

Application of EHV Pre-molded One Piece Joint for Duct Installation System

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ABSTRACT

When old EHV SCFF cables are replaced with XLPE cables in existing ducts and manholes, there is a problem that the space needed for cable joints might not be enough. Therefore, the application of EHV pre-molded one-piece joints, which are more compact than conventional joints, is being considered. However, manipulating these joint under the constraints presented by confined manholes has raised concerns about the defects such as interface characteristics and misalignment between rubber units and cables. Accordingly, we constructed offset testing equipment to simulate a local manhole and conducted various tests in order to confirm its applicability to confined spaces. We have now adopted those joints at actual sites.

KEYWORDS

Self-Contained Fluid-Filled (SCFF) cable; XLPE cable; extra high voltage (EHV) cable; duct installation system; pre-molded one-piece joint; Heating cycle test

INTRODUCTION

In Japan, self-contained fluid-filled (SCFF) underground transmission cables have been installed since the 1970s as urban areas have developed. Recently, those old SCFF cables that were installed in ducts have been replaced with cross-linked polyethylene (XLPE) cables. Cable replacement using the installed duct system, using existing empty ducts, can shorten the power outage period and sustain the reliability of supply. In addition, it can also reduce environmental impact by avoiding repeated excavations [1]. Kansai Transmission and Distribution, Inc. (Kansai-TD) has adopted the duct installation system even for some extra-high-voltage (EHV) cables, but there is a problem that the space needed for XLPE cable joints might not be enough to keep the appropriate cable offset if existing ducts and manholes are reused for cable replacement.

Generally, XLPE cables require more space for joint installation than SCFF cables due to their larger thermal elongation characteristics. Therefore, those manholes that have been constructed for SCFF cables sometimes need to be expanded when replacement with XLPE cables is scheduled. This increases replacement costs and extends the construction period.

To solve this problem, we tried adopting pre-molded one-piece joints with rubber block insulation, which are smaller and easier to install than conventional joints, as cable joints in existing confined manholes. However, in order to install

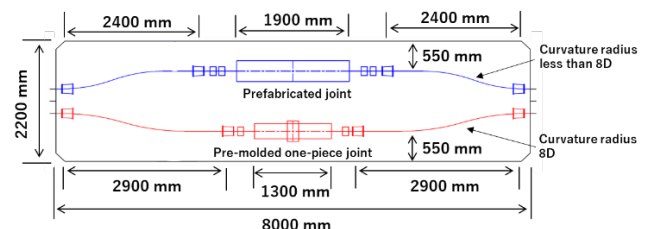
an EHV (275 kV) pre-molded one-piece joint into a confined manhole, we need to check whether any failures caused by thermal behavior of cables due to fine offsets would occur during operation under load [2, 3]. Therefore, we conducted various tests on EHV pre-molded one-piece joints under conditions of confined manholes to verify their applicability.

Furthermore, since we successfully completed on-site construction, we would like to report the progress and results.

APPLICATION OF PRE-MOLDED ONE-PIECE JOINT FOR CONFINED MANHOLES

A pre-molded one-piece joint consists of the main insulation part, which comprises a rubber block unit that shrinks at room temperature. Its insulation performance (surface pressure) at the interface between the cable and unit is maintained by the shrinkage force of the rubber block. Compared with a conventional prefabricated joint (PJ), a pre-molded one-piece joint has fewer parts in the main insulation section, and is both smaller and easier to install. Pre-molded one-piece joints have therefore become the favored XLPE cable joints in recent years. Especially in the EHV class, pre-molded one-piece joints have already adopted for many directly buried cable installations around the world.

Figure 1 below shows an offset simulation of a cable connection in a confined manhole for a duct installation system. The size of the manhole is the actual size used for SCFF cable connections. When reusing an existing manhole to lay XLPE cables, although the minimum cable curvature radius of 8 diameter (8D) could not be kept by connecting with the PJ, it does appear to be possible when using a using pre-molded one-piece joint.



	Prefabricated joint	Pre-molded one piece joint
Cable size	275 kV XLPE	1 × 2000 mm ²
Manhole size	W 2,200 mm × D 8,000 mm × H 3,000 mm	
Offset length	2,400 mm	2,900 mm
Minimum Curvature radius	795 mm (6.1D)	1045 mm (8.0D)

Fig. 1: Offset simulation in a confined manhole