Quality and Selection Parameters of Splice Protection Sleeves

Overview

The use of fusion splicing as a method of joining two or more fibers (Ribbon Fiber) in a fiber optic network is the most common and reliable method used these days. It offers best splice loss and a permanent, long lasting joint.
Splice Protection sleeves are used to restore environmental and mechanical integrity of fiber after splicing. It is by far the most important component of any splicing system.
Since most of the splicing is done in "Field" that is outdoor and remote conditions it becomes very important that quality of splicing work is not affected in these places due to quality of components involved. Also it has been seen that cost of access and restoration is very high in such circumstances, often many times the cost of the joint closure itself. As all network managers know that there is very high cost involved with downtime of a network. This paper seeks to identify and define various technical and quality parameters involved with manufacturing and usage of splice protection sleeves.

A fusion Splice Protection sleeve consists of three parts:

1. Outer tubing/ Heat shrinkable tubing
2. Inner Tubing / Hot Melt Adhesive Tubing
3. Strength member

All the three elements are locked together to form an assembly.

Outer tubing or heat shrinkable tubing is made of cross linked polyolefin and is designed to shrink by a predetermined ratio. It is available in various colors and grades in the market. The important parameters that influence its suitability in splice protection sleeves are listed below:

- .Axial shrinkage and longitudinal shrinkage. All heat shrinkable tubes are designed to shrink in axial direction that is direction perpendicular to its axis. This ratio can vary between 2:1 to 4:1.It is important that tubing selected has a suitable axial shrinkage ratio. More importantly the variation or tolerance in this ratio should be minimal so that the desired fitting of sleeves is achieved in the splice holder. Longitudinal shrinkage is the shrinkage of the sleeve in direction of the axis. Ideally this shrinkage or expansion should be zero. High longitudinal shrinkage can result in exposure of steel rods, after shrinking of the sleeves, which can cause breaking of fiber. The value of this parameter should not exceed 2% of the length**. Change in length of the sleeves should not be more than 1mm in standard 60mm sleeves.**
- The ends should be free from burrs and consistency of length should be achieved.
- The outer tubing should have very good clarity and should enable good visibility and color identification of the fiber. Please note that often this identification needs to be carried in the field or low light conditions and even seemingly small differences in clarity can make critical difference

Inner Tubing. The inner tube is made of Ethylene Vinyl Acetate copolymer of suitable grade and is a hot melt adhesive. Selection of material for this application is critical as this material comes in direct contact with the fiber.

- The material should be free from halogens and other substances which can affect the life of glass fiber.
- The wall thickness and diameter of the inner sleeves influences the recovered diameter of the splice protection sleeves thus affecting "pinching Force" on sleeves.

Strength member. This element provides mechanical stability to the assembly during and after shrinking. The most common strength member used is Stainless Steel of suitable grade.

- Though use of S.S of 302 and 304 grades is prevalent in the industry and is usually adequate, however it is seen that these grades are often found lacking in coastal and other harsh environments. It is therefore recommended that stainless steel of 316 or higher is selected for this application.
- Tensile strength of the steel rod is also important as this will determine ability of sleeve to resist deformation under stress. The rod should not bend under all circumstances of handling activity. **Any bend or non-uniformity in the rods can result in change of attenuation after splicing.**
- **End geometry and surface finish**. This parameter is of utmost importance in splice protection sleeves. During cutting process of these rods a burr is formed on the edges. This burr or sharp edge if present can result in breakage of fiber or rupturing of entire sleeve during shrinking especially if it is present in axial direction. The strength member should be free from all burrs and should be polished to the highest level to eliminate the possibility of sharp edges or burrs. This end grinding is a very specialized process and should be carried out with high degree of skill otherwise the process might generate or leave non uniform and sharp surfaces.
- The diameter and length should be within specified parameters and tolerance to give designed results after shrinking.

Complete assembly

- The assembly of these elements is made and is then heat bonded to ensure perfect alignment during transportation handling and shrinking. This end shrinking / heat bonding should be uniform and consistent to achieve desired parameters of handling.
- The splice sleeves should provide complete environmental sealing.
- The splice sleeves should strain relieve the fused fibers so that there is no fiber breakage when the tensile load is applied.
- The splice sleeve should be capable of handling all temperatures and humidity conditions which might arrive in it's service life
- The splice protection sleeves under no circumstances should affect the splice loss after shrinking.

CONCLUSION:

The paper has tried to establish an evaluation guide for Q.C personals and engineers to help them identify correct product that goes into their network.