

**MM-MOEE-TS**

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# **TECHNICAL SPECIFICATION**

**TS-CO-05**

**MV and LV Insulators**

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## MV AND LV INSULATORS

### 1. SCOPE

This specification covers the Design, Manufacture, Testing and delivery of Medium and Low Voltage Insulators. The document describes the general characteristics that insulators should comply to.

The particular technical characteristics for each voltage and type are listed in the technical schedules for each type of insulator used in the system. These technical requirements form an integral part of the specification under the same reference code. The bidding document shall specify the required types of insulators as per client requirements for the particular application that is specified in the bid.

### 2. SYSTEM PARAMETERS & SERVICE CONDITIONS

See Specification TS-GN-01 – General System Data

The insulators in this document are intended to be used with for LV, 11kV and 33kV system at altitudes of up to 1000m. For higher Altitudes Insulators with suitable characteristics as per the altitude correction figures per IEC 60071 and IEC 6071-1 shall apply. See section 2.1 of specification TS-GN-01.

### 3. REFERENCE STANDARDS

The insulators supplied shall conform to the latest edition of the appropriate IEC standards and/or other recognized international standards. The following IEC publications or other national or international standards, which ensure equal or higher quality, shall be applicable:

Standard	Description
ANSI C29.1	Test methods for electrical power insulators.
ANSI C29.2	Wet process porcelain and toughened glass insulators suspension type.
ANSI C29.3	Wet process porcelain insulators (Spool type).
ANSI C29.7	Wet process porcelain insulators (High voltage line- post type).
ANSI C29.9	Wet process porcelain insulators (Apparatus, post type).
BS 137	Insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1000V.
BS 3288-2	Insulator and conductor fittings for overhead power lines Part 2: Specifications for a range of fittings.
BS-EN-ISO 1461	Hot dip galvanised coating on iron and steel articles. Also previously as BS 729
IEC 60060	High voltage testing techniques -Part 1: General definitions and techniques
IEC 60071 -1	Insulation co-ordination -Part 1: Terms, definitions, principles and rules
IEC 60168	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1 000 V

IEC 60273	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1 000 V
IEC 60305 (Also BS-EN)	Characteristics of String Insulator Units of Cap & Pin Type.
IEC 60375	Locking device for ball and socket couplings of string insulator units: Dimensions and tests
IEC 60383	Test on insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1,000 V
IEC 60383-1	Insulators for overhead lines with a nominal voltage above 1000 V-Part I: Ceramic or glass insulator units for a.c. systems -Definitions, test methods and acceptance criteria.
IEC 60437	Radio interference test on high voltage insulators
IEC 60471	Dimensions of clevis and tongue couplings of string insulator units
IEC 60507	Artificial pollution tests on high voltage insulators to be used on AC systems.
IEC 60575	Thermal – Mechanical performance test and mechanical performance test on string insulator units.
IEC 60720	Characteristics of line post insulators
IEC 61109	Composite insulators for A.C. overhead lines with a nominal voltage greater than 1000V. Definitions Test methods and Acceptance criteria
IEC 61109	Composite Insulators for ac overhead lines with a nominal voltage greater than 1000 V-Definitions, test methods and acceptance criteria

### 3.1 CONFLICT AND CLIENT SPECIFICATIONS

See Spec TS-GN-03 for general material specifications

In case of conflict between the above general specification and this particular equipment specification the current specification requirements shall prevail.

## 4. INSPECTION AND TESTING

### 4.1 TYPE TESTS

The following type tests as per the relevant standard shall be conducted on the Insulators of identical design to prove that the offered insulator satisfies all the design requirements set out in this specification.

- (i) Verification of the dimensions
- (ii) Electro-mechanical or mechanical failing load
- (iii) Thermal-mechanical performance test
- (iv) Dry lightning impulse withstand voltage test
- (v) Wet Power-frequency withstand voltage test
- (vi) Residual strength test

## 4.2 ROUTINE TESTS

The manufacturer shall carry out, at his own expense, the routine tests; specified in IEC 60383. The routine tensile load shall be 50% of the electromechanical failing load.

- (i) Routine visual inspection
- (ii) Routine mechanical test
- (iii) Routine electrical test

## 4.3 ACCEPTANCE TESTS

- (i) Verification of the dimensions
- (ii) Temperature cycle test
- (iii) Electro-mechanical failing load test
- (iv) Residual strength test
- (v) Porosity test

# 5. COMMON DESIGN REQUIREMENTS

## 5.1 GENERAL

The insulators will be in a damp tropical and sub-tropical climate with intense lightning storms at certain periods of the year.

The design shall be such as to facilitate inspections, cleaning, repairs, and hot line maintenance. All corresponding parts to be made to gauge and shall be interchangeable.

## 5.2 MECHANICAL FAILURE LOAD CHARACTERISTICS

All insulators shall have the following characteristics:

Mechanical Failure Load (kN) for	12kV Insulators		33kV Insulators	
	Normal	Coast	Normal	Coast
Pin Insulators	10	10	10	10
POST Insulators	10	10	10	10
strain or tension Insulators	70	70	120	120

Other characteristics such as creepage distance, lightning impulse as per specification TS-GN-01 and particular requirements below for each application and type of insulator.

The contours of the metal and porcelain parts shall be such as to eliminate areas of high electrical stress concentrations. The insulator surface shall be shaped and spaced for effective natural cleaning and effective use of leakage distance for desert conditions.

## 5.3 ELECTRICAL CHARACTERISTICS

Radio Interference Test Applied Voltage (50Hz) Measured voltage @ 1MHz according to IEC 60437 for each voltage and type of insulator.

The insulator shall be “radio interference free” type at operating voltage with minimum values as stated in the technical schedules.

#### **5.4 REQUIREMENTS FOR PORCELAIN INSULATORS**

Porcelain Insulators shall be made of good commercial grade wet process porcelain. Porcelain insulator shall be of puncture proof porcelain constructions.

The porcelain shall not engage directly with the hard metal but shall use appropriate cement.

The entire exposed porcelain surface of the insulators shall be standard glazed and shall be brown or Grey in colour as it is specified in the technical schedule.

The entire porcelain surface shall be smooth and free of imperfections.

The glazing of the porcelain shall be of A-Type to minimize radio interference (RIV) and corona discharge voltage.

#### **5.5 COMMON REQUIREMENTS FOR METALLIC PARTS**

Metal parts of insulators shall be made of a good commercial grade of malleable iron, ductile iron or steel, galvanized in accordance with specification TS-GN-03. All ferrous components except those made of stainless steel shall be galvanized in accordance with BS EN ISO 1461 with the exception of cotter pins which shall be phosphor bronze or stainless steel.

The porcelain or glass shall not engage directly with hard metal.

#### **5.6 COMMON REQUIREMENTS FOR CEMENTS**

Portland cement type shall be used as the bonding agent and for filling the gap between the porcelain and the metal parts. It must have high compressive strength to maintain the cantilever strength ratings of the insulators specified in the technical data schedule. Sulphur based cements are not acceptable.

The hardware shall be cemented on the porcelain with load distribution evenly throughout the porcelain. Before cementing, the hardware surface in contact with the cement shall be coated with bituminous compound.

Cement used in the construction of the insulator shall not cause fracture by expansion or loosening by contraction, and proper care shall be taken to locate the individual parts correctly during cementing.

## **6. PIN INSULATORS**

### **6.1 USE AND TYPES**

The insulator shall be Class B solid type porcelain construction. According to IEC 600383.

The Insulators shall be used with the 11kV and 33kV system with suitable characteristics as per table below.

**Table 7.1 The characteristics of the PIN insulator shall be as follows:**

No	Description	Unit	11kV	33kV
1	Glazing		Brown	Brown
2	Maximum Conductor Size diameter	mm	20	20
3	Minimum Failing Load	kN	10	10
4	Rated Voltage	kV	12	36
7	Creepage Distance	mm	320	900
8	Cross arm height for mounting	mm	100	125
9	Power frequency flash over voltage	kV	75 (wet)	80 (wet)
		kV	40 (dry)	120 (dry)
10	Impulse flash over voltage	kVp	105 (Pos)	175 (Pos)
		kVp	110 (Neg)	- (Neg)
11	Power frequency withstand voltage	kV	35 (Wet)	100 (Wet)
		kV	65 (Dry)	75 (Dry)
12	Impulse withstand voltage	kVp	95 (Pos)	170 (Pos)
		kVp	105 (Neg)	- (Neg)
13	Visible Discharge Voltage	kV	9	27
14	Power frequency puncture voltage	kV	150	180

## 6.2 MATERIALS TO BE SUPPLIED WITH INSULATOR

The Insulator shall be supplied complete with necessary hardware for mounting on steel or wood cross arm, such as steel pin, locknut, spring washer and two numbers of flat washers of suitable size for attachment to the channel iron cross-arms. The cross arms used have a height for the insulation fitting of 50x100x50x5 mm for the 11kV and 65x125x6x6 mm for the 33kV.

## 6.3 MATERIAL

The insulator shall preferably be of porcelain glazed colour brown or grey specified in the technical schedules, but toughened glass insulators may also be offered.

All ferrous parts shall be of hot-dip galvanized. The materials shall be free from folds, cracks and other exterior and interior defects, which can affect its strength, ductility, durability or ability to function.

All material shall be inspected and tested in full to prove compliance with the requirements of the specifications. The free surface of insulating parts shall be cleaned from cement and other impurities.

## 6.4 DESIGN AND CONSTRUCTION

The relevant vertical dimensions of the insulator shall be such that when combined with the pin insulator spindles the design requirement at the relevant voltage level for conductor clearance from the cross-arm, shall be met. Typical shape of the pin insulator is shown in the drawing.

The design shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. Precautions shall be taken to avoid chemical reaction between cement and metal fittings.

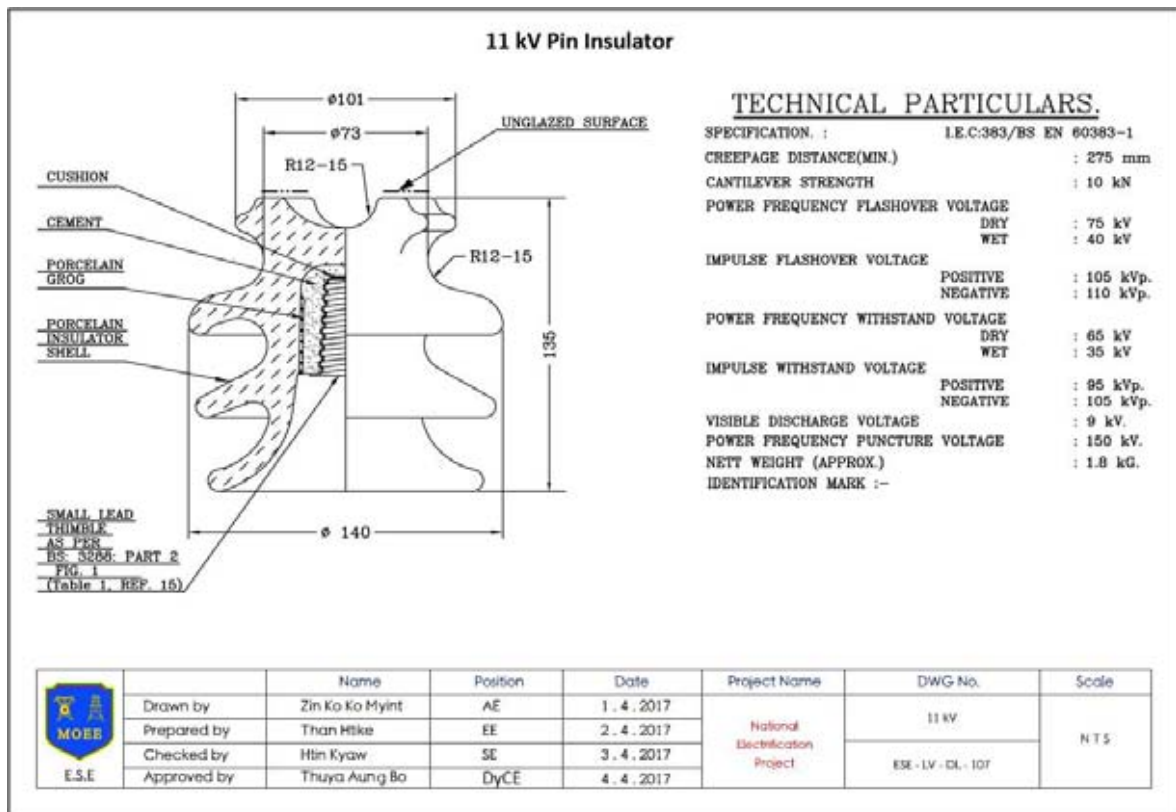
The insulating material shall not engage directly with hard metal. Pin insulators shall be provided with a thimble of suitable material. Cement used in the construction of the insulator shall not cause fracture by expansion or loosening by contraction and proper care shall be taken to locate the individual parts correctly during cementing.

### 6.5 SPINDLE DESIGN

The insulator spindle shall be in accordance with BS 3288 Part 2 Ref. 29 or equivalent. Typical spindle design is shown on the sketches in the following pages for the 11 and 33kV types.

The pin shall be supplied complete with necessary hardware: a) One main nut , b) One spring washers and c) a lock nut

The thread length from the pin flange sitting on the cross arm must be 130mm for the 11kV and 150mm for the 33kV types



**Typical 11kV Pin Insulator (Minimum Characteristics as per table 7.1)**



### Small Steel Head Spindle

Minimum Failing Load	A	B	C	D	E	F	G	X*
10 kV	230	50	24	17	M22	6	12	130

**NOTES:**

- DIMENSIONS X\* TO BE 150 mm SCREWED 120 mm.
- MATERIAL:- FORGED STEEL.
- ALL DIMENSIONS ARE AFTER HOT DIP GALVANIZING. GALVANIZING TEST TO CONFORM TO B.S: 729.
- PIN WILL BE SUPPLIED WITH SPRING WASHER, LOCK NUT & FULL NUT.
- MINIMUM FAILING LOAD 10 KN.
- MASS OF ZINC COATING 9min@ 610 gm/m<sup>2</sup>(85#)

**SMALL STEEL HEAD**  
TABLE 1, REF.16

	Name	Position	Date	Project Name	DWG No.	Scale
 E.S.E	Drawn by	Zin Ko Ko Myint	AE	1 . 4 . 2017	National Electrification Project	11 kV
	Prepared by	Than Htike	EE	2 . 4 . 2017		
	Checked by	Htin Kyaw	SE	3 . 4 . 2017		ESE - LV - DL - 106
	Approved by	Thuya Aung Bo	DyCE	4 . 4 . 2017		

### 33 kV Pin Insulator

**TECHNICAL PARTICULARS**

**SPECIFICATION:-** IEC: 383 / BS EN 60383-2

**CREEPAGE DISTANCE(MIN)** :- 720 mm

**MECHANICAL FAILING LOAD** :- 11 kN

**POWER FREQUENCY FLASHOVER VOLTAGE**  
 DRY :- 120 kV(RMS)  
 WET :- 80 kV(RMS)

**IMPULSE FLASH OVER VOLTAGE**  
 POSITIVE :- 175 kVp

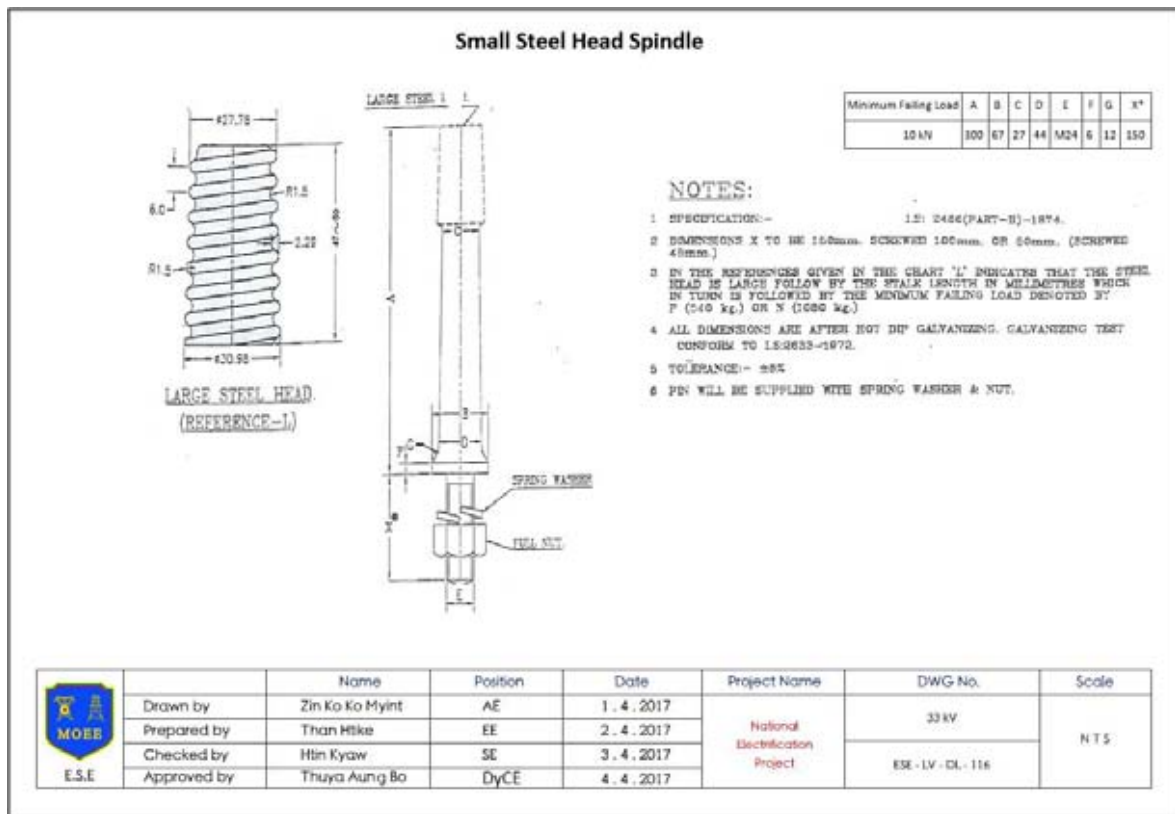
**UNDER OIL PUNCTURE VOLTAGE** :- 210 kV(RMS)

**APPROX. WEIGHT OF UNIT** :- 9.5 kG.

**IDENTIFICATION MARK:-**

	Name	Position	Date	Project Name	DWG No.	Scale
 E.S.E	Drawn by	Zin Ko Ko Myint	AE	1 . 4 . 2017	National Electrification Project	33 kV
	Prepared by	Than Htike	EE	2 . 4 . 2017		
	Checked by	Htin Kyaw	SE	3 . 4 . 2017		ESE - LV - DL - 115
	Approved by	Thuya Aung Bo	DyCE	4 . 4 . 2017		

**Typical 33kV Pin Insulator (Minimum Characteristics as per table 7.1)**



## 7. DISK - CAP & PIN STRAIN INSULATORS

### 7.1 USE AND TYPES

The insulator shall be Class B solid type porcelain construction. According to IEC 60305, 600383 and IEC 60305. The Insulators shall be used with the 11kV and 33kV system with suitable characteristics as per table below.

**Table 8.1 The characteristics of Disc insulator shall be as follows:**

No	Description	Unit	70kN	120kN
1	IEC Ref Type		<b>U70BL</b>	<b>U120B</b>
2	Min.Mechanical Failing Load	kN	70	120
3	Colour		Brown	Brown
4	Leakage/Creepage distance	mm	320	320
5	Coupling Type according to UEC 60120		16	16
6	Minimum Power Frequency Withstand Wet 50Hz 1 Min. (Type Test IEC 60383)	kV	40	40
7	Minimum Standard Lightning Impulse Withstand voltage	kV	110	110

No	Description	Unit	70kN	120kN
8	Radio Interference		IEC 60437	IEC 60437
9	Maximum RIV at 1MHz		BS 60305	BS 60305

## 7.2 PERFORMANCE

The Cap and Pin or disk Strain insulators shall be standard IEC sea level specified insulators. The requirement for the Altitude will be accommodated by the use of additional discs. The design shall be such as to allow easy removal for replacing of insulator units or fittings without the necessity to remove the insulator string from the cross arms. The locking device shall be incapable of rotation in position.

The terminal and tension Insulator sets shall be complete with ball eye, socket eye anchor shackle, cotter pins, conductor tension clamps, fixed and adjustable type arcing horns where required etc..

Applications shall be as shown on the drawings in the following pages.

## 7.3 DESIGN AND CONSTRUCTION

The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. Precautions shall be taken to avoid chemical reaction between cement and metal fittings, e.g. by the choice of suitable materials, or by the method of construction.

The Insulators shall be used for the 11 and 33kV distribution network.

### 7.3.1 33kV Application

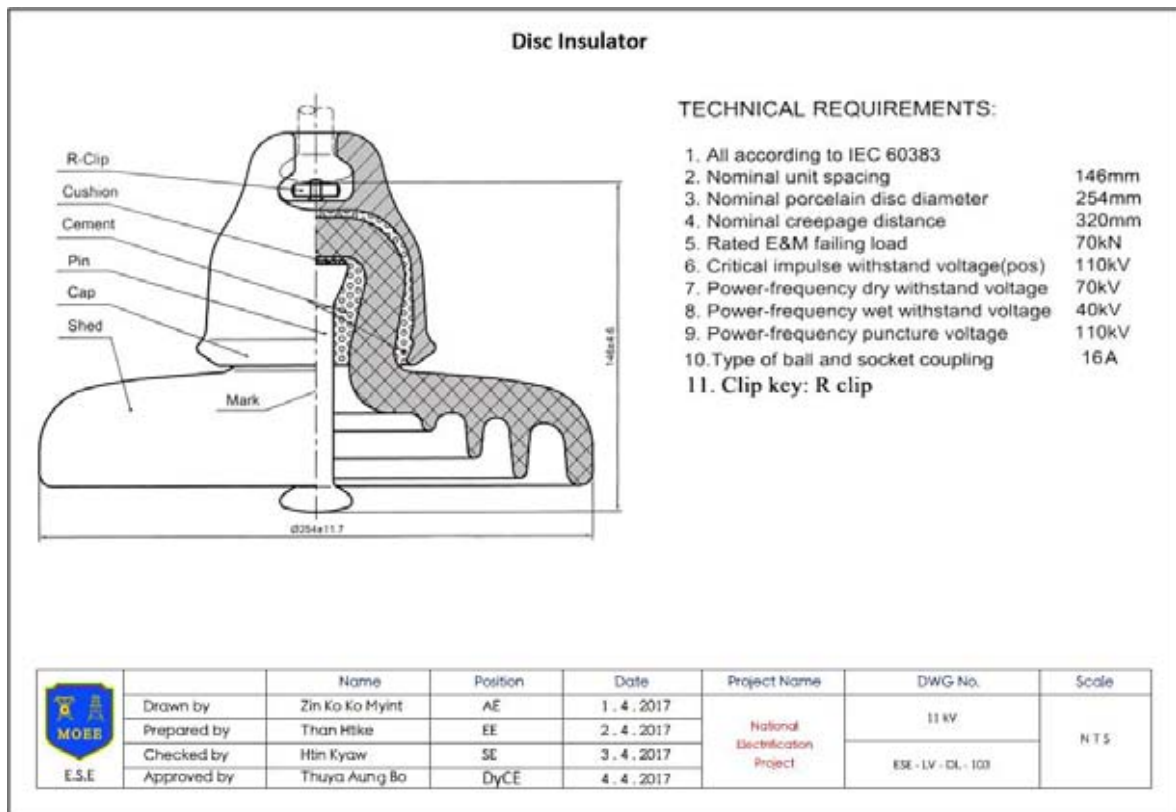
For the 33kV system disk insulators shall be used predominately at dead end – terminations or section poles. In this case FOUR disk insulators must be used. The type used will be the 120kN type

### 7.3.2 11kV application

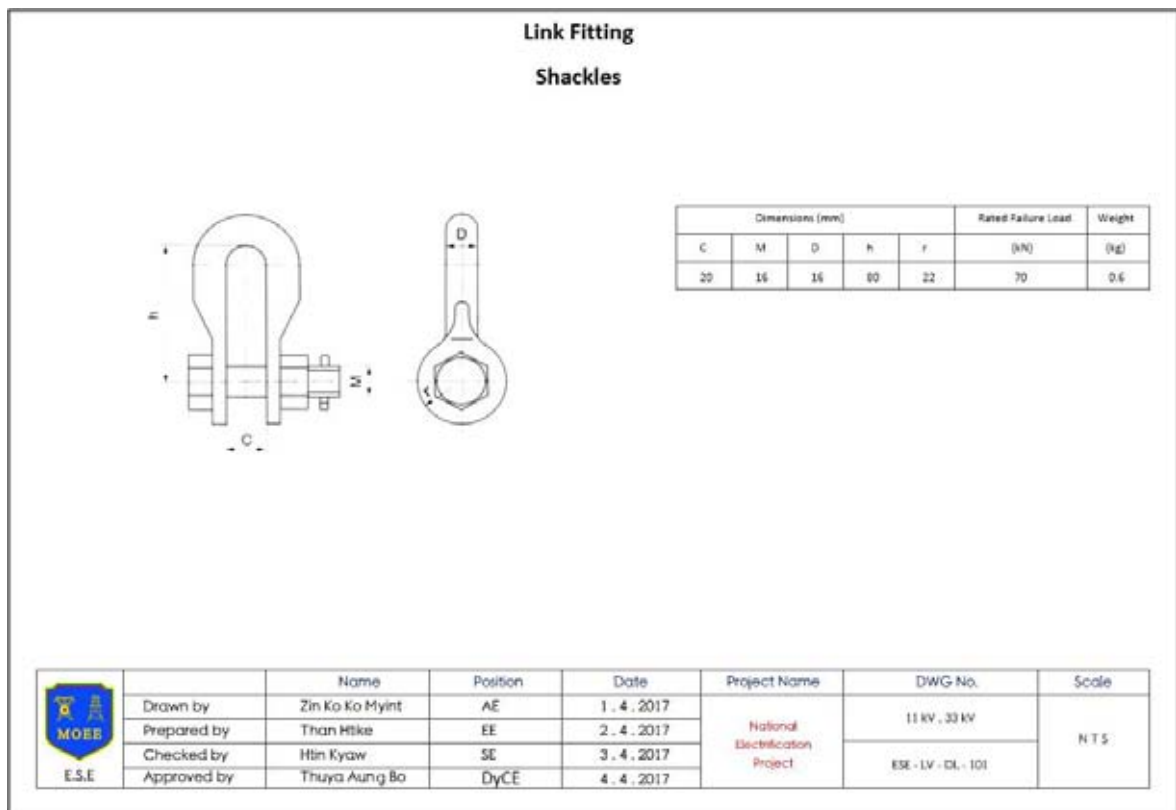
For the 33kV system disk insulators shall be used predominately at dead end – terminations or section poles. In this case TWO disk insulators must be used. The type used will be the 70kN type

## 7.4 DRAWINGS OF DISK – CAP AND PIN INSULATORS

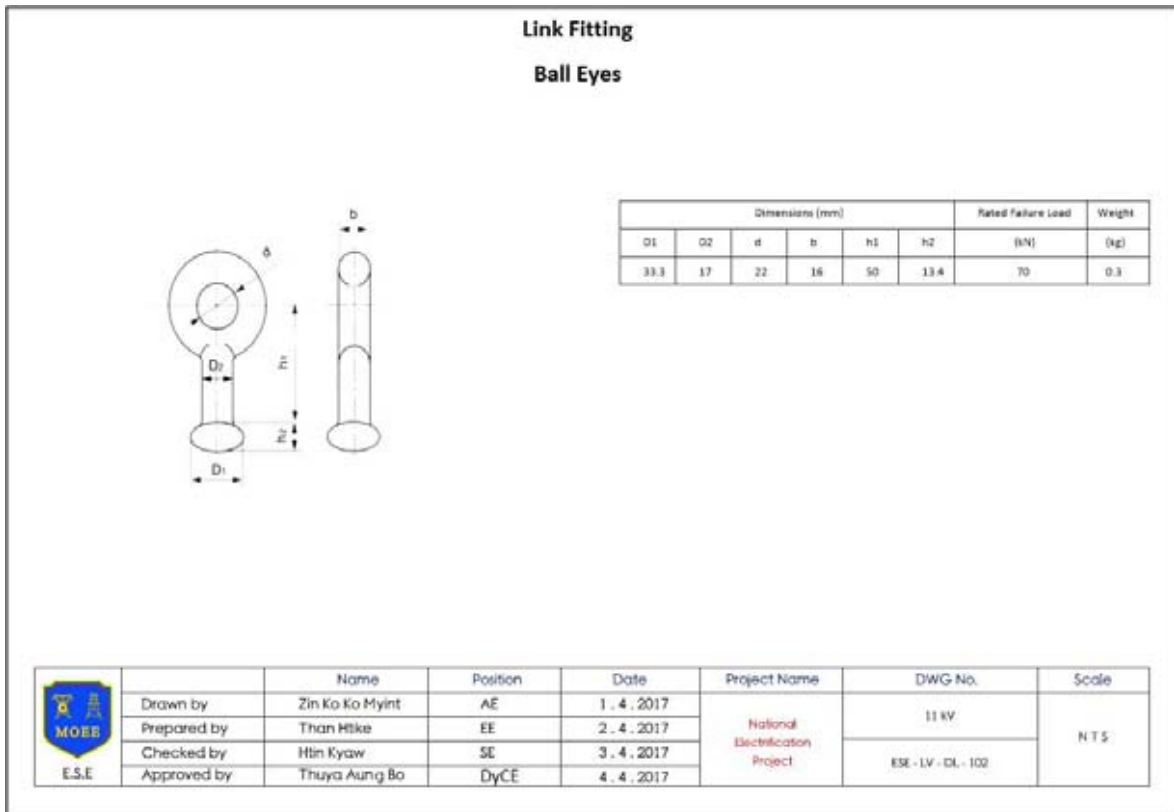
Typical Drawings are included in the following pages for the disk Insulators for the application of 11kV and 33kV systems.



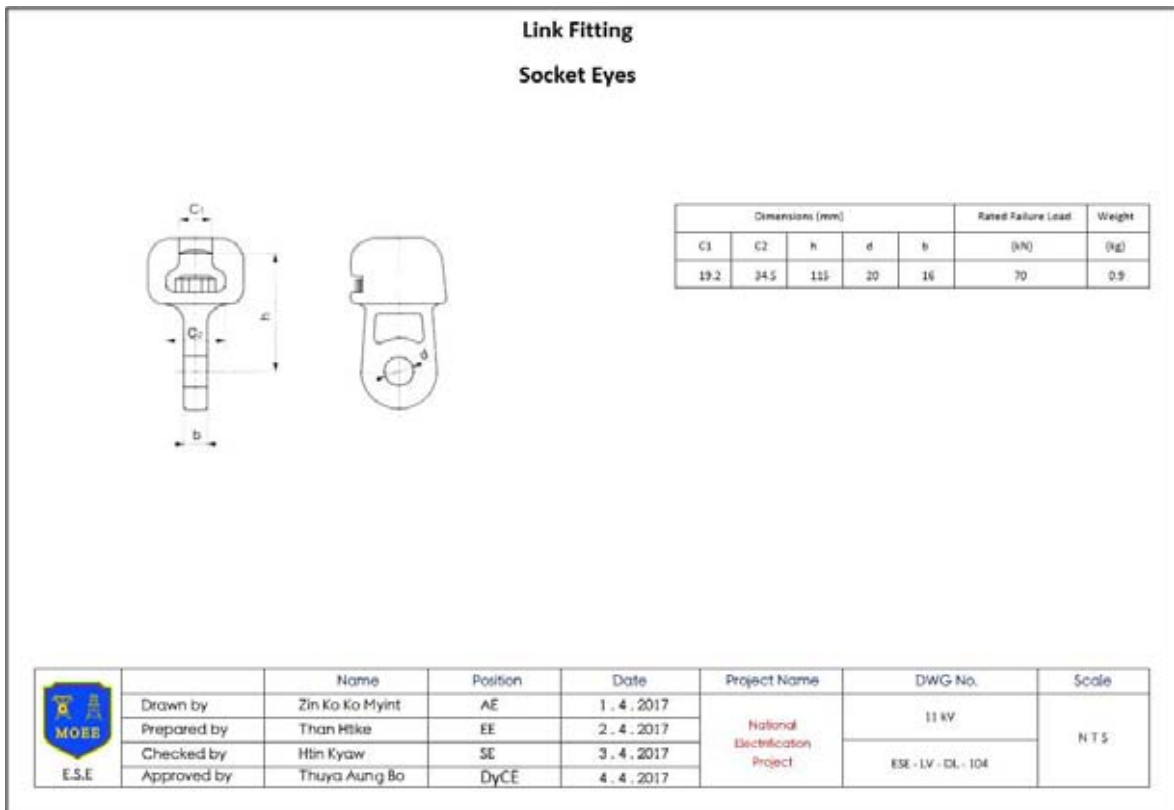
**Fig 11 – Disk Insulator Used for 11kV Application – Fittings follow for this application**



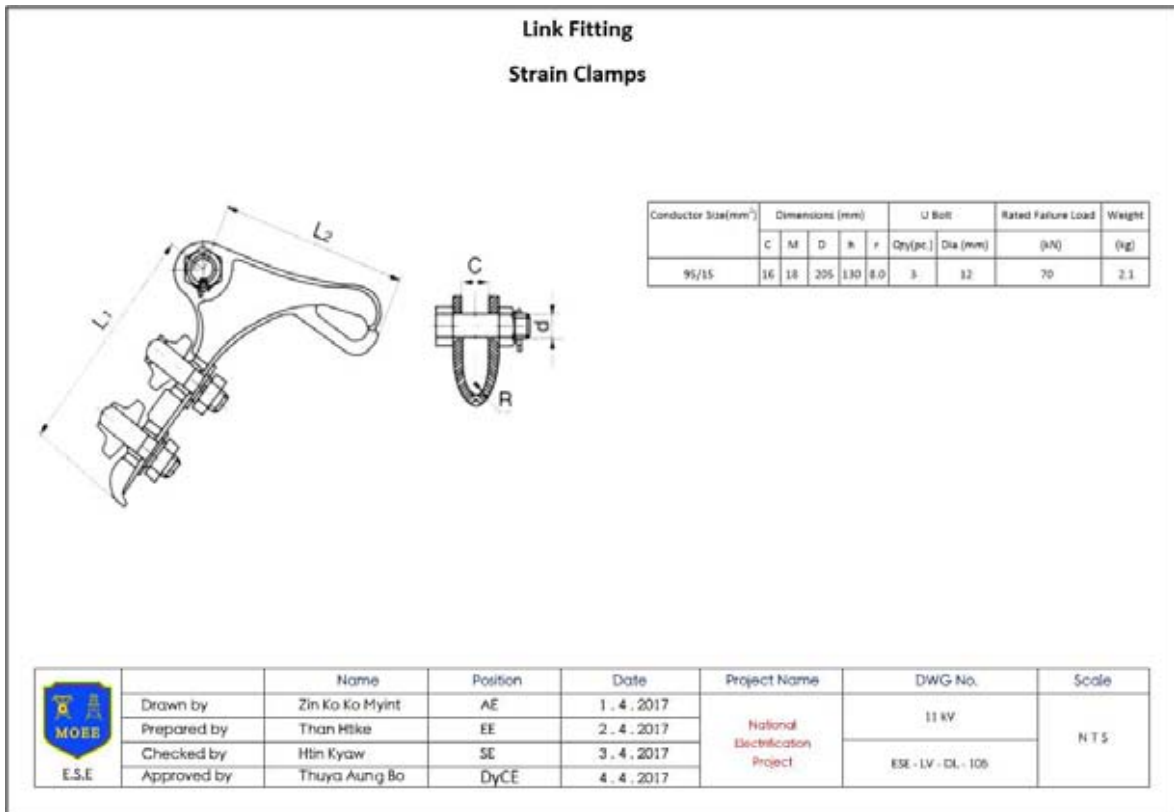
**Fig 11-1 - 11kV fittings 1**



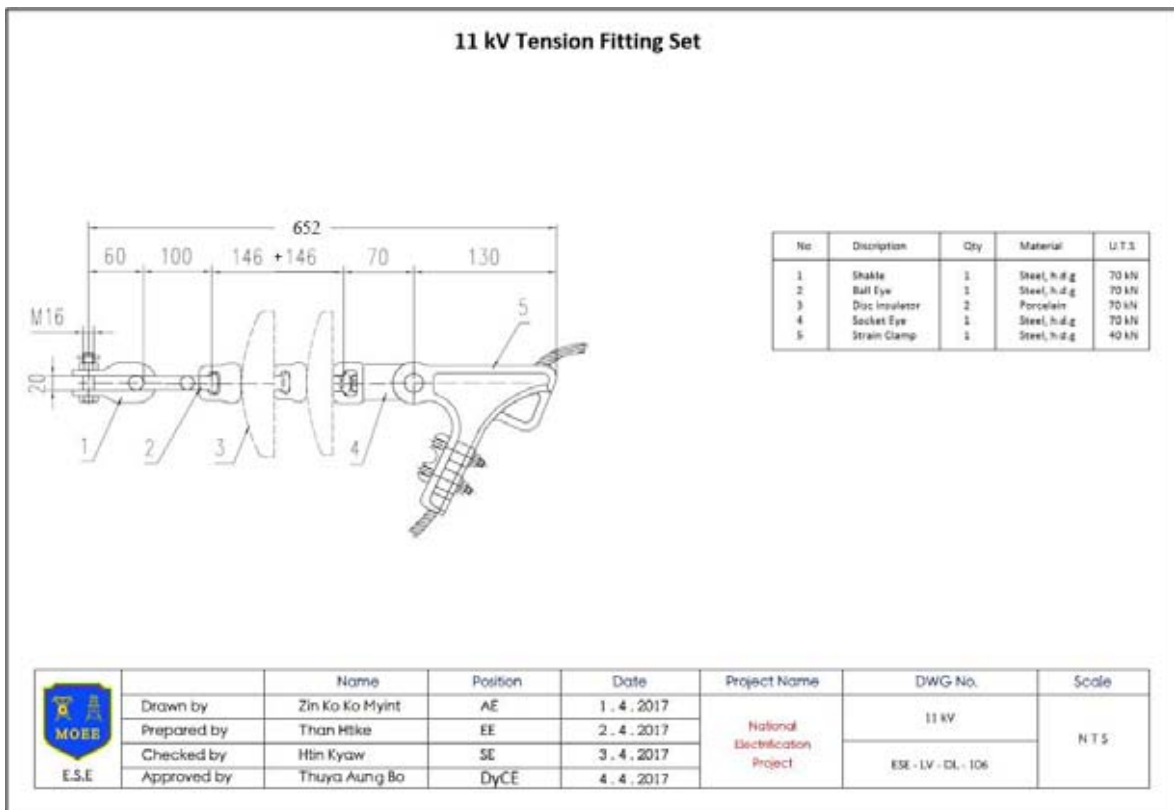
**Fig 11-2 - 11kV fittings 2**



**Fig 11-3 - 11kV fittings 3**

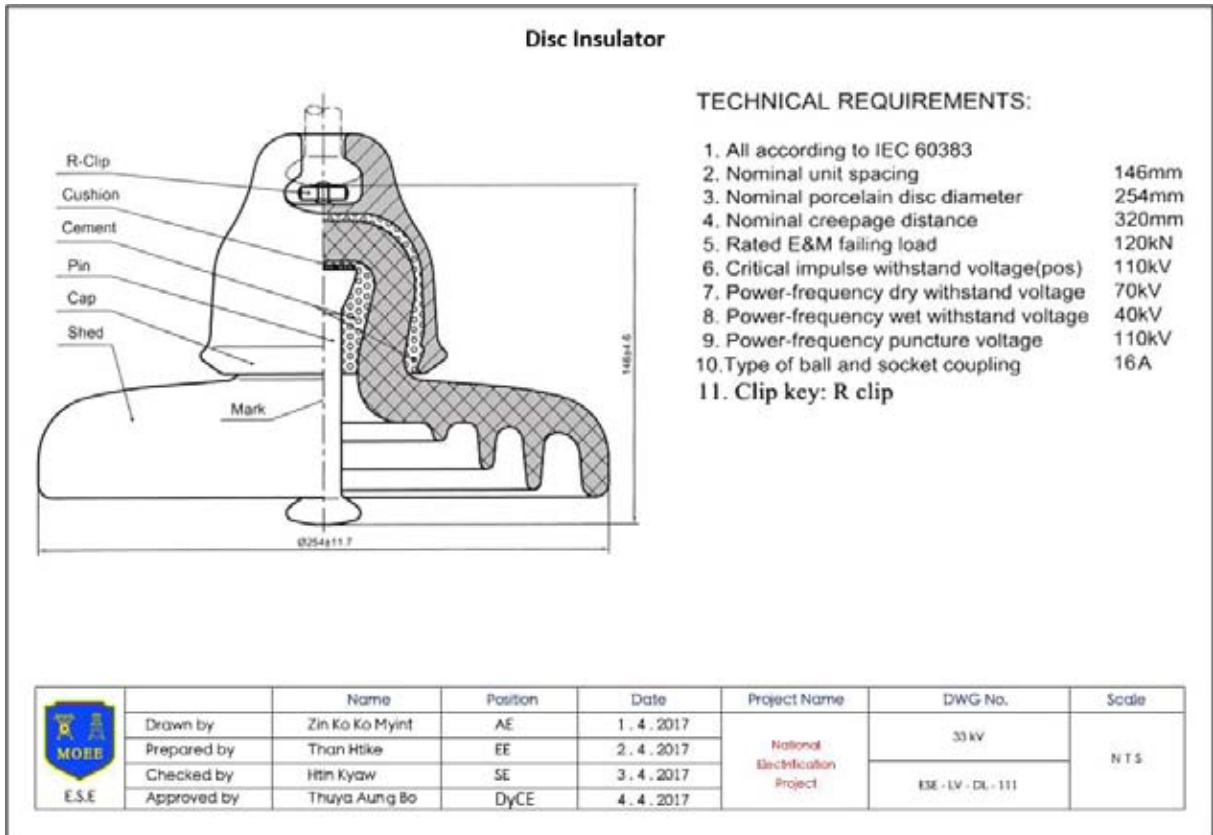


**Fig 11-4 - 11kV fittings 4**

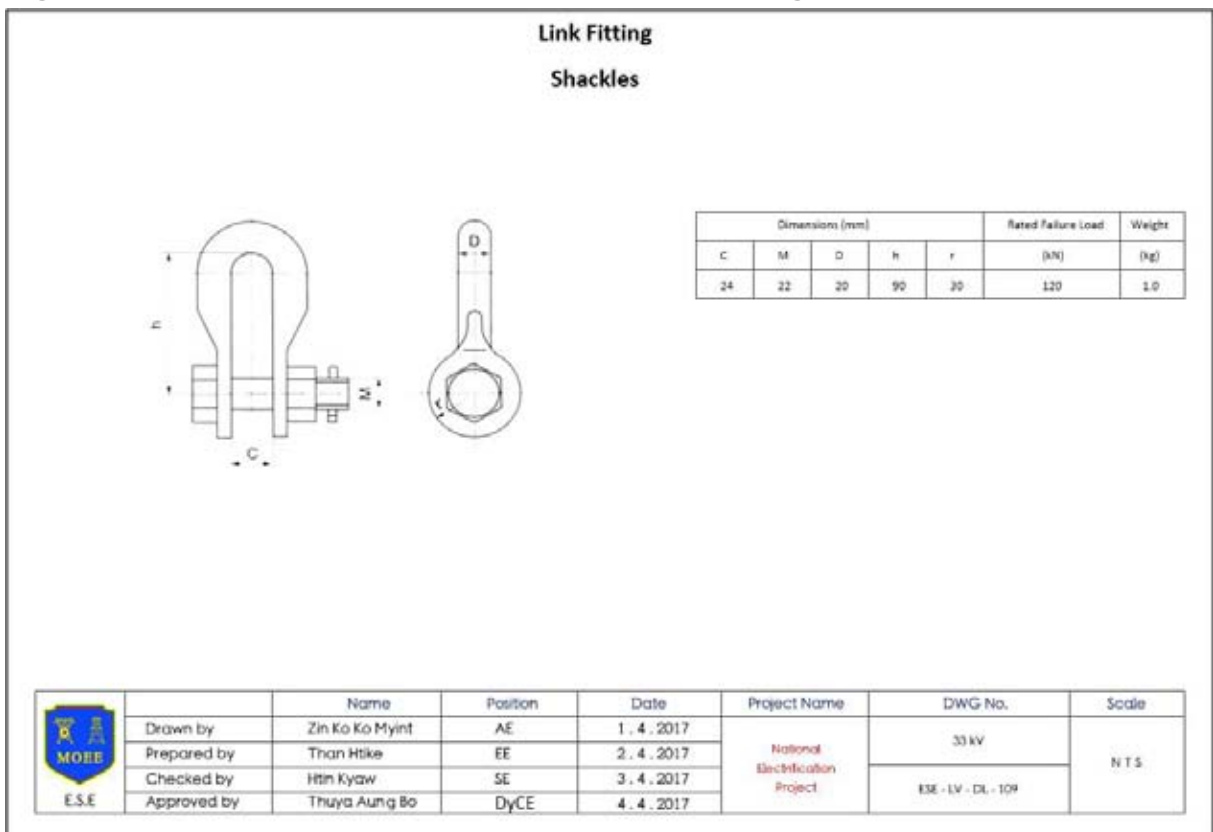


**Fig 11-5 - 11kV fittings 5**

### Disk Insulator Strings for 33kV Application

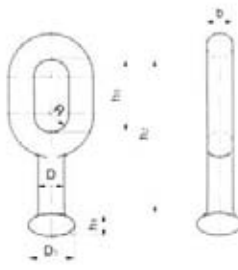


**Fig 33 – Disk Insulator Used for 33kV Application – Fittings follow for this application**






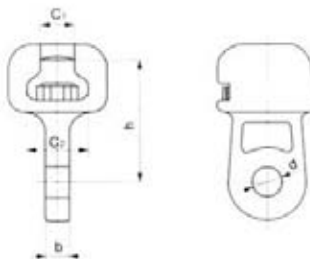
### Link Fitting Ball Eyes




Dimensions (mm)							Rated Failure Load	Weight
h1	h2	h3	R	D	D1	b	(kN)	(kg)
13.4	100	50	18	17	33.3	19	120	1.1

	Name	Position	Date	Project Name	DWG No.	Scale
 E.S.E	Drawn by	Zin Ko Ko Myint	AE	1 . 4 . 2017	National Electrification Project	33 kV
	Prepared by	Than Htike	EE	2 . 4 . 2017		
	Checked by	Htin Kyaw	SE	3 . 4 . 2017		
	Approved by	Thuya Aung Bo	DyCE	4 . 4 . 2017		E3E - LV - DL - 110

### Link Fitting Socket Eyes

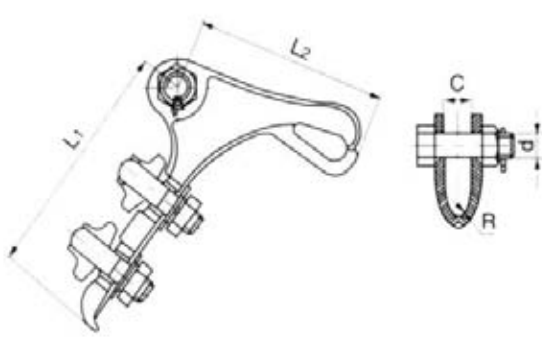


Dimensions (mm)					Rated Failure Load	Weight
C1	C2	h	d	h1	(kN)	(kg)
19.2	34.5	115	24	20	120	1.1


	Name	Position	Date	Project Name	DWG No.	Scale
 E.S.E	Drawn by	Zin Ko Ko Myint	AE	1 . 4 . 2017	National Electrification Project	33 kV
	Prepared by	Than Htike	EE	2 . 4 . 2017		
	Checked by	Htin Kyaw	SE	3 . 4 . 2017		
	Approved by	Thuya Aung Bo	DyCE	4 . 4 . 2017		E3E - LV - DL - 112



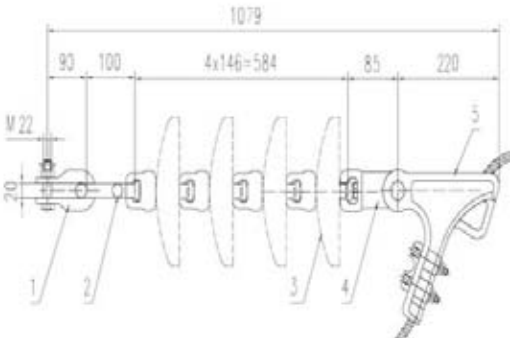
### Link Fitting Strain Clamps




Conductor Size(mm <sup>2</sup> )	Dimensions (mm)					Qty(pc.)	U Bolt Dia.(mm)	Rated Failure Load (kN)	Weight (kg)
	C	M	D	h	r				
150/25	17	25	410	220	32.5	5	16	120	7.1

 E.S.E	Name	Position	Date	Project Name	DWG No.	Scale	
	Drawn by	Zin Ko Ko Myint	AE	1 . 4 . 2017	National Electrification Project	33 kV	N T S
	Prepared by	Than Htike	EE	2 . 4 . 2017			
	Checked by	Htin Kyaw	SE	3 . 4 . 2017			
	Approved by	Thuya Aung Bo	DyCE	4 . 4 . 2017			
						ESE - LV - DL - 113	

### 33 kV Tension Fitting Set



No	Description	Qty	Material	U.T.S
1	Shackle	1	Steel, h.d.g	120 kN
2	Ball Eye	1	Steel, h.d.g	120 kN
3	Disc Insulator	4	Porcelain	120 kN
4	Socket Eye	1	Steel, h.d.g	120 kN
5	Strain Clamp	1	Steel, h.d.g	120 kN

 E.S.E	Name	Position	Date	Project Name	DWG No.	Scale	
	Drawn by	Zin Ko Ko Myint	AE	1 . 4 . 2017	National Electrification Project	33 kV	N T S
	Prepared by	Than Htike	EE	2 . 4 . 2017			
	Checked by	Htin Kyaw	SE	3 . 4 . 2017			
	Approved by	Thuya Aung Bo	DyCE	4 . 4 . 2017			
						ESE - LV - DL - 114	

## 8. ASSOCIATED HARDWARE

Hooks, conductor clamps and other associated hardware for all insulators if not detailed in this specification and included in the technical schedules, shall be in accordance with associated Specification for line fitting materials.

## 9. MARKING

Each insulator shall bear a legible and durable marking as per ANSI or IEC 61109 Standards and as a minimum shall bear the following in English:

- 1) Manufacturer name, Year of manufacturing.
- 2) Clients name designation (NEP-MOEE according to contract)
- 3) Designation number.
- 4) Cantilever strength (Combined M&E strength suspension insulator).
- 5) Country of origin.

## 10. PACKING

The insulators general packing requirements shall be according to TS-GN-03.

Line post insulator units shall be packed in crates containing 6 insulator units and fittings. Each set shall be sealed in a strong plastic bag.

The crates shall be packed on a pallet. The packing shall afford adequate protection for the insulators during international transportation and rough handling during delivery to site.

The crate marking shall be in English with the following data

- 1) Manufacturer name / Country of origin / data of manufacture
- 2) Nominal System voltage.
- 3) Type of insulator (Spool, Suspension, Line post etc.).
- 4) Client order / contract number.
- 5) Weight, Kg.

## 11. INFORMATION WITH THE BID

The following shall be furnished with the Bid. **Catalogues** describing the item and indicating Model No.

- 1) **Constructional features**, materials used for components.
- 2) **Dimensional drawings**.
- 3) **Additional tests for Cap and Pin Insulators**. In addition Type Test Certificates for the cap and pin / string insulator units shall include thermal mechanical performance test as per IEC 60575 (1977).




MM-MOEE-TS

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# TECHNICAL SCHEDULE

TS-CO-05-S

MV and LV Insulators

**Technical Schedule for MV Pin Insulators**

<b>No</b>	<b>Item</b>	<b>Unit</b>	<b>Requirement</b>	<b>Bid Offer</b>	<b>Requirement</b>	<b>Bid Offer</b>
1	Manufacturer		to state		to state	
2	Manufacturer's Code		to state		to state	
3	Nominal System Voltage		11kV system		33kV System	
4	Material		Porcelain		Porcelain	
5	Colour		Brown		Brown	
6	General Specification for Insulators		IEC 60383		IEC 60383	
7	Leakage/Creepage distance	mm	320		900	
8	Protected Leakage distance		96		290	
9	Minimum Power Frequency Withstand Wet 50Hz 1 Min. (Type Test IEC 60383)	kV	28		70	
10	Minimum Standard Lightning Impulse Withstand voltage	kV	75		170	
11	Min.Mechanical Failing Load	kN	10		10	
12	Radio Interference to IEC 39437 and IEC	μV	200		200	
13	<b>Dimensions of Insulator</b>					
14	Minimum Top Conductor Seat Radius	mm	12		16	
15	Minimum Side Conductor Seat Radius	mm	12		16	
16	Total Height	mm	to state		to state	
17	Larger Shed diameter	mm	to state		to state	
18	Weight of insulator without fittings		to state		to state	
19	<b>Spindle Data</b>					
20	Lengthh of Screw part for fixing in channel iron	mm	130		150	
21	Bolt Type		M20		M20	
22	Weight of Complete Pin		to state		to state	
23	Weight of Complete Insulator		to state		to state	
24	No of Insulators in the crate		to state		to state	
25	Weight of crate		to state		to state	
26	Mass of Zince Coating	u	85		85	

Technical Schedule for

Disc-Strain Insulators

No	Item	Unit	Requirement	Bid Offer	Requirement	Bid Offer
1	Manufacturer					
2	Manufacturer's Code					
	Nominal System Voltage		11kV system		33kV system	
3	Type of Insulators		70kN		120kN	
4	General Standard for Insulators		IEC 60383		IEC 60383	
5	Class of Insulator according to IEC 60383		B		B	
6	Specific IEC Standard Insulator		IEC 60305		IEC 60305	
7	IEC Ref Type		U70BL		U120B	
8	Min.Mechanical Failing Load	kN	70		120	
9	Material		Porcelain		Porcelain	
10	Colour		Brown		Brown	
11	Leakage/Creepage distance	mm	320		320	
12	Coupling Type according to UEC 60120		16		16	
13	Minimum Power Frequency Withstand Wet 50Hz 1 Min. (Type Test IEC 60383)	kV	40		40	
14	Minimum Standard Lightning Impulse Withstand voltage	kV	110		110	
15	Radio Interference to IEC 39437 and IEC	µV	50		50	
16	Pinhole gauge test, Sample Test - this specification and see also BS 60383, 60305		Sample Test		Sample Test	
18	<b>Dimensions of Insulator</b>					
19	Diameter of the Insulating part	mm	255		255	
20	Nominal Spacing	mm	146		146	
21	Weight of insulator without fittings	kg	to state		to state	
22	No of Insulators in crate		to state		to state	
23	Weight of crate	kg				
24	<b>Couplings Data</b>					
25	Ball and Socket		IEC 60120		IEC 60120	
26	Clevis and Touge couplings		IEC 60471		IEC 60471	
27	Locking devices for ball and socket couplings of string insulator units – Dimensions and tests		IEC 60372		IEC 60372	