K-LINE INSULATORS LIMITED
TORONTO, ONTARIO, CANADA

Catalogue T-TIF

Totally Insulated Framing System (TIF™)
TIF™ - Transmission (H-Frame)
69kV - 230kV (Patent No.: US 9,685,772)

Certified System

ISO9001
SAI GLOBAL
FILE No. 000117

TIF™ - Transmission (H-Frame) (Patent No.: US 9,685,772)

Totally Insulated Framing System

The new **K-LINE INSULATORS LIMITED (KLI)** Totally Insulated Framing Systems for Transmission Lines (TIF™) improves conventional H-Frame Pole and Crossarm construction by using KLI Insulators assembled in innovative and new configurations to perform the Crossarm function.

Typically, Treated Lumber, Steel or Composite Crossarms are used to support Insulators/Conductors on Overhead Transmission Line H-Frame structures. Conventional Crossarms have service life limitations due to wood rot, steel corrosion or fiber reinforced polymer (FRP) deterioration.

KLI is introducing TIF™ designs for Transmission Lines for nominal voltages up to and including 230 kV. The innovative Silicone InsulArm of TIF™, replaces conventional Crossarms and addresses service life limitations and concerns with standard Crossarm materials. Field proven, **KLI** Transmission Post Insulators, manufactured to KLI's high standards are assembled to form the Crossarm in a variety of configurations.

Flexibility is one special characteristic of the TIF™ design for Transmission. The Silicone InsulArm is an assembled part and can be delivered in Modular Components or factory assembled as One-Piece. In areas with difficult access, Line Crews can easily transport lightweight InsulArm modules for on-site assembly of the Silicone InsulArm. Heavy transport or high capacity moving and material handling equipment is not required. Another advantage of the modular Silicone InsulArm is simple replacement of individual components in place without having to remove the assembled Silicone InsulArm.

Installation simplicity is an important feature of the TIF™ H-Frame InsulArm system. If acquired as One-Piece, the H-Frame InsulArm is simply and safely hoisted to position and quickly bolted in position with two machine bolts per pole. Installation time and cost is minimized as the TIF™ Silicone InsulArm is in place and ready for attachment of Conductor Suspension Hardware direct to the TIF™ Silicone InsulArm.

Integrated Conductor Hardware attachment points on the Silicone InsulArm facilitate positioning of the Conductor Hardware/Conductor direct to the InsulArm eliminating the need for Suspension Insulators. Vertical Ground Clearance is increased. This feature allows the option of using shorter poles or increasing line operating current. Fixed positioning of Conductors on the TIF™ InsulArm eliminate suspension insulator swing under ice and wind conditions and ROW width requirements may be reduced.

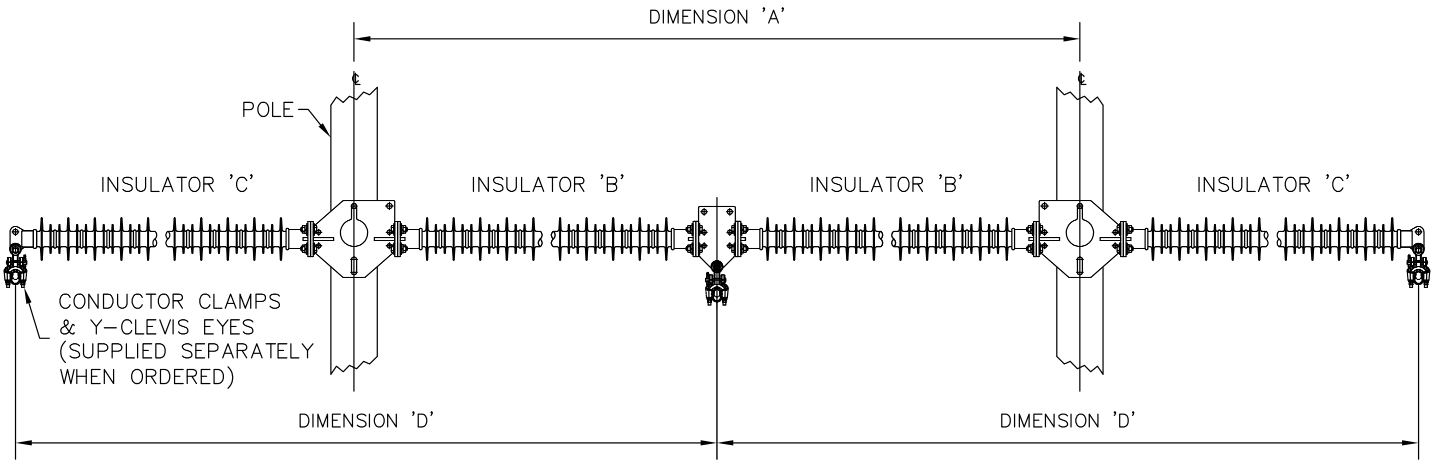
For transmission line framings, optional "Brace" Insulators are available to increase load carrying capacity up to 80% depending on the angle between the Horizontal InsulArm and the supporting Brace Insulator. Standard Conductor Suspension Clamps can be used for line attachment. The H-Frame system is available for common transmission line voltages but can also be customized.

TIF™ Silicone InsulArm systems for H-Frame construction offer innovative, cost effective solutions for Crossarm life limitation concerns while maintaining required horizontal and vertical conductor spacing and clearances based on the voltage of the application.

An example for technical data is Catalogue No. KL115TIF1010 with 10' Pole & Conductor Spacing:

SPECIFICATIONS	UNITS	CATALOGUE NUMBER
		KL115TIF1010
Voltage Class	kV	115
Leakage Distance	mm (in)	2583 (101.7)
Critical Impulse Flashover (Pos.)	kV	590
Low-Frequency Wet Flashover	kV	330
DIMENSION 'A'	mm (in)	3136 (123.4)
DIMENSION 'D'	mm (in)	2898 (114.1)
Max. Design Vertical Load	kN (lbs)	9.1 (2042)

TIF™ -Transmission Spacing Options: (Patent No.: US 9,685,772)



TIF™ -TRANSMISSION SPACING OPTIONS

K-Line Cat. No.	System Voltage (kV)	Approx. Pole Spacing Dimension 'A' mm (ft)	Insulator/s 'B'	Insulator/s 'C'	Conductor Spacing Dimension 'D' mm (ft)	Max. Design Vertical Load kN (lbs) (See Notes)	Approx Weight kg (lb)
KL69TIF0908	69	2640 (8.6)	19 sheds	19 sheds	2527 (8.3)	10.5 (2375)	127 (280)
KL115TIF1010	115	3136 (10.3)	25 sheds	22 sheds	2898 (9.5)	9.1 (2042)	137 (302)
KL138TIF1211	138	3631 (11.9)	31 sheds	28 sheds	3394 (11.1)	6.9 (1550)	150 (330)
KL161TIF1413B	161	4127 (13.5)	37 sheds	34 sheds	3890 (12.7)	43.9 (9865)	223 (492)
KL230TIF2018B	230	6088 (20.0)	28 sheds x 2	22 sheds x 2	5517 (18.1)	44.6 (10,025)	306 (675)

BUILDING A TRANSMISSION TIF™ SYSTEM

1. Insulators 'B' in the TIF™-TRANSMISSION SPACING OPTIONS Table are selected to match existing pole spacing (Dimension 'A') or for new lines, Insulators 'B' may be selected so that pole spacing (Dimension 'A') is reduced due to TIF™ eliminating insulator swing.
2. Insulators 'C' can then be selected for a reduced and optimized ROW since TIF™ eliminates insulator swing, while still maintaining required conductor spacing Dimension 'D'.
3. Technical Data is based on Insulator/s 'C' and can be found by referencing the **KLI** catalogue Transmission Line Post section for the Insulator(s) 'C' selected. The correlation between No. of sheds and the catalogue part number is explained in that section.

NOTES:

1. For higher loads bracing may be required. Please contact **K-Line** Engineering.
2. For other combinations and system voltages that are not covered in the table above. Please contact KLI Engineering.
3. The Max. Design Vertical Load (MDVL) is the allowable load. The Ultimate Load is two times the MDVL.

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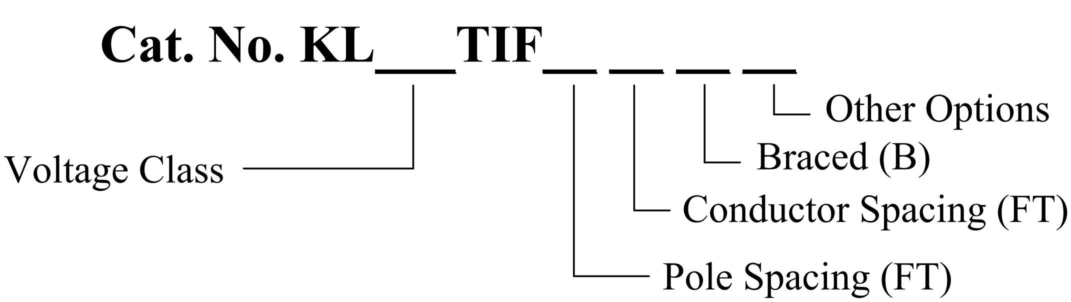
ORDERING INFORMATION

For ordering, the catalog number of the specific insulator is formulated as shown below:



Summary of TIF™ Silicone InsulArm Features/Advantages/Benefits:

(Patent No.: US 9,685,772)

- Attachment of Conductors direct to TIF™ Silicone InsulArm eliminates the need for Suspension Insulators on Transmission H-Frame type Tangent Structures
- Vertical Clearance increases up to 1 meter for 115 kV and 2 meters for 230 kV applications facilitate the use of shorter structures on new lines
- For Line “Uprating” projects, increased Vertical Clearances permit higher line operating currents and the resultant increase in Conductor Sags (refer to Figure 1)
- TIF™ reduces ROW width requirements. Conductors are mounted directly to TIF™ eliminating Suspension Insulator contribution to Conductor Swing (refer to Figure 2). Sample calculations give a reduction of almost one meter for 115 kV and approximately 1.5 meters for 230 kV applications
- Non-conductive TIF™ Silicone InsulArm improves safety of the application when working in Energized Line environments
- TIF™ eliminates Crossarm life limitations due to wood rot, hidden corrosion and deterioration of composite materials
- Modular Design of TIF™ simplifies transportation into difficult access areas in small, lightweight sections for assembly and installation in place without heavy transport or material handling equipment
- TIF™ Silicone InsulArm are Engineered and customized to fit existing H-Frame Pole Spacings
- Standard pole attachment hardware allows for TIF™ to simply bolt to Pole using existing holes on uprating/ Crossarm replacement projects
- TIF™ deters vandalism normally associated with glass and porcelain insulators in remote locations
- Silicone InsulArm protects wildlife by reducing possibilities of Phase-to-Ground Contacts from energized lines to conductive Crossarms. Irregular surfaces of alternating Insulator “Sheds” of Silicone InsulArms discourage bird roosting and nesting
- TIF™ enhances Transmission System Reliability and offers significant cost savings for line construction and maintenance
- TIF™ is ideal for Emergency Restoration or Emergency Bypass Construction

Figure 1

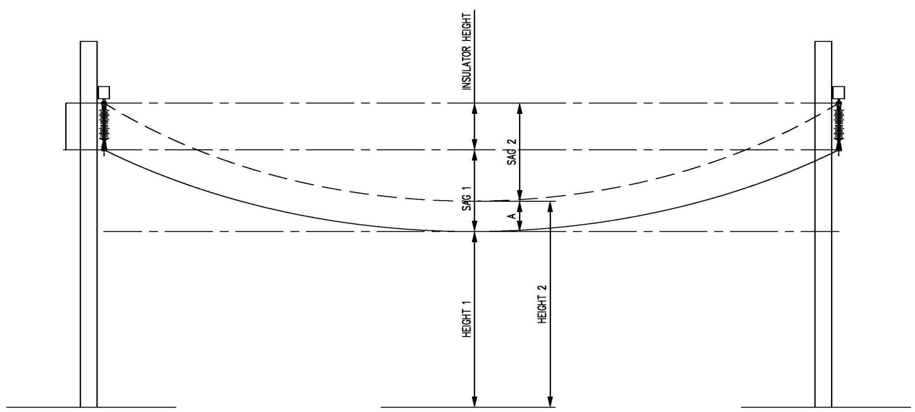


Figure 2