Nuts : 16mm dia. x 45 mm long (SS-41)	piece	1,000				
12M-10.2	Galvanized Bolts and Nuts : 16mm dia. x 120 mm long (SS-41)	piece	200				
12M-10.3	Galvanized Bolts and Nuts : 20mm dia. x 90 mm long (SS-41)	piece	200				
12M-10.4	Galvanized Bolts and Nuts : 24mm dia. x 70 mm long (SS-41)	piece	100				

SCHEDULE FOR RATES AND PRICES FOR TRANMISSION LINES

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	Thap Cham - Phan Thiet Section Materials						
12M-11.1	Counterpoise Wire, GSW 12mm dia. x 25 m	piece	200				
12M-11.2	Galvanized Steel Rod, 16mm dia. x 2.4 m	piece	300				
12M-11.3	Galvanized Steel Terminal for fixing Counterpoise Wire	piece	1,000				
12M-11.4	Guywire of GSW 55 sq.mm	meter	3,000				
12M-11.5	Guy Grip of Thimble Type	piece	200				
12M-11.5	Anchor Shackle for Guywire	piece	200				
12M-11.6	Wire Clip for GSW 16mm dia.	piece	1,000				
12M-12.1	Midspan Joint for Conductor AC	set	150				
12M-13.1	Repair Sleeve for Conductor AC	set	200				
12M-14.1	Midspan Joint for GSW TK-50	piece	50				
	Thap Cham - Cam Ranh Section Materials						
13M-1.1	Galvanized Steel Crossarm	set	42				
13M-2.1	Galvanized Steel Pole : Type PA+0	set	2				
13M-2.2	Galvanized Steel Pole : Type PA+2	set	2				
13M-3.1	Standard Type Insulator Disc, 254mm x 146mm	unit	7,000				
13M-3.2	Fog Type Insulator Disc, 254mm x 146mm	unit	3,000				
13M-4.1	Power Conductor, ACSR 336.4 MCM including Midspan Joint	ton	102				

SCHEDULE FOR RATES AND PRICES FOR TRANMISSION LINES

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	Thap Cham - Cam Ranh Section Materials						
13M-5.1	Guywire of GSW 55 sq.mm	meter	2,500				
13M-5.2	Guywire Fitting for The Above	set	100				
13M-6.1	Earthing Set, GSW 38 sq.mm	set	100				
	Cam Ranh - Dien Khanh Section Materials						
13M-7.1	Standard Insulator Disc, 254mm x 146mm	unit	5,000				
13M-7.2	Fog Type Insulator Disc, 254mm x 146mm	unit	7,000				
13M-7.3	110kV Single Suspension Insulator Set (Hardware only)	set	800				
13M-7.4	110kV Single Tension Insulator Set (Hardware only)	set	200				
13M-8.1	Power Conductor, ACSR 336.4 MCM	ton	102				
13M-8.2	Midspan Joint for ACSR 336.4 MCM	set	330				
13M-8.3	Repair Sleeve for ACSR 336.4 MCM	set	100				
13M-9.1	Overhead Earthwire, GSW 22 sq.mm	km	50				
13M-9.2	Midspan Joint for GSW 22 sq.mm	set	30				
13M-10.1	Counterpoise Wire Set	set	400				
	Tools for Line (Da Nhim-Thap Cham-Phan Thiet)						
12T-1.1	Engine Winch	set	2				
12T-2.1	Shoe-Chain Type Conductor Tensioner (1.2m dia.)	unit	2				
12T-3.1	Hand Winch (4-ton Capacity)	set	4				
12T-4.1	Lever Block (0.75 ton Capacity)	set	3				

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	Tools for Line (Da Nhim-Thap Cham-Phan Thiet)						
12T-4.2	Lever Block (1.5 ton Capacity)	set	3				
12T-5.1	Tower Form of 3 meter long	set	10				
12T-6.1	Insulator Replacer including 1 set for Double Tension Set	set	5				
12T-6.2	Inulator Lifter	set	4				
12T-7.1	Torque Wrench for 50 - 225 kgf-cm	set	4				
12T-7.2	Torque Wrench for 200 - 900 kgf-cm	set	4				
12T-8.1	Wire Joint Clevis (12 mm to 14 mm)	piece	20				
12T-9.1	Hook Type Turnbuckle (2-ton Capacity)	set	10				
12T-9.2	Clevis Type Turnbuckle (2-ton Capacity)	set	10				
12T-10.1	Hydraulic Compressor with Dies	set	4				
12T-11.1	Wire Rope (10 mm dia.)	km	2				
12T-11.2	Wire Rope (14 mm dia.)	km	1				
12T-12.1	Nylon Rope (16 mm dia.)	km	2				
12T-13.1	Hand Drill	set	2				
12T-14.1	Pulling Grip for Power Conductor of 19mm-25mm dia.	set	20				
12T-14.2	Pulling Grip for Overhead Earthwire of 26-32 mm dia.	set	20				
12T-15.1	Swivel for 2,500 kg Pulling	set	30				
12T-16.1	Stringing Roller	set	30				
12T-17.1	Aerial Conductor Car for Single Conductor Use	set	4				
12T-18.1	Temporary Earthing Equipment for 150kV Line	set	10				
12T-18.2	Temporary Earthing Equipment for 300kV Line	set	5				
12T-19.1	Conductor Cutter with Dies	set	3				
12T-20.1	Oil Pressure Type Cutter	set	2				
12T-21.1	U-type Clevis-A	piece	20				
12T-21.2	U-type Clevis-B	piece	20				
12T-22.1	Hanger of Pulley 2,600 kg	set	10				
12T-22.2	Hanger of Pulley 3,200 kg	set	10				

SCHEDULE FOR RATES AND PRICES FOR TRANMISSION LINES

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	Tools for Line (Da Nhim-Thap Cham-Phan Thiet)						
12T-23.1	Tension Meter for 1-ton Use	set	2				
12T-23.2	Tension Meter for 3-ton Use	set	2				
12T-24.1	Chicago Type Conductor Grip (18mm-32mm dia.)	set	10				
12T-25.1	Conductor Hook	set	5				
12T-26.1	Universal Pulling and Lifting Machine	set	2				
12T-27.1	Wire Clip-A	piece	20				
12T-27.2	Wire Clip-B	piece	20				
12T-27.3	Wire Clip-C	piece	20				
12T-28.1	Safety Belt for Lineman	set	50				
12T-29.1	Double Wheel Snatch Block, 2-ton Capacity	set	4				
12T-29.2	Double Wheel Snatch Block, 5-ton Capacity	set	4				
12T-29.3	Single Wheel Snatch Block, 2-ton Capacity	set	4				
12T-29.4	Single Wheel Snatch Block, 5-ton Capacity	set	4				
12T-30.1	Pressed Steel Plate Block, 150 mm	set	10				
12T-31.1	Aluminium Pulley	set	40				
12T-32.1	Stringing Tension Meter	set	2				
12T-33.1	Drum Stand, Oil Jack Type	set	2				
12T-34.1	Derrick with Pedestal	set	2				
12T-35.1	Binocular	unit	4				
	Tools for Line (Thap Cham-Cam Ranh-Dien Khanh)						
13T-1.1	Engine Winch mounted on 4WD Vehicle	set	4				
13T-2.1	20-ton Capacity Hand Winch	set	2				
13T-3.1	4-ton Capacity Hand Winch	set	5				
13T-4.1	Shoe-chain Type Conductor Tensioner (1.2 m dia.)	unit	5				
13T-5.1	Chain Hoist (4.5 - 6 ton Capacity)	set	5				

SCHEDULE FOR RATES AND PRICES FOR TRANMISSION LINES

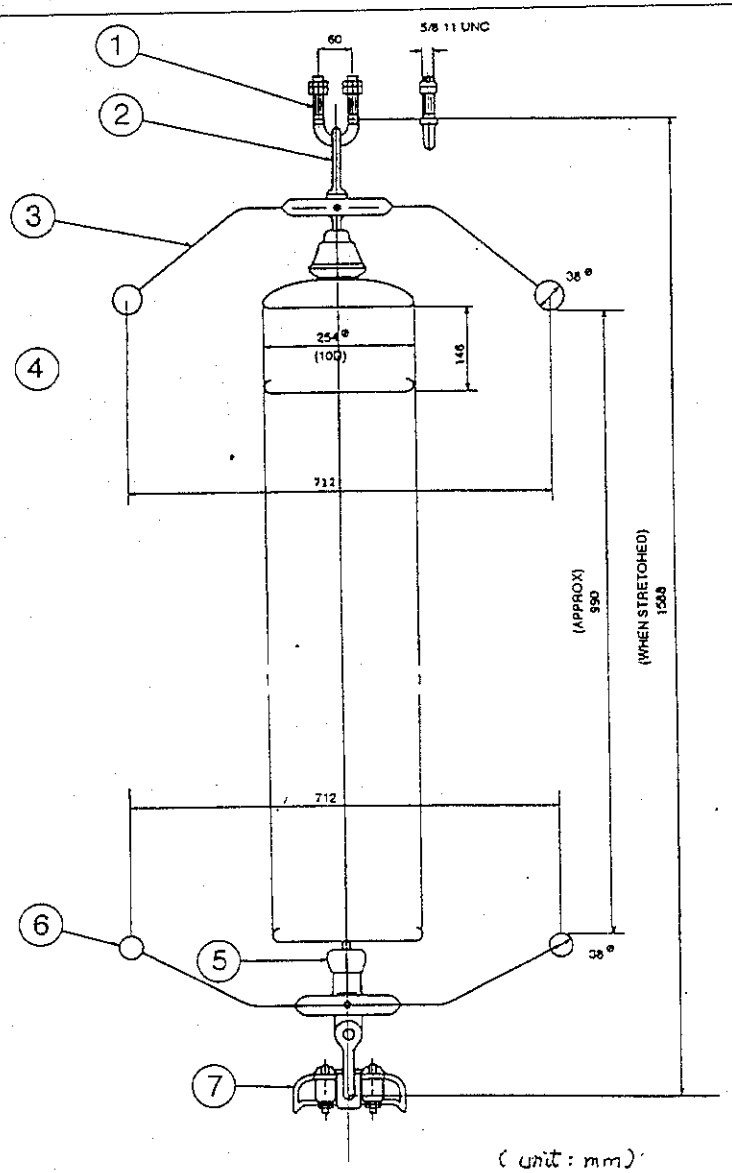
ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	Tools for Line (Thap Cham-Cam Ranh-Dien Khanh)						
13T-6.1	Universal Pulling and Lifting Machine	set	10				
13T-7.1	12 meter long Aluminium Ladder	set	5				
13T-8.1	Insulator Replacer for 254 mm x 146 mm	set	10				
13T-9.1	Torque Wrench for 200-900 kgf-cm	set	5				
13T-10.1	Gin Pole, 15 m long	set	5				
13T-11.1	Pulling Grip for Power Conductor of ACSR 336.4 sq.mm	set	10				
13T-11.2	Pulling Grip for Power Conductor of ACSR 185 sq.mm	set	10				
13T-12.1	Pulling Grip for Overhead Earthwire of GSW 70 sq.mm	set	10				
13T-13.1	Turnbuckle of 3- 5 ton Capacity	set	10				
13T-14.1	Hydraulic Compressor with Dies	set	5				
13T-15.1	Hydraulic Cutter for ACSR Linnet and 185 q.mm	set	5				
13T-16.1	Hand Drill	set	5				
13T-17.1	Swivel for 2,000kg Pulling (Clevis Type)	set	10				
13T-18.1	Swivel for 4,000kg Pulling (Clevis Type)	set	10				
13T-19.1	Fault Insulator Detector for 230kV Line	set	10				
13T-19.2	Fault Insulator Detector for 110kV Line	set	10				
13T-20.1	Aerial Conductor Car for Single Conductor Use	set	5				
13T-20.2	Aerial Conductor Car for Four Conductor Use	set	2				
13T-21.1	Earthing Roller	set	10				
13T-22.1	Temporary Earthing Equipment for Line Use	set	40				
13T-23.1	Line Throwing Equipment (Spring Type)	set	5				
13T-24.1	Portable Hydraulic Punch	set	1				
13T-25.1	Ratchet Spanner for 14 mm and 16 mm dia.	set	10				
13T-25.2	Ratchet Spanner for 16 mm and 18 mm dia.	set	10				
13T-25.3	Ratchet Spanner for 20 mm and 22 mm dia.	set	10				
13T-26.1	Tension Meter for 3-ton Use	set	5				

SCHEDULE FOR RATES AND PRICES FOR TRANMISSION LINES

ITEM	SHORT DESCRIPTION	UNIT	Q'TY	Rate			AMOUNT
				FOB	INSURANCE AND FREIGHT	CIF	
	Tools for Line (Thap Cham-Cam Ranh-Dien Khanh)						
13T-26.2	Tension Meter for 5-ton Use	set	5				
13T-27.1	Come-along Clamp for ACSR 300 q.mm	set	20				
13T-27.2	Come-along Clamp for ACSR 185 sq.mm	set	20				
13T-28.1	Wire Grip	set	5				
13T-29.1	Pulley Grip of 309 mm dia.	set	200				
13T-30.1	Snatch Block of 3 Wheels	set	10				
13T-30.2	Snatch Block of 3-6 ton Capacity	set	10				
13T-32.1	Screw Anchor	set	10				
13T-33.1	Joint Protector for ACSR 185 sq.mm	set	10				
13T-33.2	Joint Protector for ACSR 300 sq.mm	set	10				
13T-33.3	Joint Protector for ACSR 500 sq.mm	set	10				
13T-34.1	Stringing Yoke, 6-ton Capacity	set	10				
13T-35.1	Wire Rope, 10 mm dia. with 25 connectors	km	5				
13T-35.2	Wire Rope, 12 mm dia. with 25 connectors	km	5				
13T-35.1	Wire Rope, 14 mm dia. with 25 connectors	km	5				
13T-36.1	Nylon Rope, 12 mm dia.	km	4				
13T-36.2	Nylon Rope, 16 mm dia.	km	4				

DRAWINGS FOR CHAPTER 6

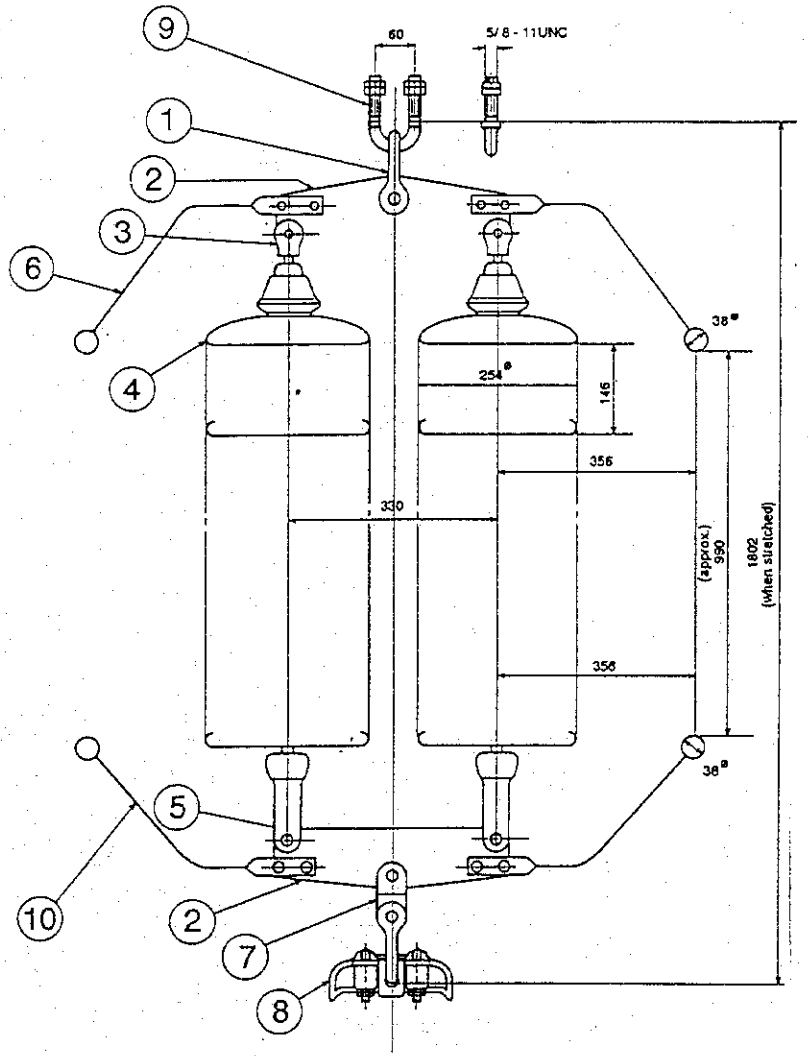
MATERIALS AND EQUIPMENT FOR TRANSMISSION LINES



ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT.NO.
1	U-BOLT	HIGH TENSION STEEL	1	4H-1805BU
2	HORN HOLDER BALL-EYE	HIGH TENSION STEEL	1	4H-2046A
3	ARCING HORN	STEEL	1	2H-1810AU
4	SUSPENSION INSULATOR	PORCELAIN	8	CA-525EC or CA-825EC
5	HORN HOLDER SOCKET-EYE	MALLEABLE IRON	1	4H-20496L
6	ARCING HORN	STEEL	1	2H-1810BU
7	SUSPENSION CLAMP	ALUMINIUM ALLOY	1	1H-1075AU
SUITABLE CONDUCTOR SIZE OF CLAMP				A.C.S.R. 7.6Ø~18.5Ø
MIN BREAKING STRENGTH OF STRING				7000kg
TYPE OF BALL AND SOCKET PARTS				IEC 15mmA

(unit : mm)

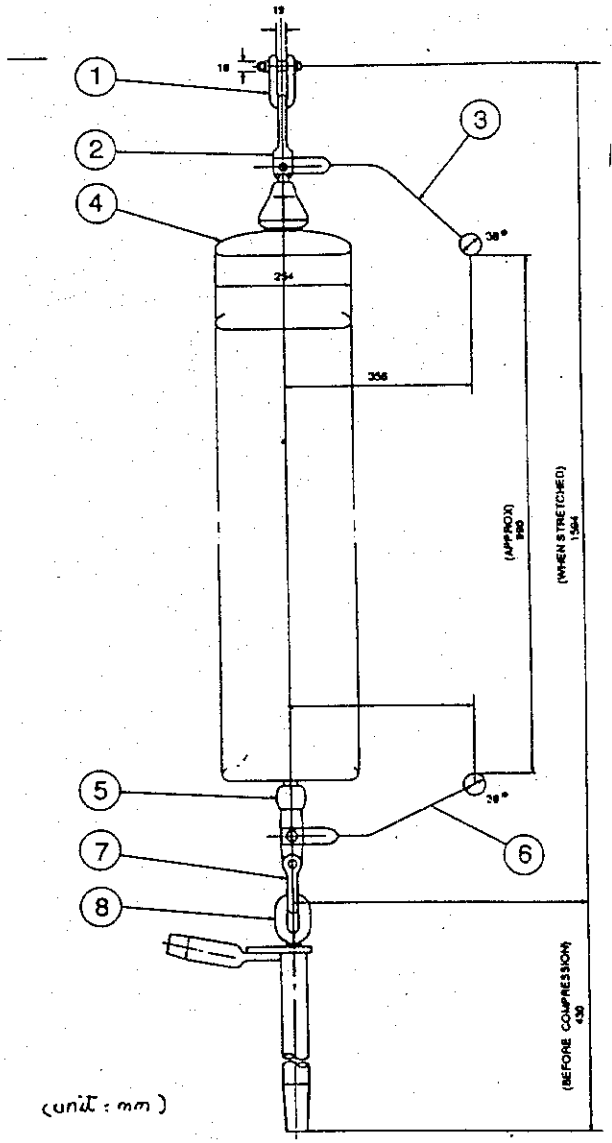
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-01 110 kV Insulator Sets (1/8)



ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT.NO.
1	ANCHOR SHACKLE	STEEL	1	4H-835A
2	YOUKE	STEEL	2	7H-166B
3	BALL-CLEVIS	STEEL	2	4H-1492C
4	SUSPENSION INSULATOR	PORCELAIN	8×2	CA-525EC or CA-825EC
5	SOCKET-CLEVIS	MALLEABLE IRON	2	4H-20491B
6	ARCING HORN	STEEL	2	2H-1812AU
7	CLEVIS EYE	MALLEABLE IRON	1	4H-603G
8	SUSPENSION	ALUMINIUM ALLOY	1	1H-1075AU
9	U-BOLT	HIGH TENSION STEEL	1	4H-1805BU
10	ARCING HORN	STEEL	2	2H-1812BU
SUITABLE CONDUCTOR SIZE OF STRING				A.C.S.R. 7.6Ø~18.5Ø
MIN BREAKING STRENGTH OF STRING				8200kg
TYPE OF BALL AND SOCKET PARTS				IEC 16mmA

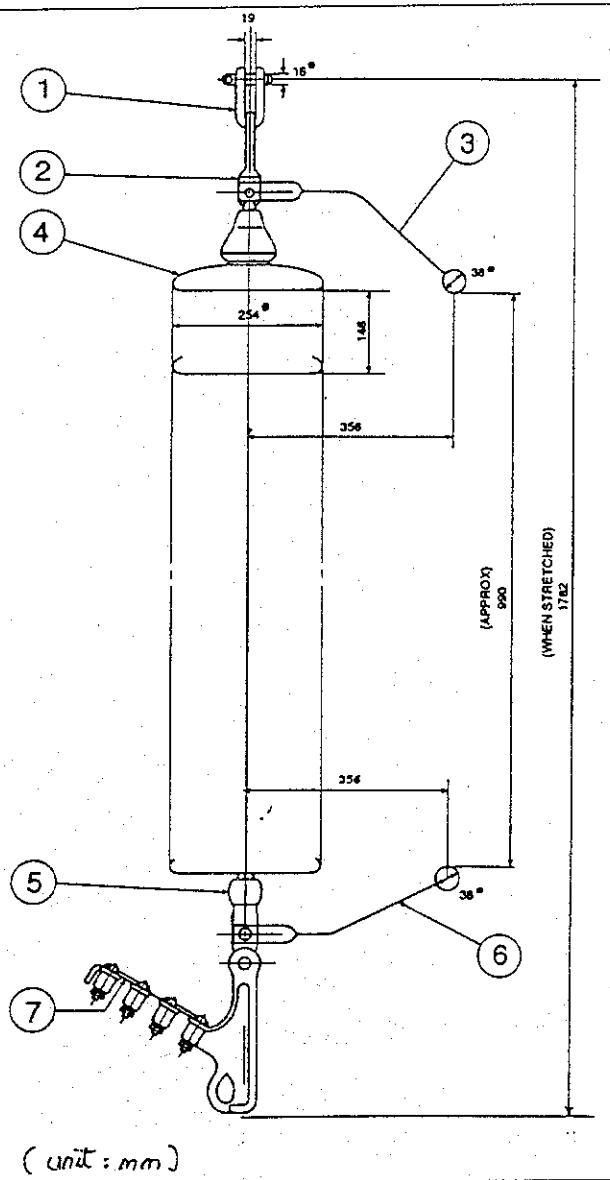
(unit : mm)

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-01 110 kV Insulator Sets (2/8)



ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT.NO.
1	ANCHOR SHACKLE	HIGH TENSION STEEL	1	4H-835A
2	HORN HOLDER BALL EYE	HIGH TENSION STEEL	1	4H-2046A
3	ARCING HORN	STEEL	1	2H-1816AU
4	SUSPENSION INSULATOR	PORCELAIN	8	CA-525EC / CA-625EC
5	HORN HOLDER SOCKET-EYE	MALLEABLE IRON	1	4H-20865X
6	ARCING HORN	STEEL	1	2H-1816BU
7	ANCHOR SHACKLE	HIGH TENSION STEEL	1	4H-631B
8	COMPRESSION CLAMP	ALUMINUM	1	2H-1025-8
SUITABLE CONDUCTOR SIZE OF CLAMP				A.C.S.R."LINNET"
※ MIN. BRAKING STRENGTH OF STRING				7,600kg
TYPE OF BALL AND SOCKET PARTS				IEC16mmA

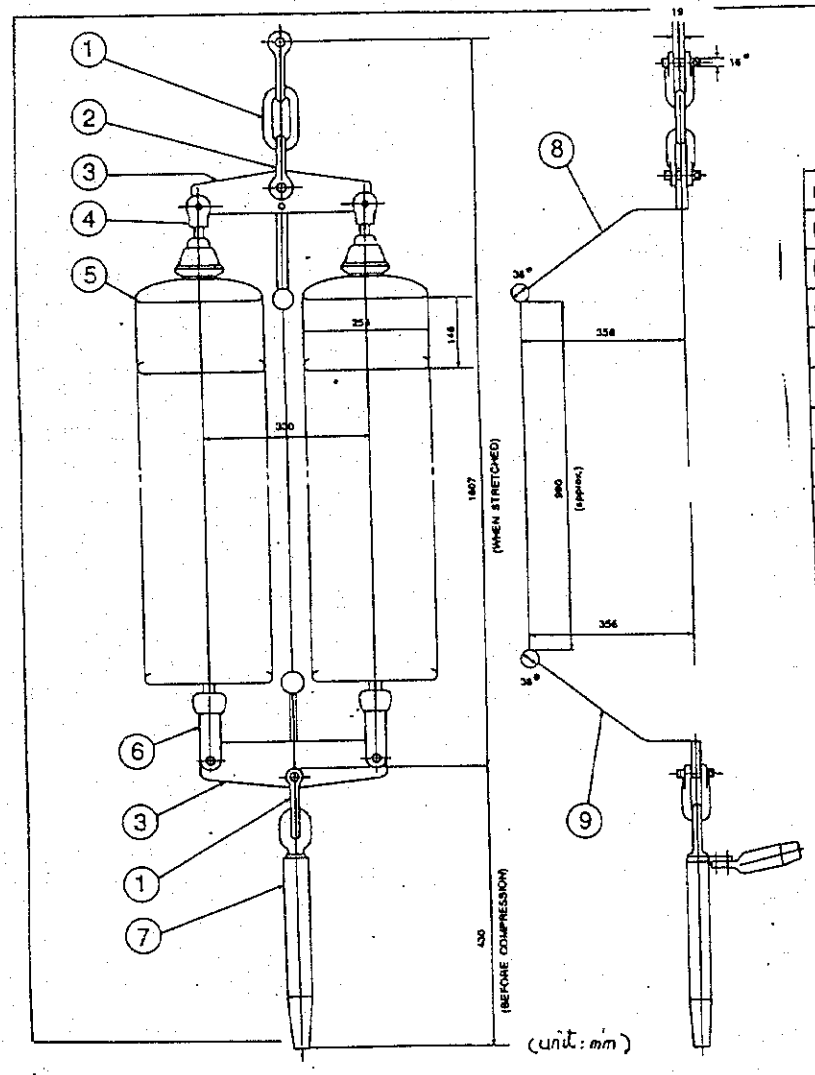
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-01 110 kV Insulator Sets (3/8)



(unit : mm)

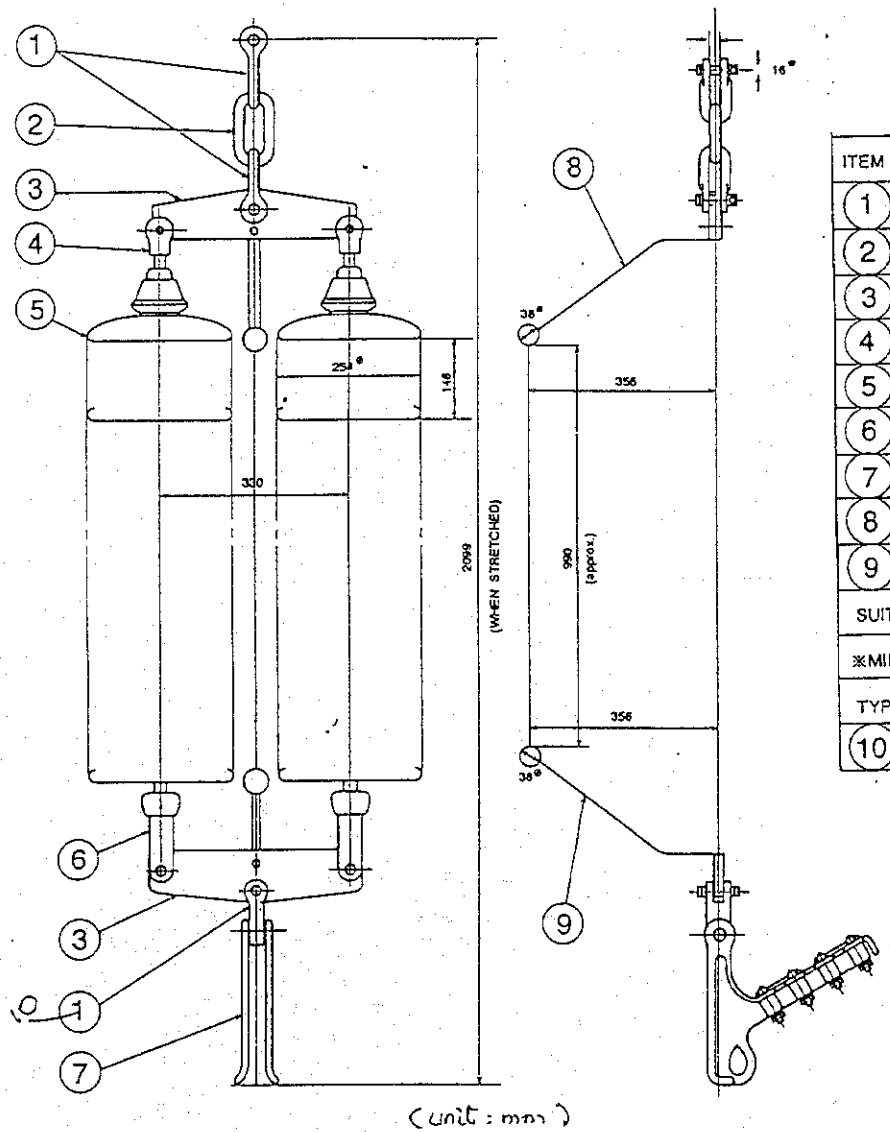
ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT.NO.
1	ANCHOR SHACKLE	HIGH TENSION STEEL	1	4H-835A
2	HORN HOLDER BALL EYE	HIGH TENSION STEEL	1	4H-2046A
3	ARCING HORN	STEEL	1	2H-1816AU
4	SUSPENSION INSULATOR	PORCELAIN	8	CA-525EC / CA-825EC
5	HORN HOLDER SOCKET EYE	MALLEABLE IRON	1	4H-20865X
6	ARCING HORN	STEEL	1	2H-1816BU
7	STRAIN CLAMP	ALUMINUM ALLOY	1	2H-970AU
SUITABLE CONDUCTOR SIZE OF CLAMP				A.C.S.R."LINNET"
※MIN. BRAKING STRENGTH OF STRING				8200kg
TYPE OF BALL AND SOCKET PARTS				IEC16mmA

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-01 110 kV Insulator Sets (4/8)



ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT.NO.
1	ANCHOR SHACKLE	HIGH TENSION STEEL	3	4H-635A
2	CHAIN LINK	HIGH TENSION STEEL	1	3H-7D
3	YOKE	STEEL	2	7H-165C
4	BALL-CLEVIS	STEEL	2	4H-492C
5	SUSPENSION INSULATOR	PORCELAIN	6×2	CA-525EC / CA-625EC
6	SOCKET-CLEVIS	ALUMINIUM	2	4H-20491B
7	COMPRESSION CLAMP	ALUMINIUM	1	2H-1025-8
8	ARCING HORN	STEEL	1	2H-1818AU
9	ARCING HORN	STEEL	1	2H-1818BU
SUITABLE CONDUCTOR SIZE OF CLAMP				ACSR LINNET
※MIN. BRAKING STRENGTH OF STRING				7000kg
TYPE OF BALL AND SOCKET PARTS				IEC 16mmA

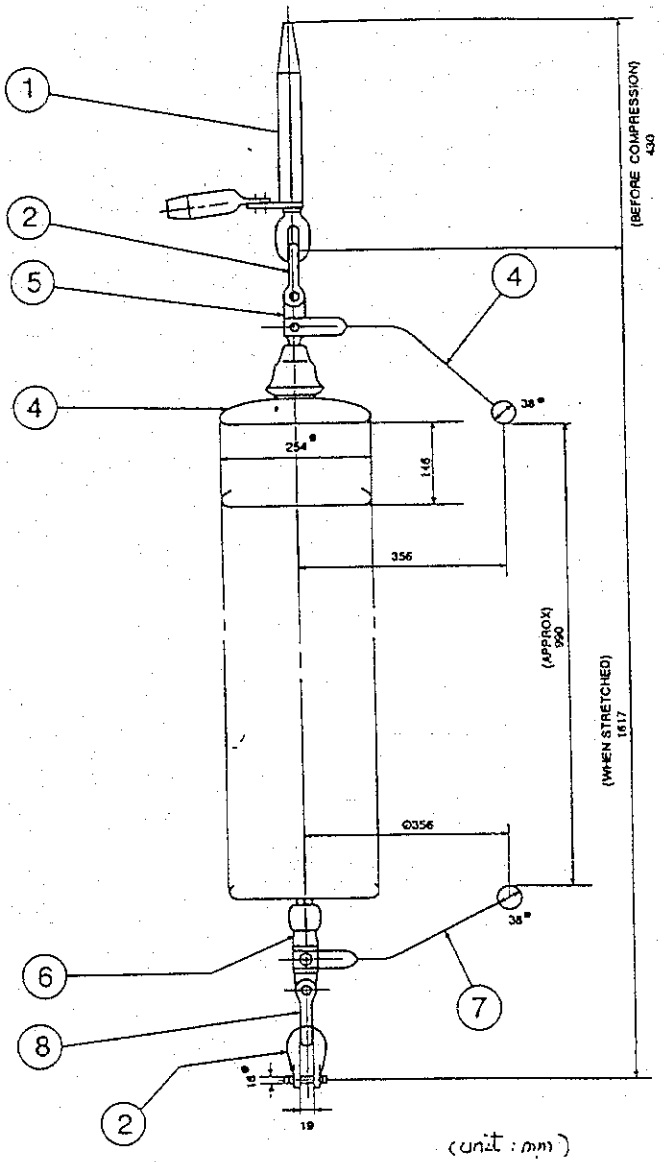
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-01 110 kV Insulator Sets (5/8)



ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT.NO.
1	ANCHOR SHACKLE	HIGH TENSION STEEL	2	4H-835A
2	CMAIN LINK	HIGH TENSION STEEL	1	3H-7D
3	YOKE	STEEL	2	7H-165C
4	BALL-CLEVIS	STEEL	2	4H-492C
5	SUSPENSION INSULATOR	PORCELAIN	8× 2	CA-525EC CA-825EC
6	SOCKET-CLEVIS	MALLEABLE IRON	2	4H-20491B
7	STRAIN CLAMP	ALUMINIUM ALLOY	1	2H-970AU
8	ARCING HOR N	STEEL	1	2H-1818AU
9	ARCING HORN	STEEL	1	2H-1818BU
SUITABLE CONDUCTOR SIZE OF CLAMP				ACSR 7.6Ø~18.5Ø
※MIN. BRAKING STRENGTH OF STRING				8200kg
TYPE OF BALL AND SOCKET PARTS				IEC 16mmA
10	CLEVIS EYE	MALLEABLE IRON	1	4A-2060A

(unit : mm)

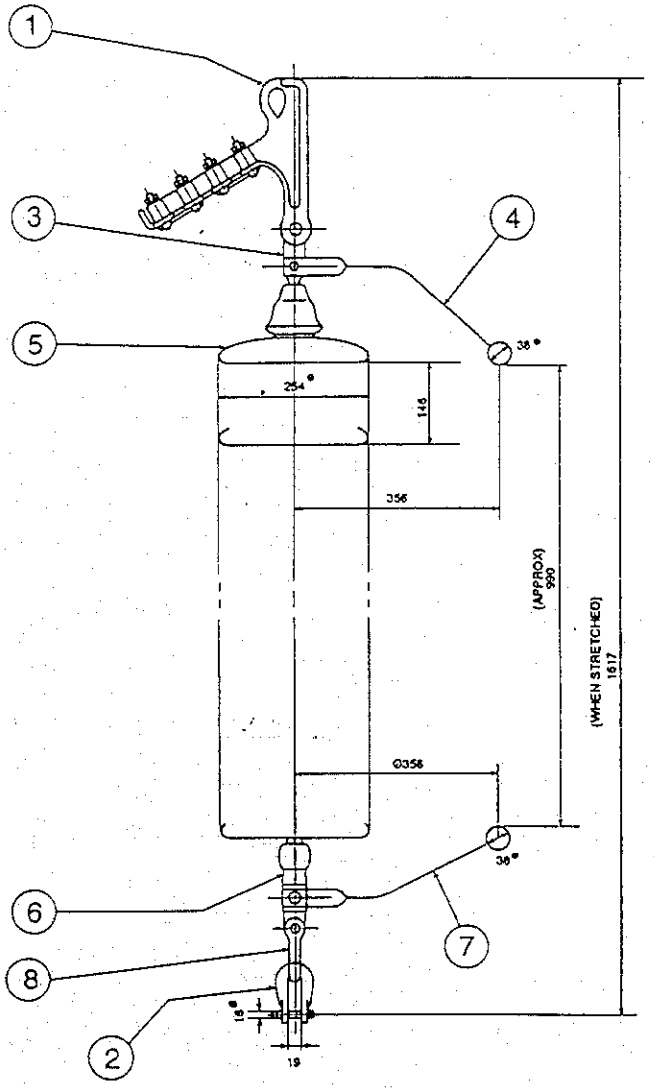
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-01 110 kV Insulator Sets (6/8)



ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT.NO.
1	COMPRESSION CLAMP	ALUMINIUM	1	2H-1025-8
2	ANCHOR SHACKLE	HIGH TENSION STEEL	2	4H-835A
3	HORN HOLDER BALL EYE	HIGH TENSION STEEL	1	4H-1798A
4	ARCING HORN	STEEL	1	2H-1816AU
5	SUSPENSION INSULATOR	PORCELAIN	8	CA-525EC CA-825EC
6	SOCKET-EYE	MALLEABLE IRON	1	4H-20865X
7	ARCING HORN	STEEL	1	2H-1816BU
SUITABLE CONDUCTOR SIZE OF CLAMP				ACSR"LINNET"
MIN. BRAKING STRENGTH OF STRING				7000kg
TYPE OF BALL AND SOCKET PARTS				IEC 16mmA
8	ANCHOR SHACKLE	HIGH TENSION STEEL	1	4H-631B

(unit : mm)

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-01 110 kV Insulator Sets (7/8)



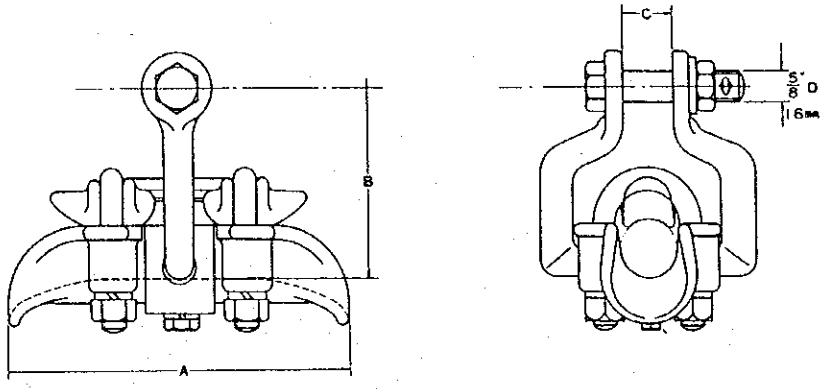
(unit : mm)

ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT.NO.	
1	STRAIN CLAMP	ALUMINIUM ALLOY	1	2H-970AU	
2	ANCHOR SHACKLE	HIGH TENSION STEEL	1	4H-835A	
3	HORN HOLDER BALL EYE	HIGH TENSION STEEL	1	4H-1798A	
4	ARCING HORN	STEEL	1	2H-1816AU	
5	SUSPENSION INSULATOR	PORCELAIN	8	CA-525EC	CA-825EC
6	SOCKET-EYE	MALLEABLE IRON	2	4H-20491B	
7	ARCING HORN	STEEL	1	2H-1816BU	
SUITABLE CONDUCTOR SIZE OF CLAMP				ACSR 7.60'~18.50	
MIN. BRAKING STRENGTH OF STRING				8200kg	
TYPE OF BALL AND SOCKET PARTS				IEC 16mmA	
8	ANCHOR SHACKLE	HIGH TENSION STEEL	1	4H-631B	

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-01 110 kV Insulator Sets (8/8)

Conductor Suspension Clamp

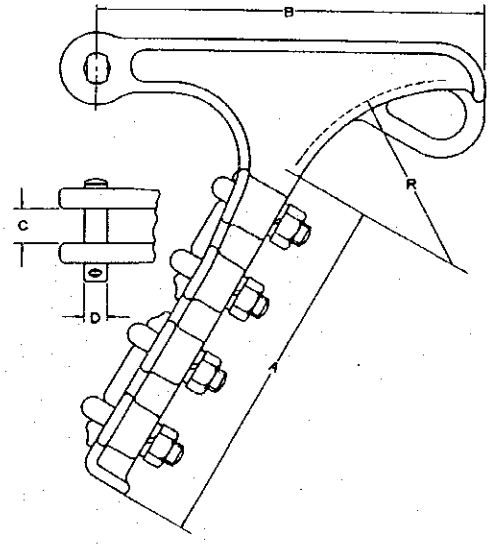
Model 1H-1075AU



Dimension / in. mm					
A		B		C	
~~6 1/2~~	~~165~~	~~3 13/16~~	~~97~~	~~3/4~~	~~19~~
7 1/2	190	4	102	1 3/16	30

Conductor Strain Clamp

Model 2H-970AU

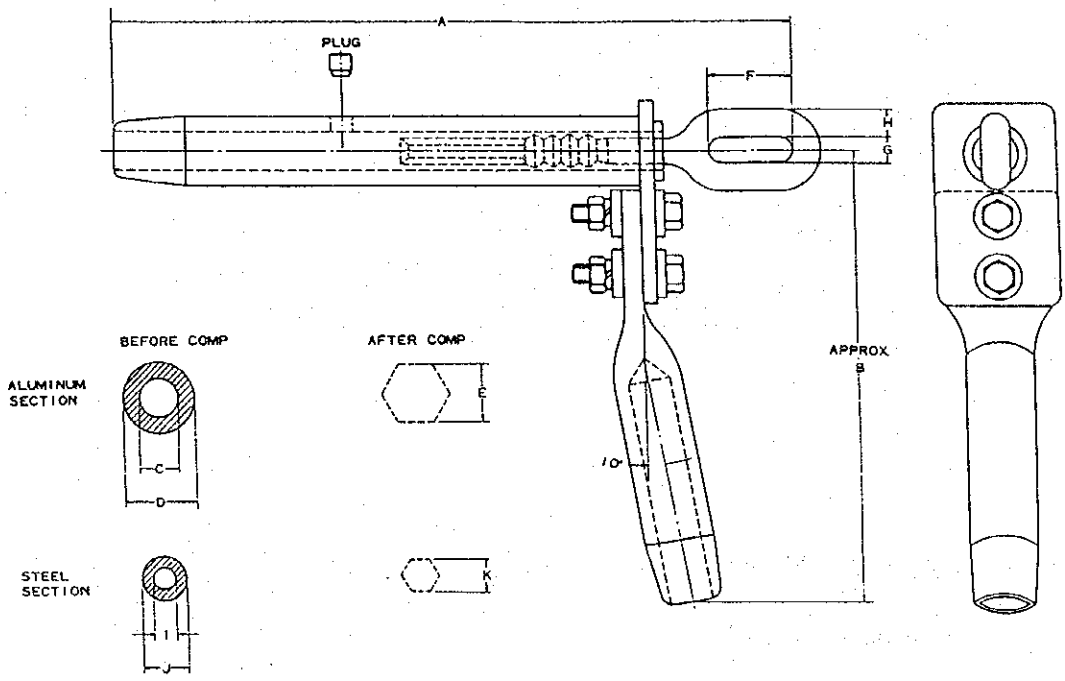


Dimension / in. mm									
A		B		C		D		R	
9 3/8	238	10 1/4	260	7/8	22	5/8	16	4 3/4	121

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-02 Power Conductor Suspension Clamp and Strain Clamp

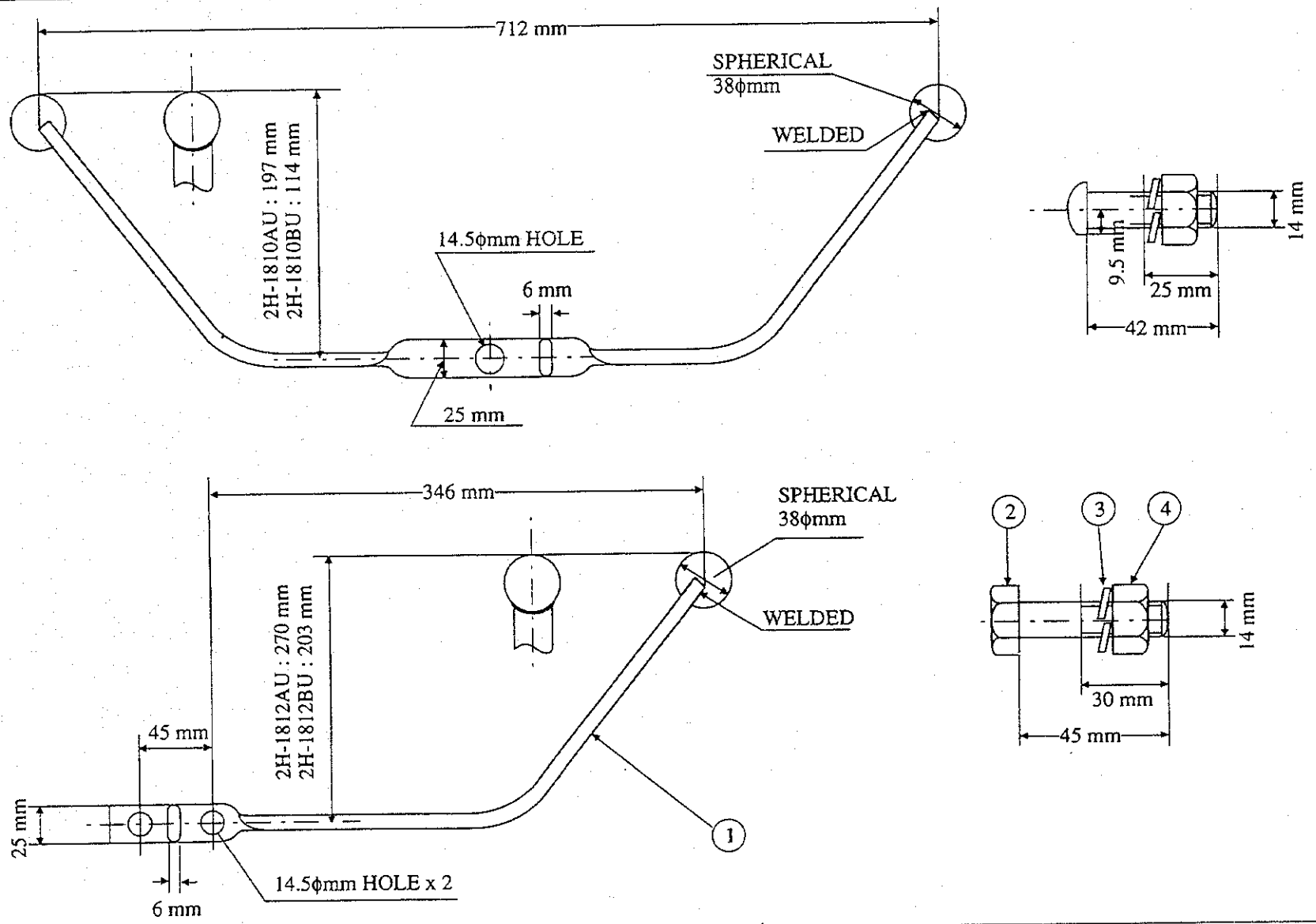
Conductor Dead End Clamp

Model 2H-1025-8



Dimension / in. mm										
A	B	C	D	E	F	G	H	I	J	K
$16^{15}/_{16}$ 430	$9^{13}/_{16}$ 250	$^{49}/_{64}$ 19.4	$1^{3}/_{16}$ 30	$^{63}/_{64}$ 25.0	$2^{3}/_{16}$ 55	$^{13}/_{16}$ 20	$^{11}/_{16}$ 18	$^{9}/_{32}$ 7.1	$^{5}/_{8}$ 16	$^{35}/_{64}$ 13.8

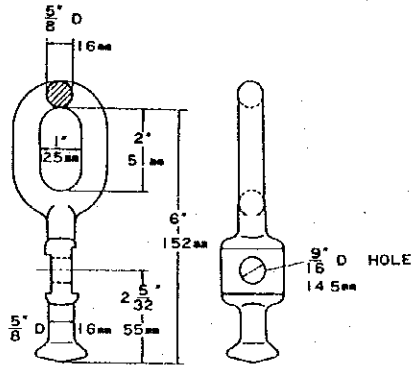
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-03 Conductor Dead End Clamp



FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-04 Arcing Horns

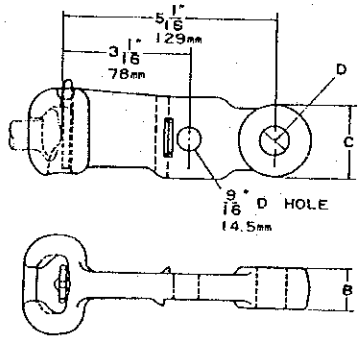
HORN HOLDER TYPE BALL EYES

4H-2046A



Ball Size	Ultimate Strength / lb kg	
ANSI Type B / IEC 16 mm	25,000	12,000

HORN HOLDER TYPE SOCEKT EYES



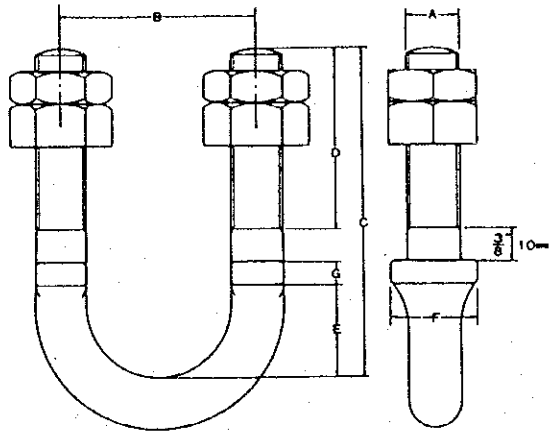
4H-20496L

Dimension / in. mm					
B		C		D	
1 1/8	29	1 1/2	38	11/16	17.5

Socket Size	Ultimate Strength / lb kg	
ANSI Type B, Type J and IEC 16-mm A	25,000	12,000

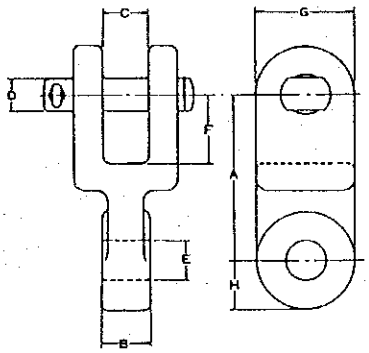
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-05 Horn Holders

U-BOLTS



Cat. No.	Dimension / in. mm												Ultimate Strength / lb kg	
	A		B		C		D		E		F		G	
4H-1805BU	5/8		2 3/8	60	3 13/16	100	2 3/16	55	1 1/8	29	1	26	1/4	6	25,000	12,000

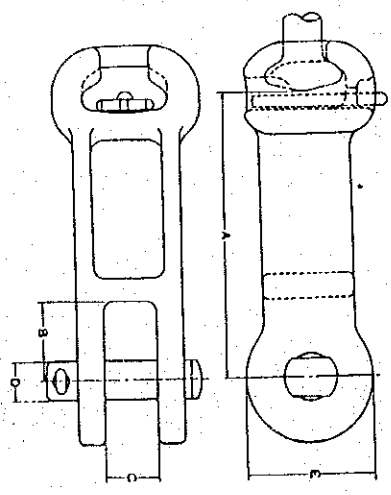
CLEVIS EYES 4H-488-10



Dimension/in. mm									
A		B		C		D		E	
3	76	5/8	16	3/4	19	5/8	16	11/16	17.5

						Ultimate Strength/lb kg	
F		G		H			
1 1/8	29	1 3/4	44	7/8	22	25,000	12,000

SOCKET CLEVISES 4H-20491B

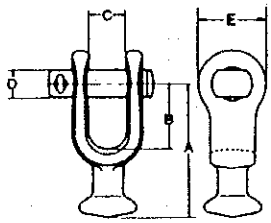


Dimension / in. mm									
A		B		C		D		E	
4 1/2	114	1 1/4	32	3/4	19	5/8	16	1 1/2	38

Socket Size	Ultimate Strength/lb kg	
ANSI Type B, Type J and IEC 16 mm A	15,000	7,000

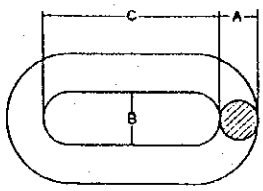
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-06 U-bolt, Clevis-eye and Socket-clevis

BALL CLEVISES



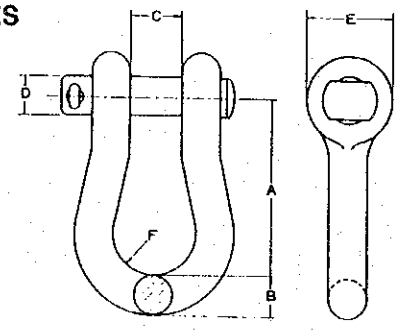
Cat. No.	Dimension / in. mm										Ball Size	Ultimate Strength / lb kg	
	A		B		C		D		E				
4H-492C	3	76	1 1/4	32	3/4	19	5/8	16	1 5/8	41	ANSI Type B/ IEC 16 mm	18,000	8,200

CHAIN LINKS



Cat. No.	Dimension / in. mm						Ultimate Strength / lb	
	A		B		C			
3H-7D	5/8	16	7/8	22	3	76	25,000	12,000

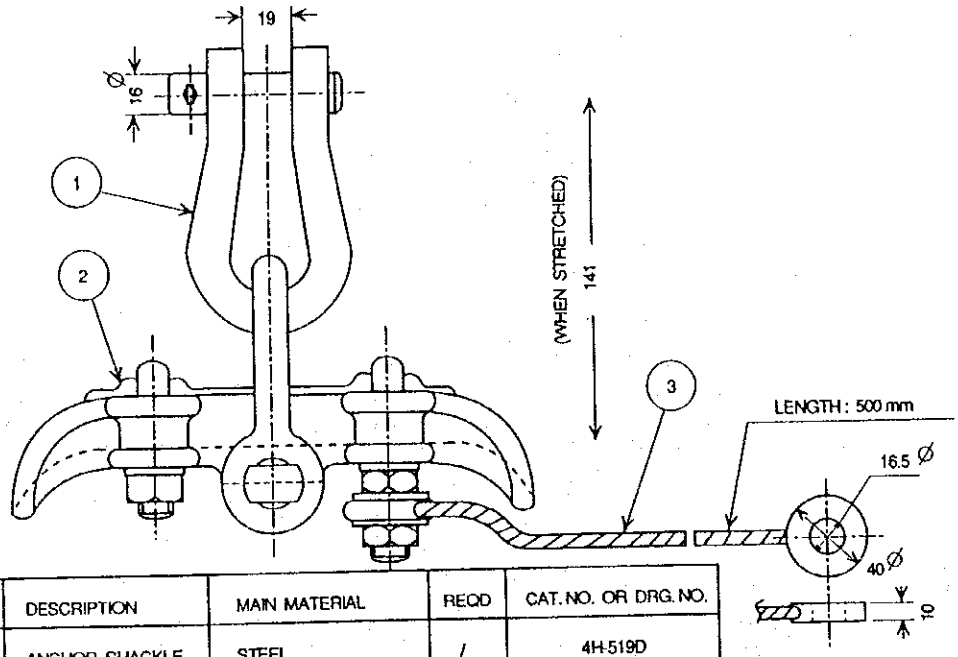
ANCHOR SHACKLES



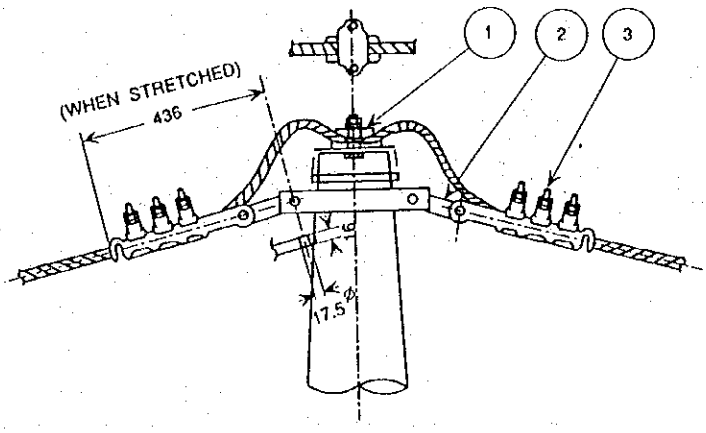
Cotter Type

Cat. No.		Dimension / in. mm										Ultimate Strength / lb kg	
Cotter Type	Bolt Type	A		B		C		D		E		F			
~~4H-519D~~	~~4H-519BU~~	~~3~~	~~76~~	~~5/8~~	~~16~~	~~3/4~~	~~19~~	~~5/8~~	~~16~~	~~1 1/2~~	~~38~~	~~7/16~~	~~11~~	~~18,000~~	~~7,000~~
4H-835A	4H-835BU	2 13/16	72	5/8	16	3/4	19	5/8	16	1 1/2	38	21/32	17	25,000	12,000

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-07 Ball Clevis, Anchor Shackle and Chain Link

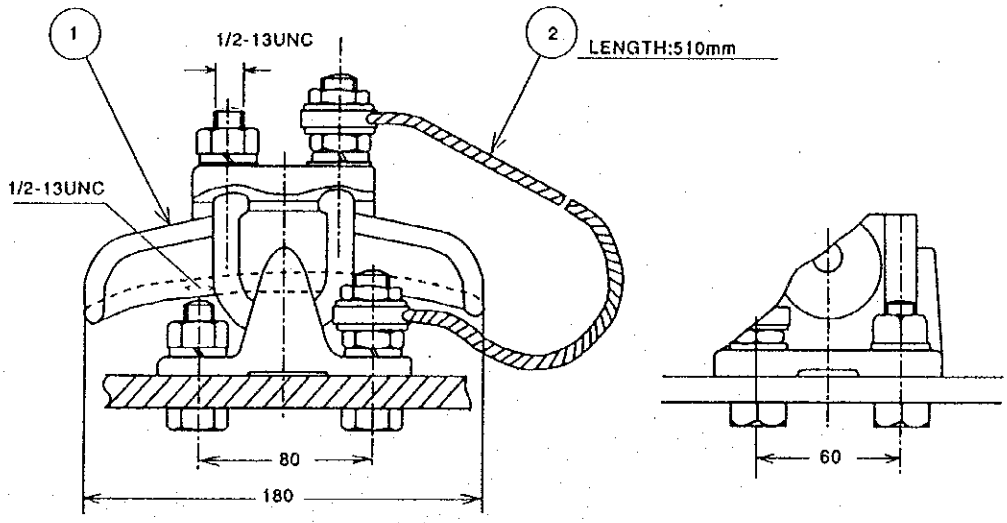


ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT. NO. OR DRG. NO.
1	ANCHOR SHACKLE	STEEL	/	4H-519D
2	SUSPENSION CLAMP	MALLEABLE IRON	/	1H-677BU
3	COPPER BOND	TINNED COPPER	/	2H-500
SUITABLE GROUND WIRE SIZE OF CLAMP				GSW 22mm^2

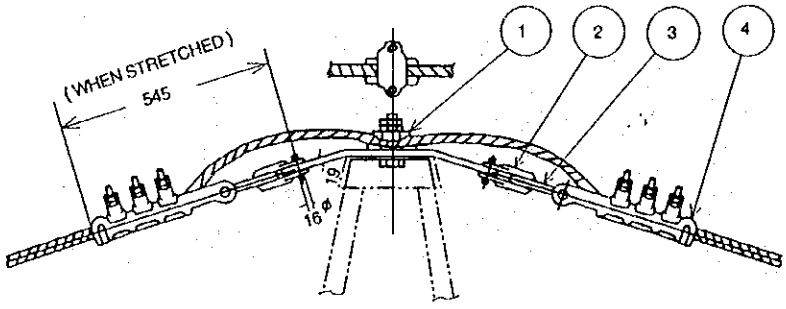


ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT. NO.
1	JUMPER CLAMP	MALLEABLE IRON	1	GC-8U
2	EYE-LINK	STEEL	2	4H-684C
3	STRAIN CLAMP	MALLEABLE IRON	2	GNB-4511U
SUITABLE CONDUCTOR SIZE OF CLAMP				GSW 22mm^2
MIN. BREAKING STRENGTH OF STRING				4500 kg

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-08 Overhead Earthwire Suspension and Tension Clamps for Pole

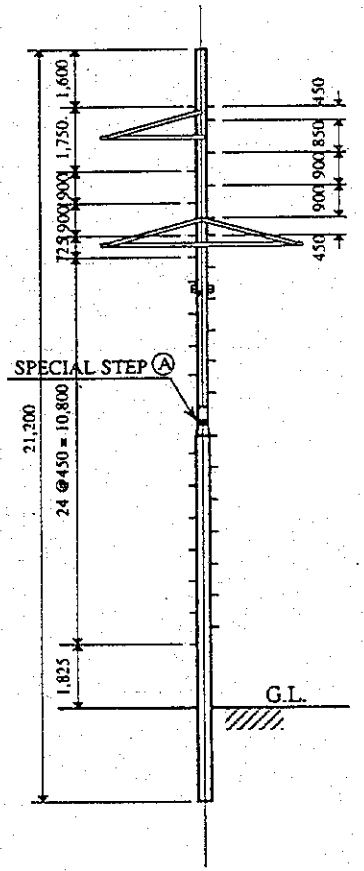


ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT. NO. OR DRG. NO.
1	TRUNION TYPE CLAMP	MALLEABLE IROM	/	AGS-2010AU
2	COPPER BOND	TINNED COPPER	/	2H-500
SUITABLE CONDUCTOR SIZE OF CLAMP				GSW 38mm^2
MIN. BREAKING STREGTH OF STRING				@ 4500 kg



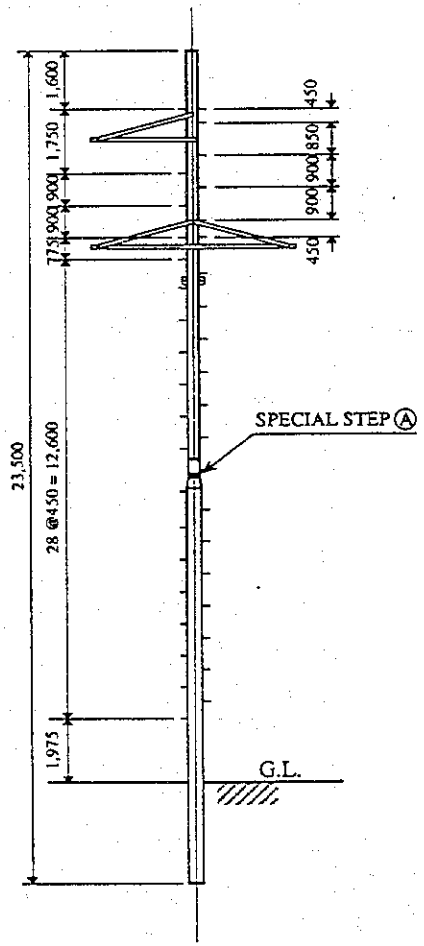
ITEM	DESCRIPTION	MAIN MATERIAL	REQD	CAT. NO.
1	JUMPER CLAMP	MALLEABLE IRON	1	GC-811
2	ANCHOR SHACKLE	STEEL	2	4H-519D
3	EYE-LINK	HIGH TENSION STEEL	2	4H-462A
4	STRAIN CLAMP	MALLEABLE IRON	2	GNB-4511U
SUITABLE CONDUCTOR SIZE OF CLAMP				GSW 38mm^2
MIN. BREAKING STRENGTH OF STRING				4500 kg

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-09 Overhead Earthwire Suspension and Tension Clamps for Tower



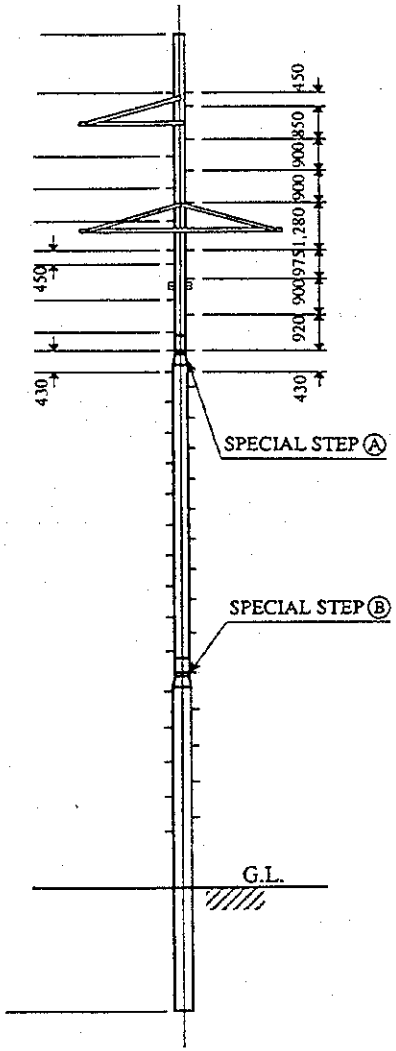
TYPE PA

Q'ty STEP BOLT 33 pcs.
SPECIAL STEP 1 pc.



TYPE PA + 2

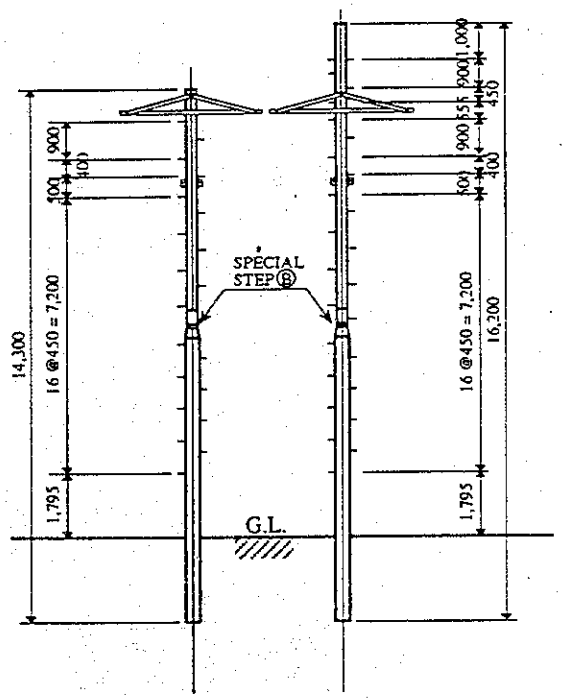
Q'ty STEP BOLT 37 pcs.
SPECIAL STEP 1 pc.



TYPE PA + 5

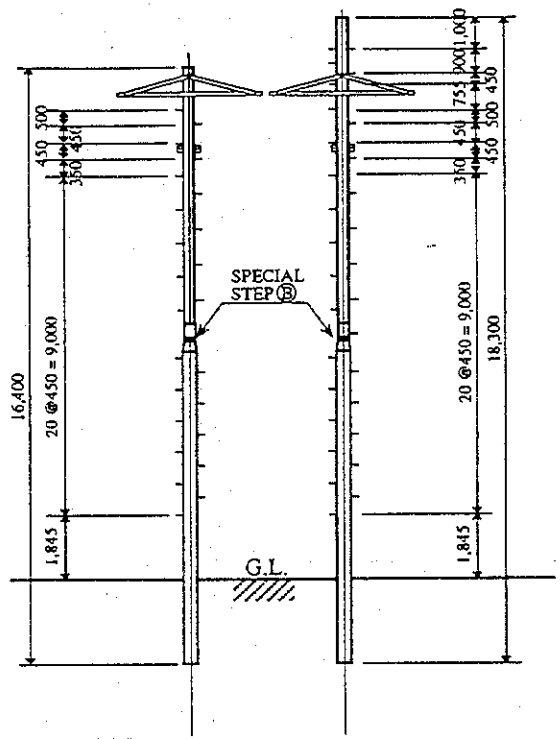
Q'ty STEP BOLT 43 pcs.
SPECIAL STEP 2 pcs.

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-10 110 kV Steel Tubular Pole (Type PA)



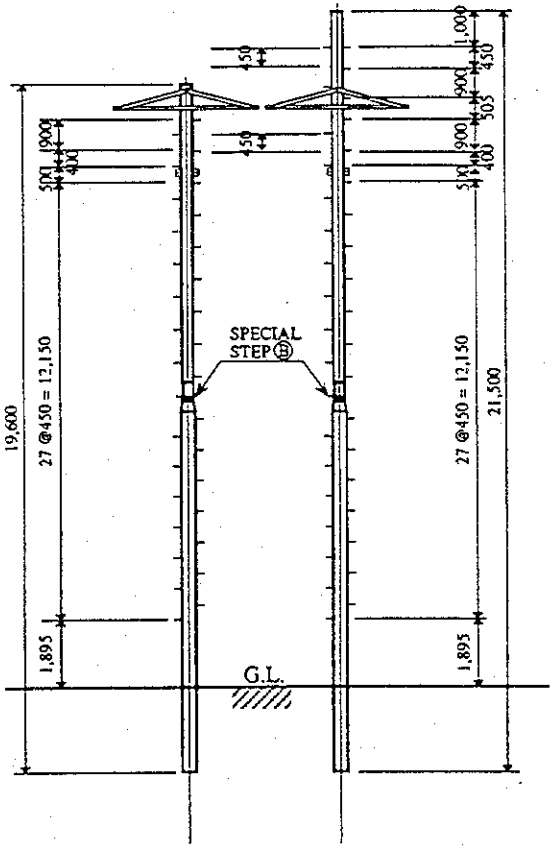
PC & PD TYPE

Q'ty STEP BOLT 45 pcs.
SPECIAL STEP 2 pcs.



PC + 2 & PL 2 TYPE

Q'ty STEP BOLT 53 pcs.
SPECIAL STEP 2 pcs.



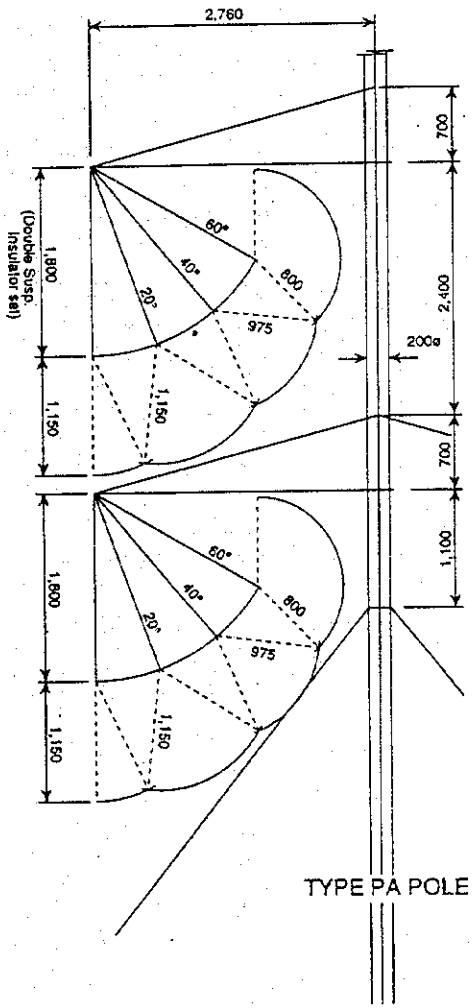
PC + 5 & PD + 5 TYPE

Q'ty STEP BOLT 67 pcs.
SPECIAL STEP 2 pcs.

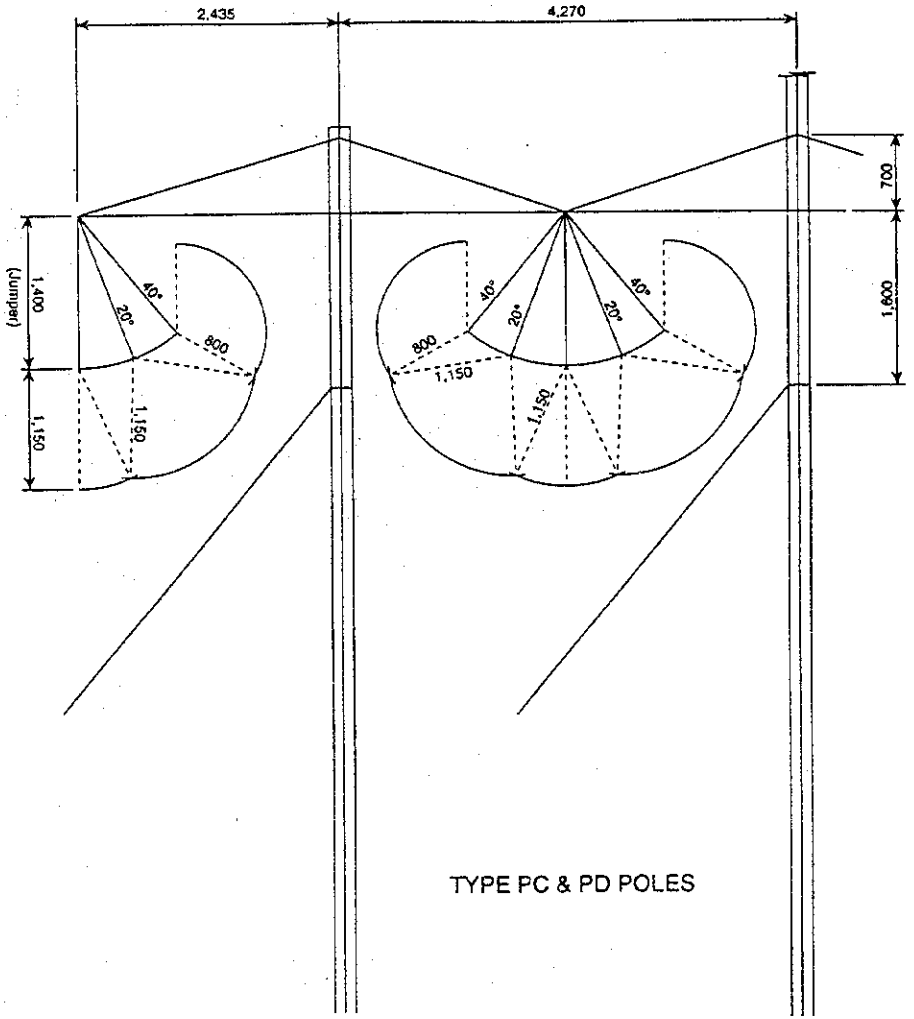
TOLERANCE OF STEP BOLTS INTERVAL ±25 mm

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-11 110 kV Steel Tubular Pole (Type PC and PD)

unit : mm

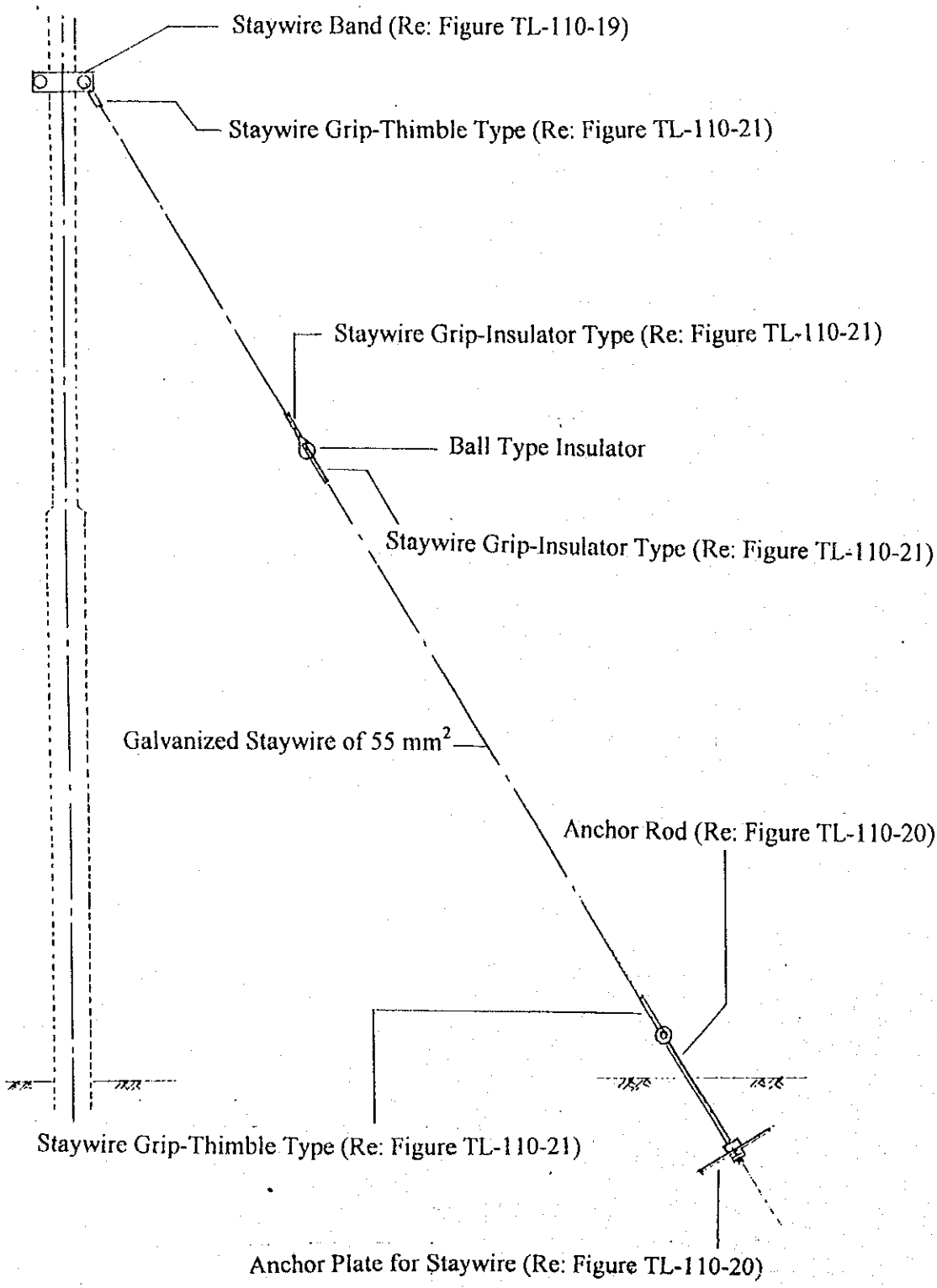


TYPE PA POLE



TYPE PC & PD POLES

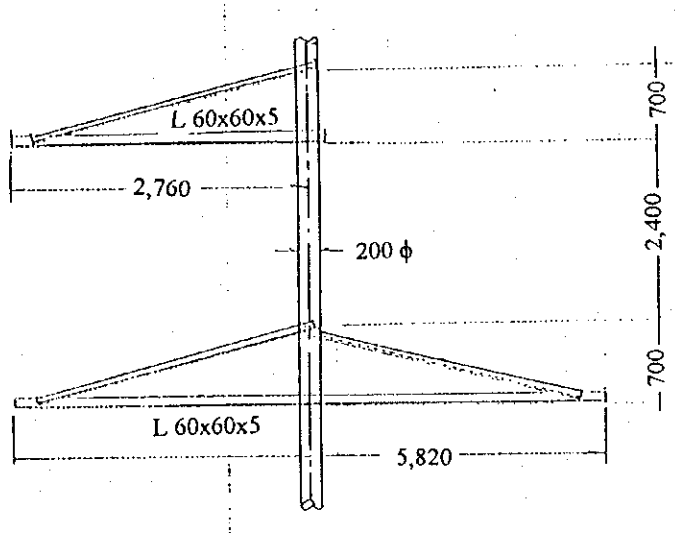
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-12 Clearance Diagram of Power Conductor



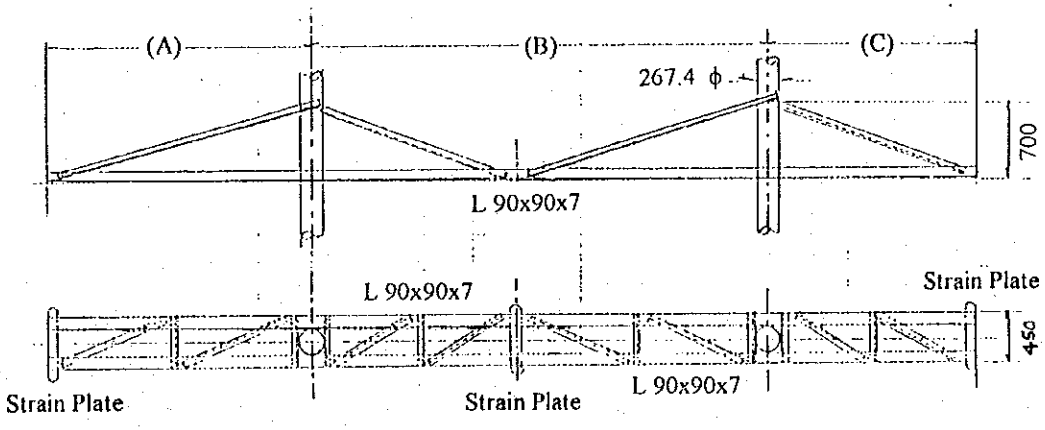
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-13 Staywire Set

(Unit : mm)

Crossarm for Type PA Pole



Crossarms for Type PC and PD Poles

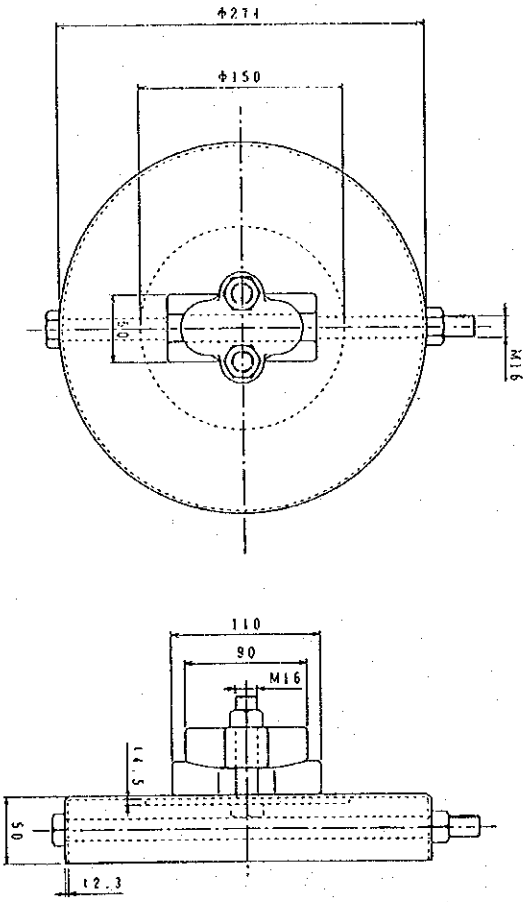


Pole Type	(A)	(B)	(C)
PC	2,435 mm	4,270 mm	1,935 mm
PD	2,050 mm	4,000 mm	2,050 mm

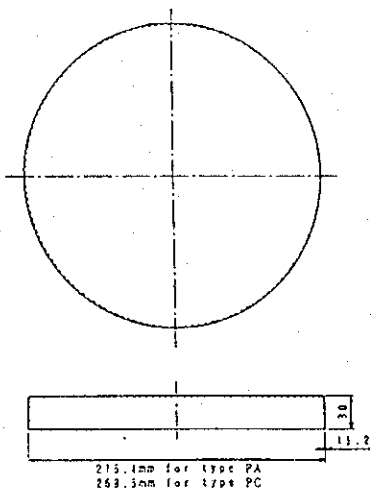
Non-dimensioned materials are L 40x40x3.

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-14 Crossarm for Thap Cham-Cam Ranh Section

Pole Cap for Type PC and PD Type with a Clamp

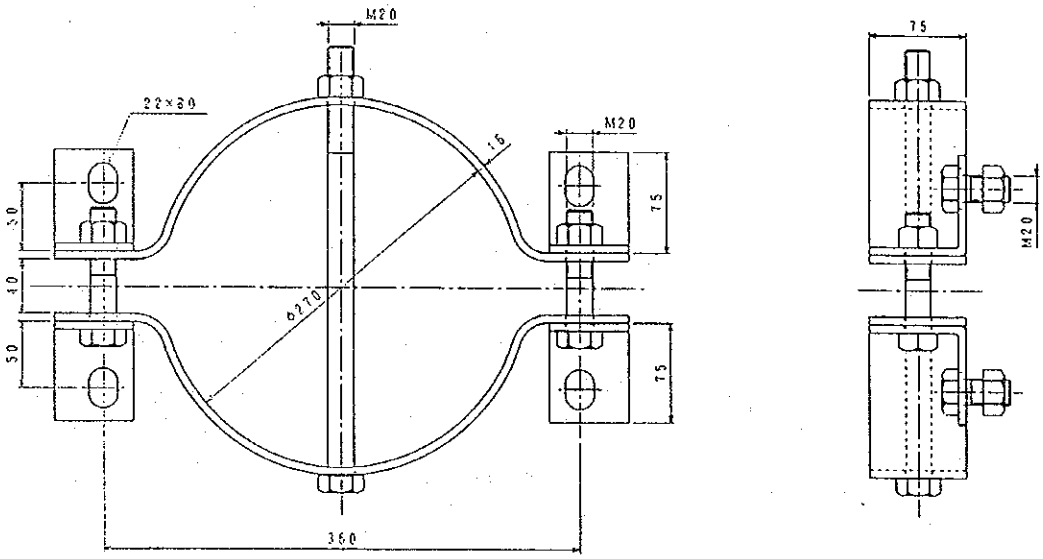


Pole Cap for Type PA and PC Poles

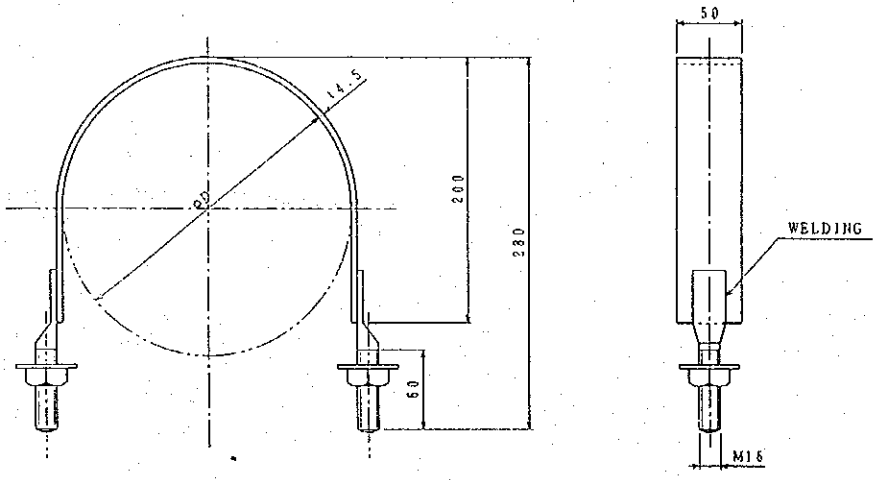


FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-16 Pole Caps

Crossarm Band for Type PC and PD

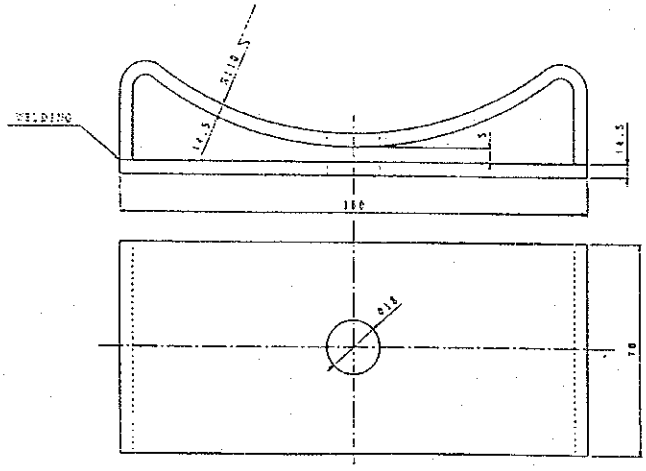


U-Band for Crossarm

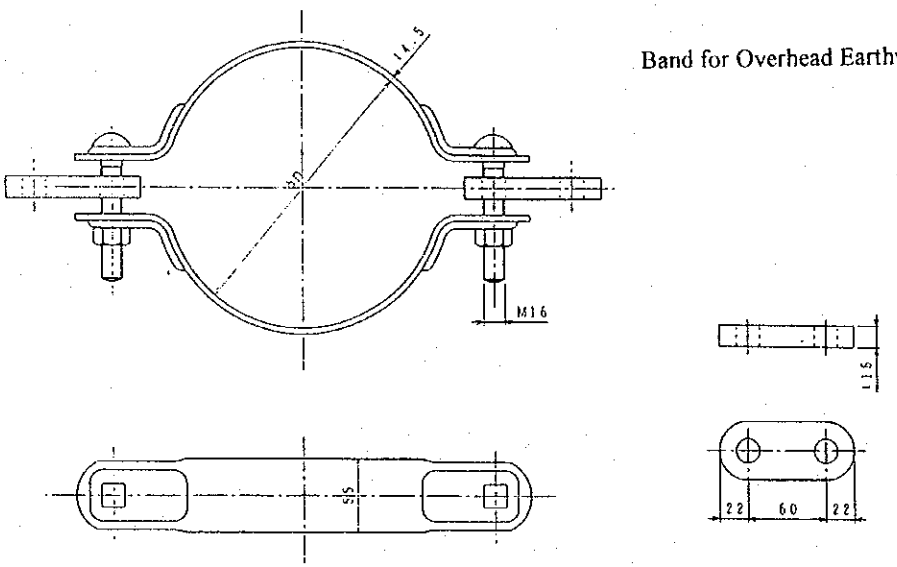


FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-17 Crossarm Bands

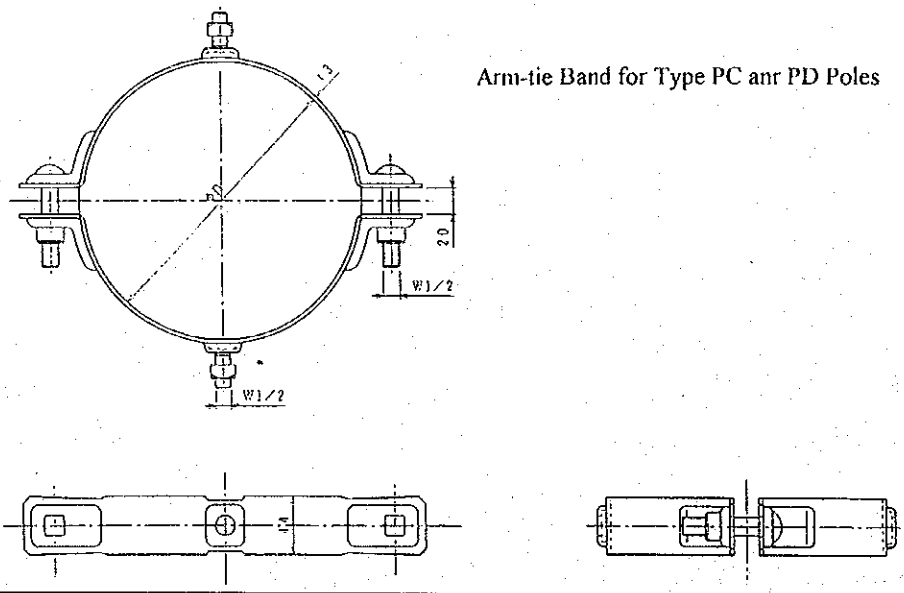
Crossarm Attachment (M-type)



Band for Overhead Earthwire

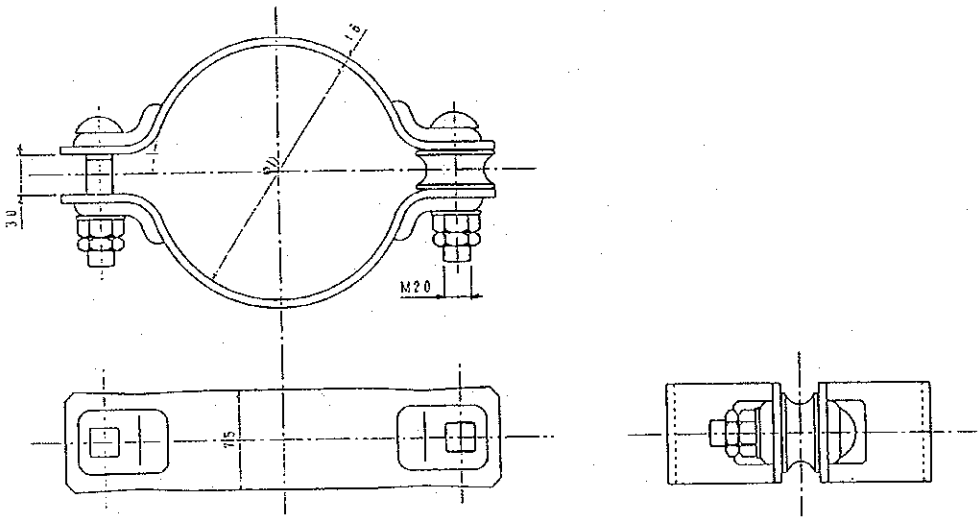


Arm-tie Band for Type PC anr PD Poles



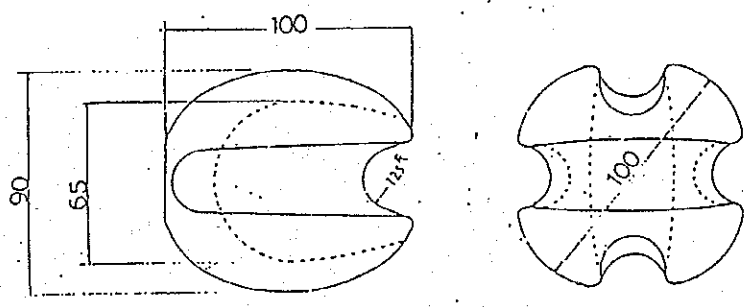
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-18 Crossarm Attachments, Band for O.H Earthwire and Arm-tie Band

Staywire Band



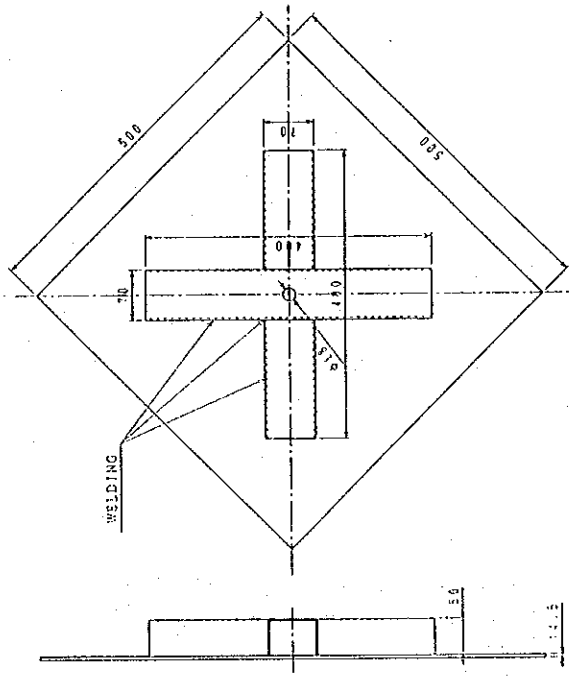
Dia. of Pole	D	Remarks
216.3 mm	220 mm	with 2 thimbles
267.4 mm	270 mm	with 2 thimbles

Ball Type Insulator

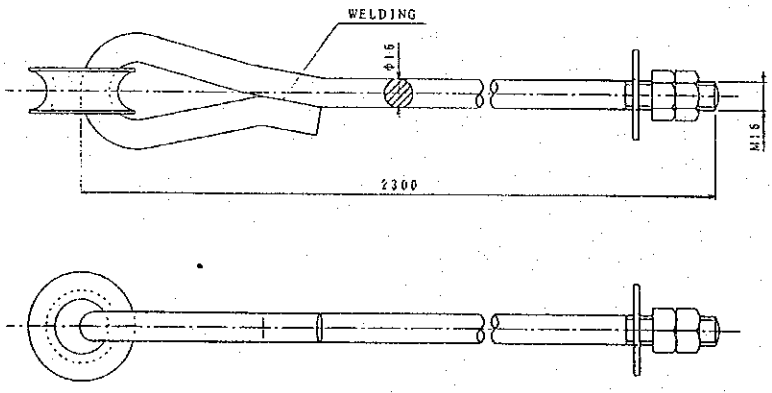


FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-19 Staywire Band and Ball Type Insulator

Anchor Plate for Staywire



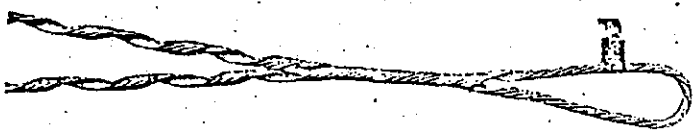
Anchor Rod



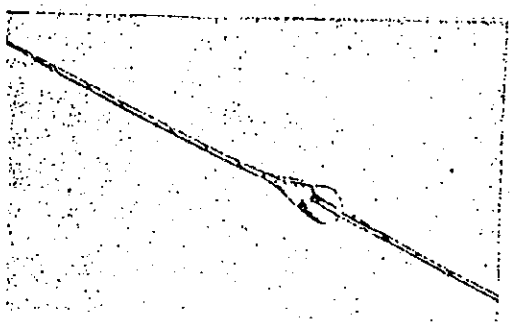
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-20 Anchor Plate for Staywire and Anchor Rod

Staywire Grips

THIMBLE TYPE



INSULATOR TYPE

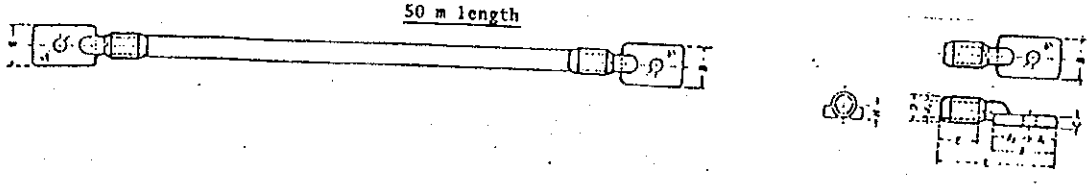


FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-21 Staywire Grips

Counterpoise Grounding Set

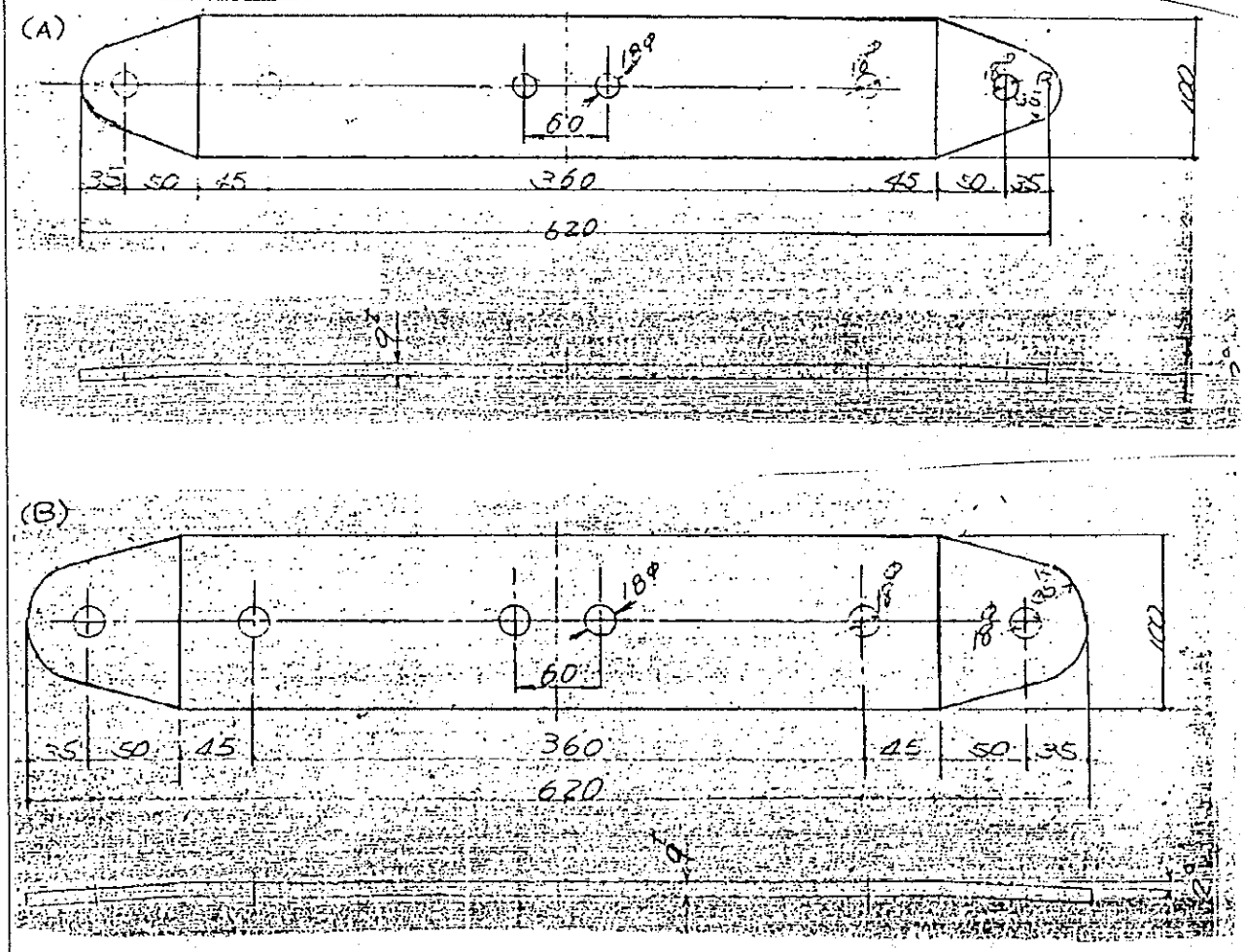
Galvanized Steel Wire

50 m length



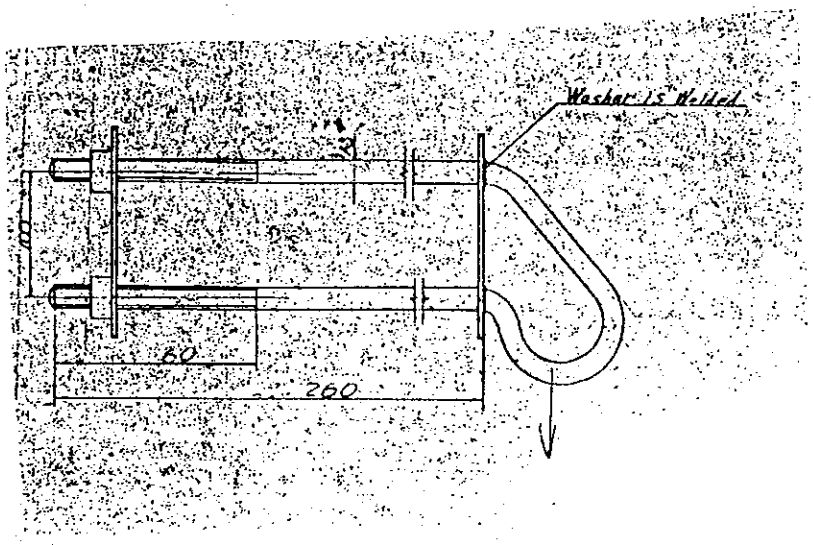
Name	Dimension mm											Bolt		
	D	d_1	E	A	A_1	A_2	B	C	d_2	L	H	Dia		Q'ty
C_1-38	$14^{+0.8}_{-0.2}$	8.3±0.2	26	55	25	30	40	5	14	90	8	M12	W1/2	1

Strain Plates

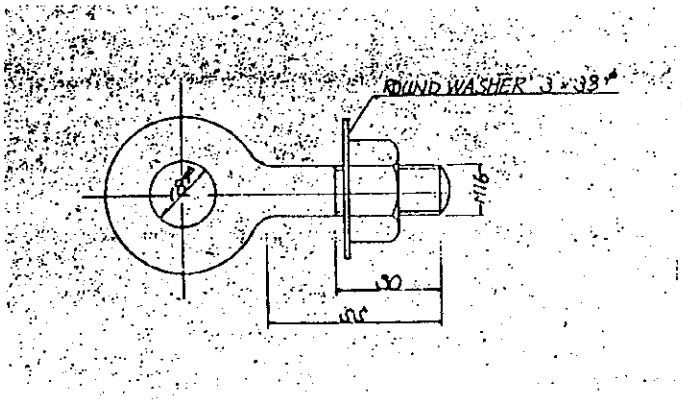


FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-22 Counterpoise Grounding Set and Strain Plates

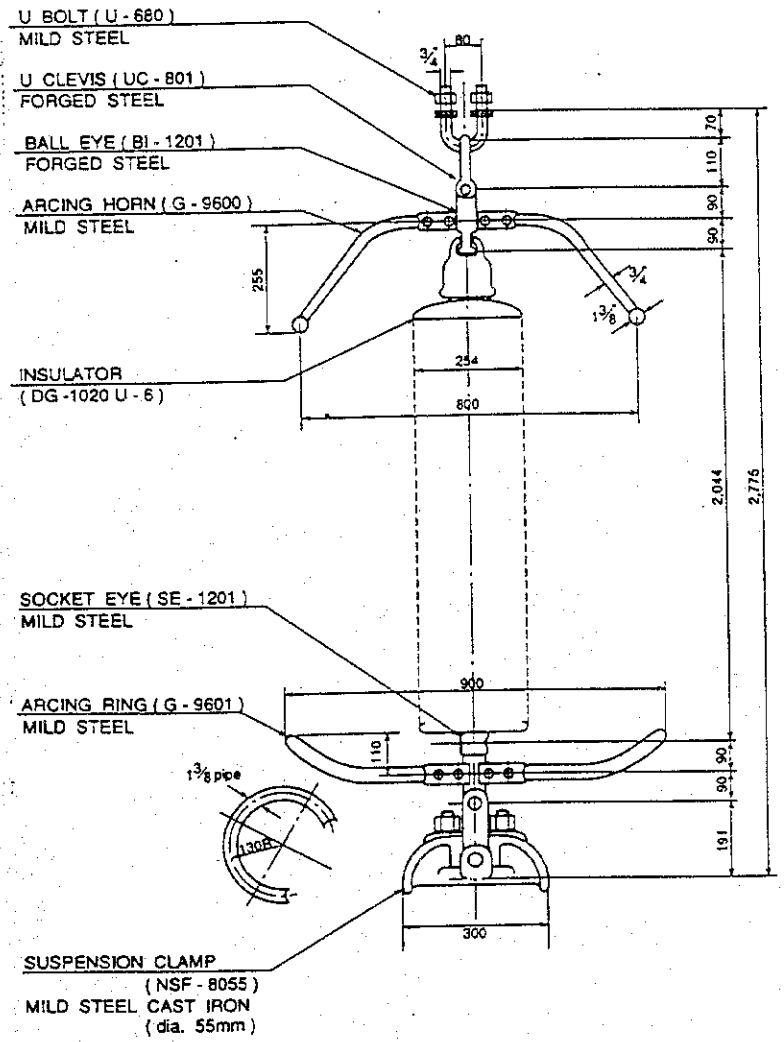
Loop Type Support

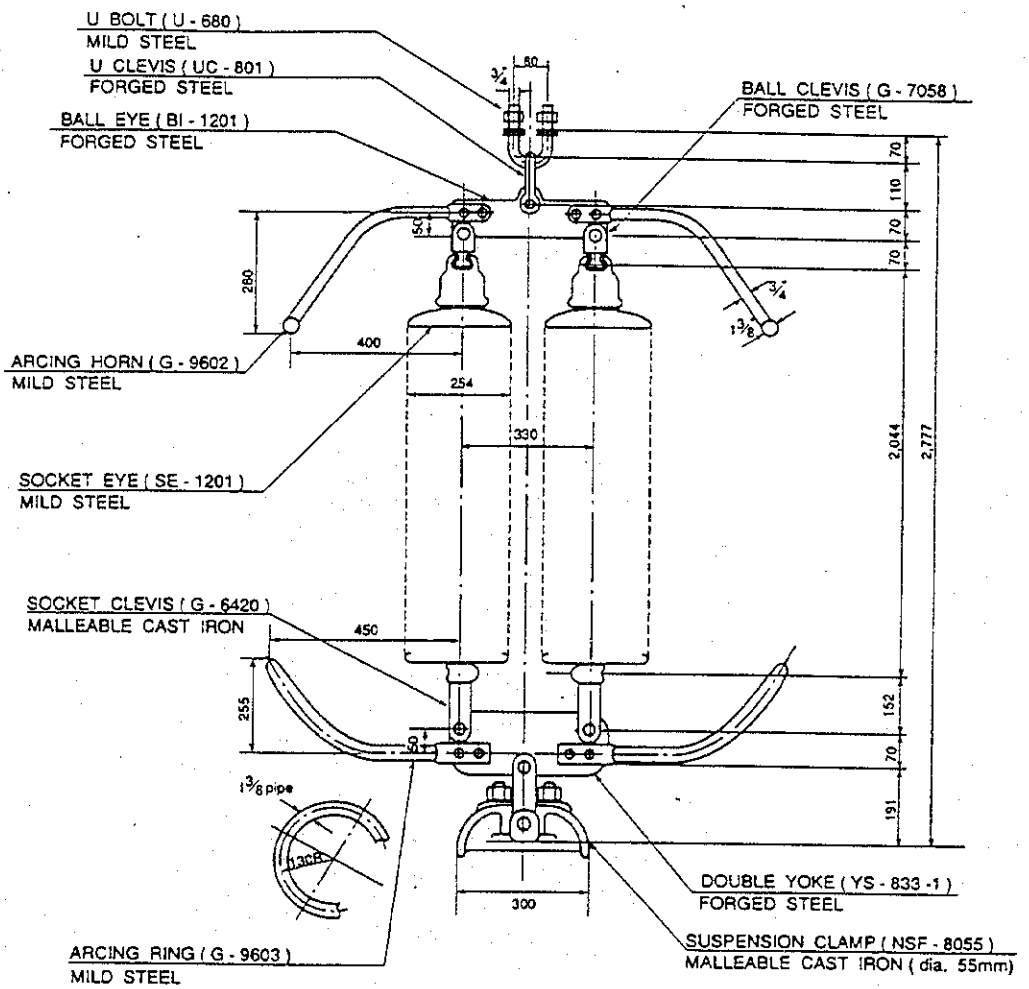


Eye Bolt for Base Plate

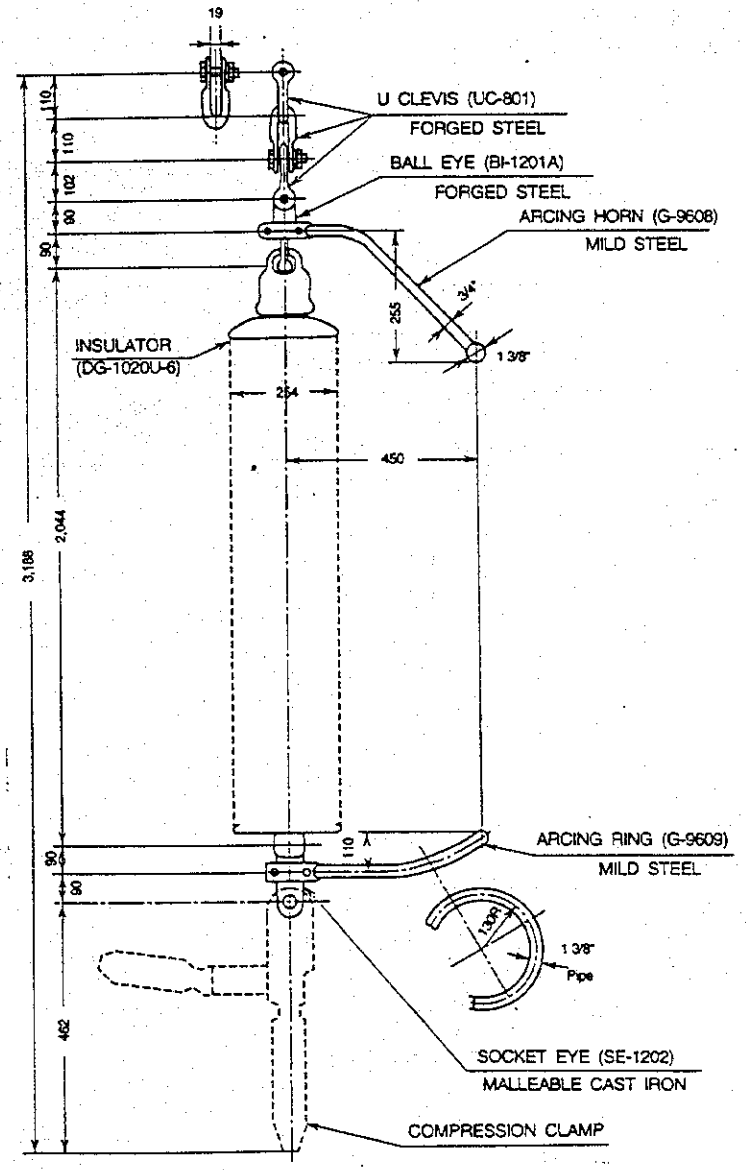


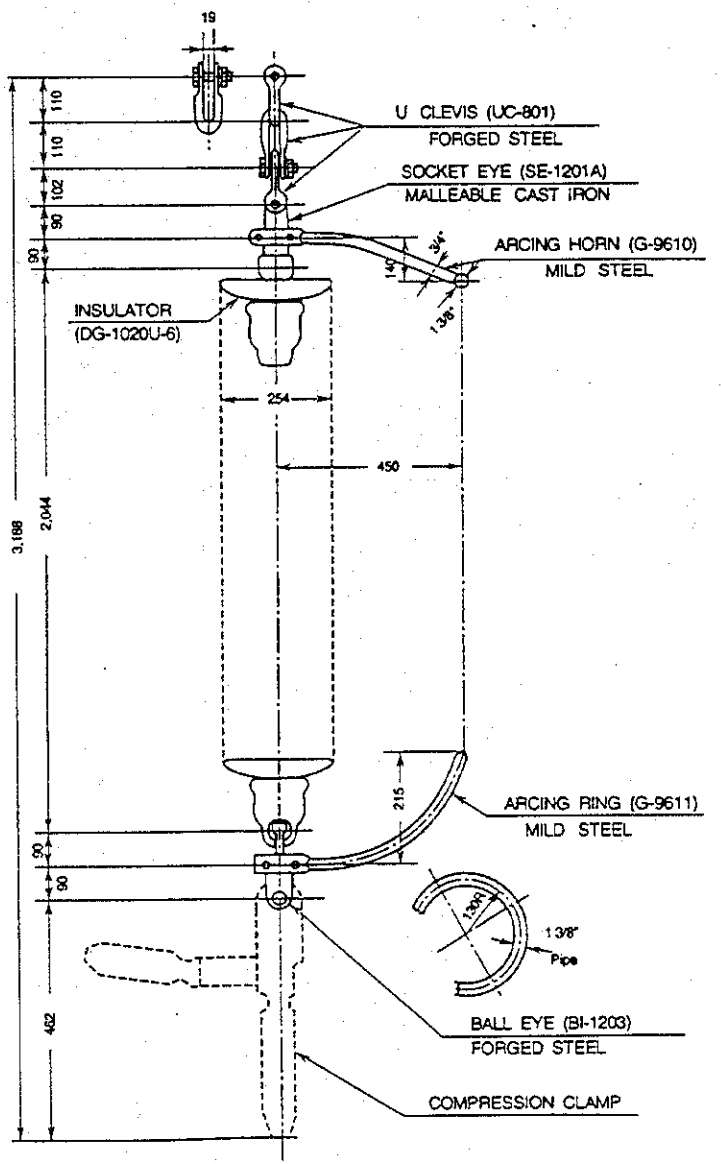
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-110-23 Loop Type Support and Eye Bolt for Base Plate



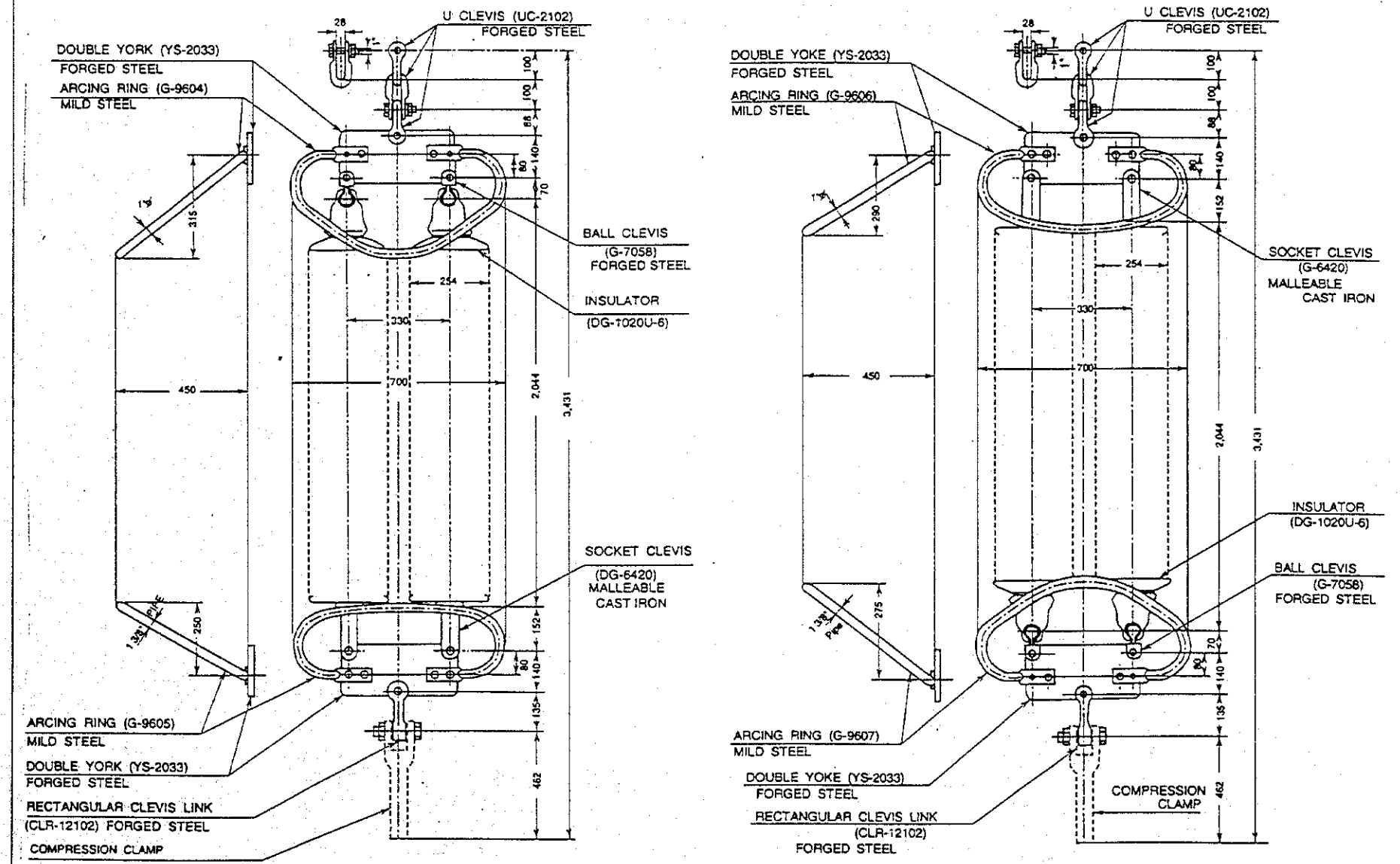


FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-230-01 230 kV Insulator Sets (1/3)



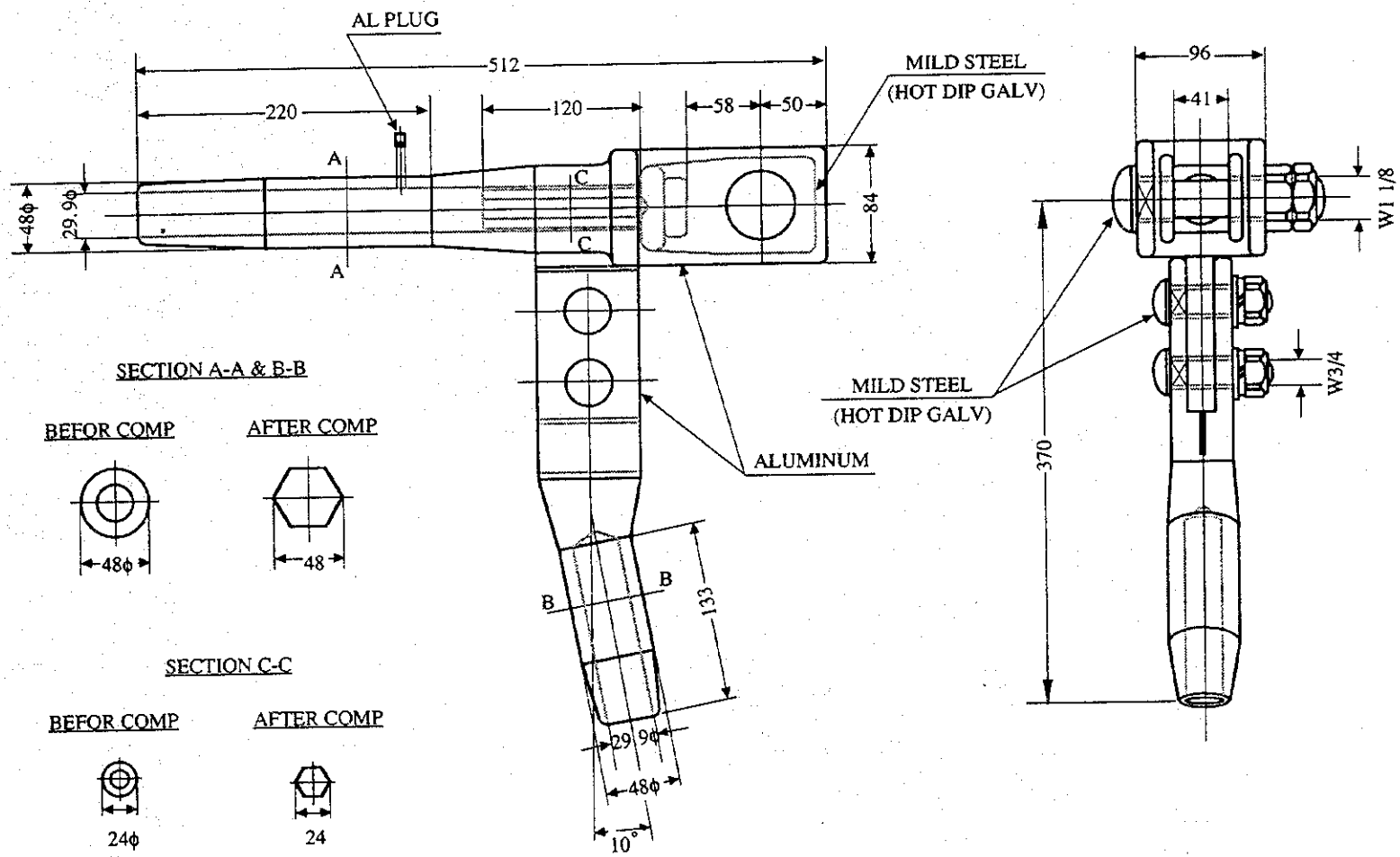


FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-230-01 230 kV Insulator Sets (2/3)

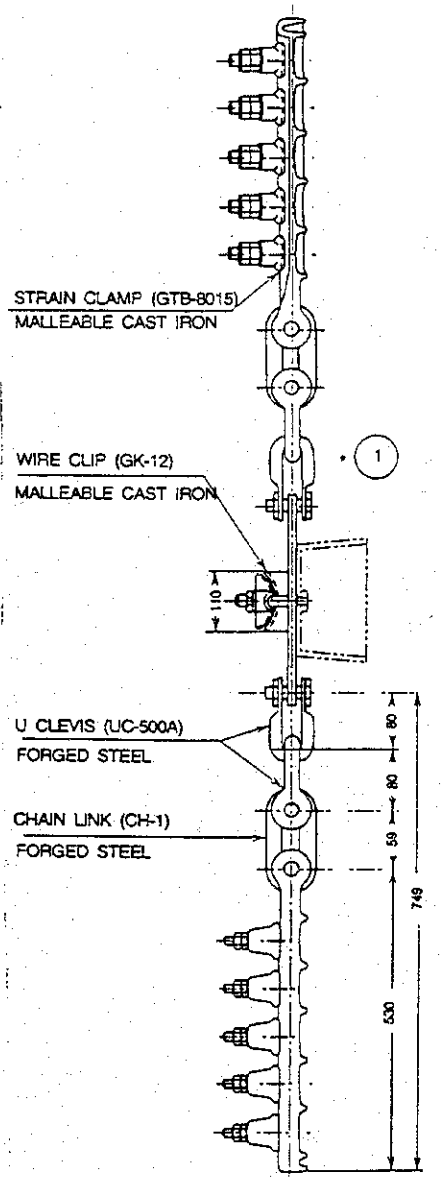


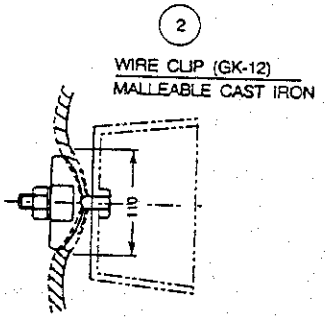
FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-230-01 230 kV Insulator Sets (3/3)

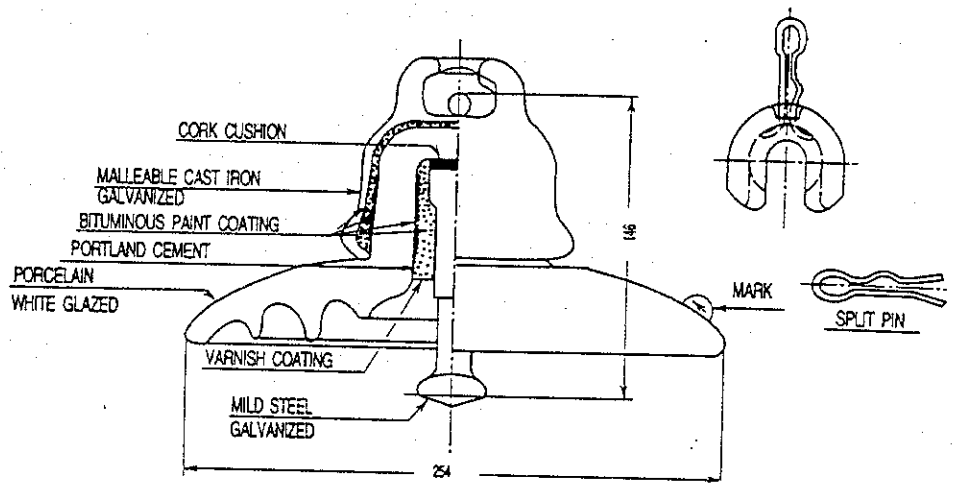
DEAD END CLAMP FOR ACSR 410 mm²
(Asahi Electric Works' Model)



FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-230-02 Dead End Clamp for ACSR 410 mm2







TECHNICAL DATA

Dry flashover voltage	80 KV
Wet flashover voltage	50 KV
Withstand dry test voltage	75 KV
Withstand wet test voltage	42 KV
Impluse flashover voltage (1 x 50/u pcs.)	125 KV
Puncture voltage	140 KV
Leakage distance	280 m.m.
Electro-Mechanical strength	10,000 Kg
Routine proof test load	3,500 Kg
Impact strength	1.15 Kg-m
Radio influence voltage of 1000 KC at 10 KV	50 μv
Net weight (Approx.)	5 Kg

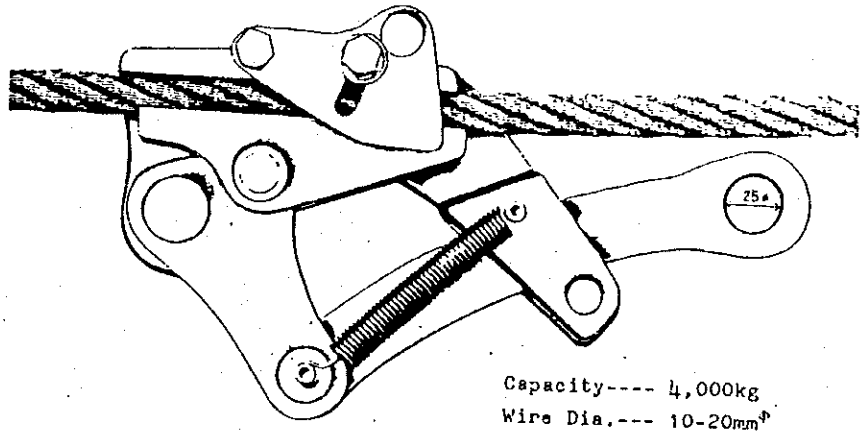
MARK

1961
MADE IN JAPAN

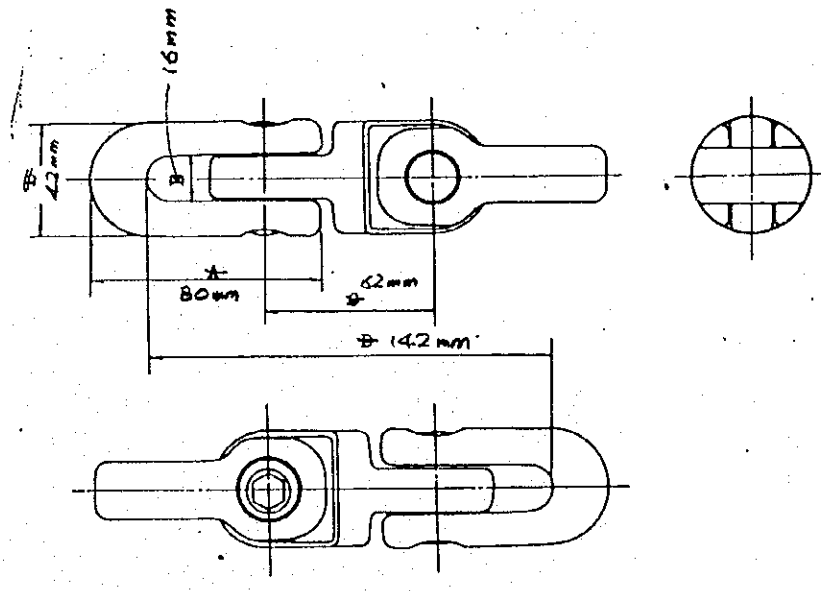
Note: The insulator shall have ball and socket connection which meet the requirements of NEMA standard class No. 52-5

FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-230-03 Suspension Clip and Complete Tension Set for Overhead Earthwire

Wire Grip



Wire Joint Clecvis



FEASIBILITY STUDY ON REHABILITATION OF DA NHIM POWER SYSTEM	MINISTRY OF ENERGY JAPAN INTERNATIONAL COOPERATION AGENCY	Figure TL-230-04 Wire Glip and Wire Joint Clevis