Production Line for Sheathing of High Voltage Cable
UNIWEMA® HV
The specifications for high voltage cable require a special cable design. The cable core of such cables, i.e. inner conductor with insulation, can be provided with a metallic sheath. The used material (aluminium, copper, steel and even their alloys) has a very high stability and does not tend to intercrystalline corrosion.

The metal sheath with helical corrugation is water and gas tight. It ensures bendability and also high impact and pressure stability. Furthermore the metal screen is suitable to withstand earth fault current.

Nexans UNIWEMA® machines are available in various sizes, for cable core diameters of around 50 mm to more than 300 mm. For sheathing of High Voltage Cables the UNIWEMA® 200 is best suitable, as core diameters range from around 50 mm to 200 mm. The sheath can be applied continuously with, for instance, aluminium of approx. 0.5 mm to 2.5 mm wall thickness, depending on the cable core diameter in a very economic process compared with the conventional extrusion or press technology. Furthermore the UNIWEMA® machine for HV cable sheathing requires lower investment and operational costs. The design with the sheathed cable core produced on the UNIWEMA® machine, compares well and withstands the same tests as cables with extruded sheaths.
The UNIWEMA® Process

The UNIWEMA® process is designed to form a metal strip into a welded smooth or corrugated cable sheath. In this process, a metal strip is introduced into the machine and, in a single operation, the strip edges are trimmed and formed around a cable core. The opposing strip edges are welded. A split clamp caterpillar capstan located downstream from the welding station pulls the sheathed cable through the machine and, if added flexibility is desired, pushes it to the corrugation unit. The perfect coordination of the forming and welding operations with the split clamp caterpillar capstan is a precondition for obtaining a uniform welded seam, thus ensuring optimum product quality.

The design and the material of the several stages of the tube forming station are dictated by the characteristics of the metal strip, its wall thickness and the diameter of the welded tube. A wide range of forming tools for the most diverse applications is available. Specially optimized tool sets for new products can be developed and supplied. A precondition for obtaining a good welded seam is the accurate positioning of the strip edges at the welding point. They must exactly meet each other with a minimum gap. With the TIG (Tungsten Inert Gas) welding method the two strip edges are molten and welded together by an electric arc. The concentrated heat effect of the arc produces a narrow weld area, whereby the welding heat is quickly dissipated along the tube surface. A protective gas layer prevents the formation of an oxide layer in the weld area. A constant welding current is required to obtain a uniform good quality of the welded seam.

A current rise control (PLC) adjusts the welding current automatically to the capstan speed. The set welding current vs. manufacturing speed relationship for a given tube or cable sheath can be stored in a computer and retrieved whenever an identical product is to be produced. Restart of the welding operation without welding defects is possible after an intermediate stop.

The standard UNIWEMA® is equipped with a single electrode. In applications where the maximum allowable welding current with one electrode is insufficient for the welding of thicker strips or if higher speeds are desired the UNIWEMA® can also be operated with a 3-electrode welding torch system, Polyarc welder. For fully continuous TIG welding, Nexans has developed a new system called TwinTorch®.

Due to the performance of the UNIWEMA® technology (perfect coordination of strip forming, welding and split clamp caterpillar action) either CO₂ - or ND: YAG LASER can be also employed, depending on the material to be welded. The Laser welding process gives the further advantage of very small heat influence zones along the seam of the sheath.

The split clamps, mounted on a pair of capstan chains, securely grip the tube and prevent any torsional movements – an essential requirement for a uniform, high-quality welded seam. Depending on the tube diameter, properly dimensioned inserts are mounted in the split clamps. The contact pressure of the clamps can be adjusted, thus ensuring an optimal positioning of the tube, without any indentations or pressure marks on the tube surface. The split clamp capstan moves the welded tube to the corrugation unit. A freely rotating corrugating ring inside the corrugating head which can be adjusted in radial direction and in its angle imparts corrugations to the tube whereby pitch and corrugation depth can be set. In cable sheaths, the corrugated tube grips the cable core tightly. Through choice of a suitable corrugating tool helical or annular corrugations can be produced.
Several types of UNIWEMA® machines are available, ensuring optimal production conditions for a specific diameter range.

**Overview**
The complete line consists of the following major sub-units:

- Cable core pay-off
- Strip pay-off
- Forming table
- Welding station
- Split clamp caterpillar capstan
- Corrugation unit
- Cable take-up
- Electrical equipment
- Accessories for continuous production

**Cable core pay-off**
Different types of cable core pay-offs can be installed in-line with the UNIWEMA®. We do recommend traversing portal pay-offs which are synchronized with the line speed via dancer.

**Strip pay-off**
The design of the strip pay-off depends on the packaging of the metal strip supply. It can be supplied with a number of desired accessories, e.g. with horizontal shifting and vertical lift unit.

**Forming table**
The following sub-units are mounted on the forming table: strip brake and strip edge guide, strip edge trimming unit and the strip forming tool. The welding torch with a video microscope is mounted at the far end of the forming table.
The metal strip must be completely free of dust and grease and the strip edges must be free of oxides. This is a precondition for obtaining a perfect welding seam, which is particularly important in TIG welding. In order to obtain oxide-free strip edges, the strip must be slightly trimmed on both sides, which is accomplished by rotary knives. The waste strip is then transported over guide rollers to take-up spools located on both sides of the forming table. The waste strip take-ups are tension controlled. The width of the cut strip can be adjusted during the set up of the operation, thus obtaining the required strip width for the subsequent forming step. The separate stages of each forming tool are mounted on its own base plate and adjusted so that the base plate can be lifted easily and replaced by another forming tool, whenever a change of type or diameter is desired.

A complete tool set consists of a base plate with forming stages, clamp inserts, calibrating rolls, guide bushings and the corrugating tool.

Changeover from one diameter size to another can be accomplished in a very short time. In cable sheathing the cable core is introduced into the forming station. The material, design and the number of forming stages are determined by the strip material, the wall thickness and the tube diameter. Besides surfacatreated steel especially developed plastic material – e.g. for forming aluminium and stainless steel strips – are applied.

In cable applications where a smooth sheath is required, the welded envelope is drawn down to its final dimension through reducing rollers or a drawing die process.
The welding station with the TIG welding head is located in the center of the UNIWEMA® machine. The design concept is based on the requirement for a reliable continuous operation of the machine whereby, after a production stop, an automated restart is assured. For this purpose, the welding head is movable in all three directions in its mounting. For the start of the machine, the welding head is moved perpendicularly to the seam to be welded and placed in the working position, adapted to the tube diameter. From this position, the welding torch is lowered by a motor to a location above the seam and via an electronically controlled distance adjustment placed in the proper working position. It is also possible to move the welding head in the direction of the welded seam to ensure restart without welding defects.

The welding equipment consists of the welding torch, control units (video microscope, camera and monitor) and exhauster.

The welding electrode in the welding torch is water-cooled and can be vertically moved. A protective gas is supplied through a nozzle, which envelops the welding arc and the weld area in order to prevent oxidation of the molten area and the heated metal surface.

For fully continuous TIG welding, Nexans has developed its new system called TwinTorch®. The TwinTorch® system consists of two torches, control program and two welding rectifiers. If the worn out electrode has to be changed the PLC controlled process will ignite the second torch. The worn out electrode now can be exchanged easily.

The TwinTorch® technology ensures an uninterrupted, high quality welding seam without any welding defects.

For Laser welding standard Laser welding sources can be employed with a modified welding optic matching the characteristics of the UNIWEMA machine. The choice of the type of Laser (CO₂ or YAG) depends on the strip material to be welded and the wall thickness.

The contact pressure of the clamps can be adjusted so that no indents are made on the tube. Another important function of the clamps is to absorb the torsional forces generated, for instance, by an optional subsequent corrugating operation.

The split clamp caterpillar capstan pulls the strip and the welded tube through the different stations of the UNIWEMA® machine. For this purpose, the clamps, which are mounted on two capstan chains, grip the welded tube. The clamps incorporate inserts, which correspond to the outer diameter of the tube.

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Corrugation unit
In the manufacture of corrugated tubes or cable sheaths the welded smooth tube is conveyed to a chamber where it is rinsed with cooling and lubricating liquids and corrugated by means of a freely rotating corrugating tool. The standard operation produces a helical corrugated tube. A special tool is available for the production of annular corrugations. The ratio of corrugation RPM to pull-off speed can be continuously varied, making it possible to produce corrugations of different shape and pitch.

Cable take-up
Different types of cable take-ups can be installed in-line with the UNIWEMA® HV. We do recommend traversing portal take-ups which are synchronized with the line speed via dancer.

Drives, control and welding equipment
The split clamp caterpillar capstan and the corrugation unit of the UNIWEMA® machine are driven by two separate motors. This makes it possible to vary the corrugation RPM independently of the production speed. During operation, the corrugation RPM are automatically adjusted to the capstan speed so that the corrugation pitch remains constant. The welding current depending on the production speed is PLC controlled. The automatic control adjusts the welding current to the manufacturing speed. Protective gas for the welding torch has to be supplied from a central gas supplier i.e. a bottle battery. Optionally a gas supply equipment for bottles can be offered. The required accessories (pressure reducers, flow meters and monitors as well as gas mixing valves, if required) are located in the electrical cabinets.

Accessories for continuous production
The continuous operation of a production line for sheathing cable cores with metal strips requires a reliable method for splicing the end of one strip length to the beginning of the next without interruption of the cable production. The usual strip preparation line consists of double pay-off strip cross-welding device and accumulator. The cross-welding device and a cutting unit (guillotine) are placed in line between the strip pay-off and the UNIWEMA® machine, if the production process permits it. The cross-welding seam must meet the same quality requirements as the longitudinal seam produced on the UNIWEMA® equipment. For continuous operation a dual strip pay-off is needed. Also, in addition to the cross-welding device and the cutting unit, a strip accumulator with a straightener is required which supplies strip to the UNIWEMA® during the cross-welding process. This makes it possible to operate without stops.
Technical Data

The small wall thicknesses apply to small tube diameters whereas the heavier wall thicknesses are preferably used with the larger tube diameters. The type of welding system (TIG or LASER) used depends on the required wall thickness and tube materials. If required, the Polyarc TIG welding torch must be employed for heavier walls and faster manufacturing speeds.

For special applications it is possible to furnish UNIWEMA® machines for smaller or larger tube diameters. The largest machine supplied so far was for a smooth tube diameter of 450 mm.

### Technical Data of Standard UNIWEMA® HV

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth Tube Outer Diameter</td>
<td>mm</td>
<td>50 - 200</td>
</tr>
<tr>
<td>Corrugated Sheath Outer Diameter</td>
<td>mm</td>
<td>50 - 200</td>
</tr>
<tr>
<td>Standard Wall Thickness Steel</td>
<td>mm</td>
<td>0.5 - 1.5</td>
</tr>
<tr>
<td>Standard Wall Thickness Copper</td>
<td>mm</td>
<td>0.5 - 2.0</td>
</tr>
<tr>
<td>Standard Wall Thickness Alumin</td>
<td>mm</td>
<td>0.5 - 2.5</td>
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<tr>
<td>Standard Wall Thickness Metal</td>
<td>mm</td>
<td>On request</td>
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<tr>
<td>Line Speed Range</td>
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<td>2 - 8</td>
</tr>
<tr>
<td>Corrugation Speed</td>
<td>1/min</td>
<td>800</td>
</tr>
</tbody>
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