Introduction

Transmission of Electrical Power in bulk for a long distance is done through overhead lines where the power flows through Conductors which are supported by Insulators from Towers. The Conductors are always of stranded type and as the quantum of power goes up, instead of single conductor, bundle conductors are adopted in the same phase viz., twin, triple, quad, hexagonal, octagonal etc. Whenever multi-bundle conductors are used, in order to avoid clashing between sub-conductors and thereby resulting in damage of conductor, Spacer Dampers are deployed to maintain sub-conductor spacing throughout the run of line as well as to control vibrations on conductors.

Conductors are exposed to wind and act as a taut string thereby are subjected to different types of vibration/oscillatory movements. Mainly following types of vibrations/oscillations may occur depending on surrounding conditions:

1) Aeolian Vibration:
This occurs under laminar flow of wind due to vortex shedding from the leeward side of the conductor and is the most common type of vibration. This high frequency low amplitude vibration generates bending strain at conductor clamping points owing to cyclic movement and give rise to fatigue failure of conductor. In case of bundle conductors, Spacer Dampers are deployed to limit such vibrations and bending strain within safe limits.

2) Sub-span Oscillation:
In case of bundle conductors, a certain sub-conductor spacing needs to be maintained which is done by putting Spacer Dampers at some intervals. Whenever a fault occurs on line, huge short circuit current flows through the sub-conductors on same direction and gives rise to repulsion between sub-conductors which results in outward movement of the sub-conductors. Since the sub-conductors are fixed with Spacer Dampers at intervals, they will be pulled back again towards one another. Thus a low frequency high amplitude vibration is inducted on the sub-conductors which is termed as Sub-span Oscillation.

3) Galloping:
This happens in case of ice-loading on conductors. When ice deposited on conductor starts melting, initially melting takes place as drop by drop. After some time, a bulk part of ice gets dropped resulting in a reaction force on opposite direction and in most cases in an angular plane. This results in a torsional mode of vibration at low frequency and high amplitude and the conductor starts galloping.

Since galloping will occur in case of ice condition which is not prevailing everywhere, Spacer Dampers are generally designed and developed to take care of Aeolian vibration and Sub-span oscillation.

The following are the problems associated with bundled conductors due to Aeolian vibration and Sub-span oscillation:

- Damage of spacers, spacer dampers
- Damage to conductors under the clamps
- Damage to hardware connecting conductor to insulator strings

Spacer damper:

IS:10162-1982 defines Spacer dampers as mechanical components fitted at specified intervals on transmission lines having more than one sub-conductor per phase to perform all functions of a spacer and in addition control Aeolian vibrations and sub-span oscillations within permissible limits.
Construction:

A spacer damper for transmission line cables comprises of a substantially planar frame and a plurality of clamping arms each resiliently pivotally connected to the planar frame at one end and provided with clamping means for respectively grasping individual conductors at the other end. The frame is of rigid one-piece construction and provided at each region of pivotal connection with a recessed portion into which the end of the arm extends so as to lie substantially in the plane of the frame. Each arm is resiliently pivotally connected to the frame by a pair of spaced resilient energy absorbing elements located on either side of the arm to be traversed by the bolt and lockingly engaged with recesses formed in the arm.

Each recessed portion of the frame is provided with at least one end cap, itself provided with a recess for lockingly engaging one of the elements, the end cap being rigidly secured to the frame by the locking bolt so as to straddle the recessed portion, hold the elements in compression and thereby secure the arm for resilient hinged part rotation relative to the frame.

Working Mechanism:

A spacer damper must incorporate some mechanism that allows large relative movements of one conductor clamp with respect to the other and this mechanism is called articulation.

A spacer damper uses an energy absorption mechanism based on the deformation of elastomer elements. The damping of vibrations is carried out by converting the vibrational energy to stresses in the spacer damper.

Each articulation contains one or more elements which are deformed by the relative movement of the arm with respect to the central frame of the damper. Hence the deformation of the rubber elements results in compressive stresses and shear stresses. However, only one of them dominates depending upon the articulation design. Hence, the construction of the rigid planar structure must be capable of handling the stresses induced due to vibrations of the conductor. The spacer damper has energy absorption capability in both the vertical and horizontal planes to account for both Aeolian vibrations and sub-span oscillations respectively.

Design:

The spacer damper shall be designed as per IEC 61854 specifications stated below:

- Maintain subconductor spacing, within any prescribed limits, under all conditions of service excluding short-circuit currents.
- Prevent, in subspans between spacers, physical contact between subconductors, except during the passage of short-circuit currents when the possibility of contact is accepted provided that specified spacing is restored immediately following fault clearance.
- Avoid damage to subconductor under specified conditions.
- To be free from unacceptable levels of corona and radio interference under specified service conditions.
- Withstand mechanical loads imposed on the spacer damper during installation, maintenance and service without any component failure or unacceptable permanent deformation.
- Be suitable for safe and easy installation. For the bolted and latching clamp the design shall retain all parts when opened or attached to the conductor.
- Ensure the individual components do not become loose in service.
- Be capable of being removed and re-installed without damage to spacers or subconductors.
- Maintain its function over entire service temperature range.
- Avoid audible noise.