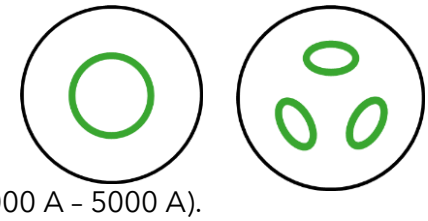
Layout options for pressurized air cables



Introduction

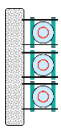
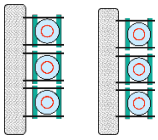
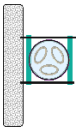
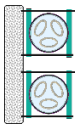
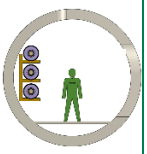
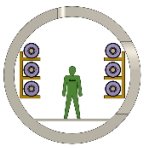
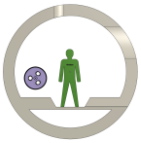
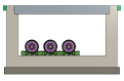
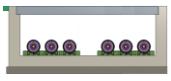
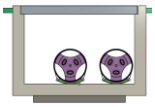
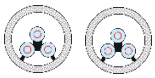
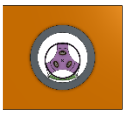
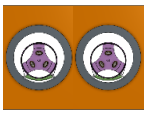
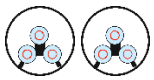
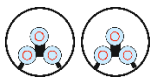
Hivoduct pressurized air cables (PAC) are designed to transmit electric energy at high voltage (12 kV – 420 kV) and AC currents (1000 A – 5000 A). They are built and used according to IEC 62271-204 standard. Three-phase systems require three conductors which can be arranged in single-phase or three-phase encapsulated designs to meet various technical, operational, spatial, and economic requirements.

Pressurized air cables are engineered to order to fit to the project specific ratings, the required layout, and interface specifications. The Hivoduct standard portfolio matches all ratings from medium voltage (12 kV) to transmission voltage (420 kV).

The layout requirements provided by the customer are analyzed to choose the most suitable encapsulation type, fixation and/or roller system. Installation, operational, and repair requirements provide additional input for choosing the optimum layout.

Overview of typical use cases and layout options

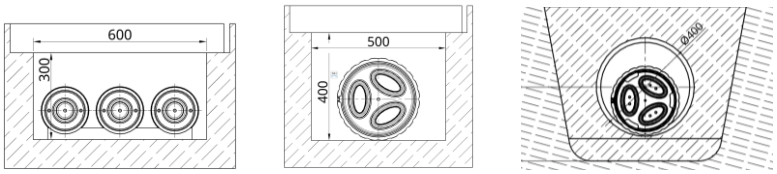
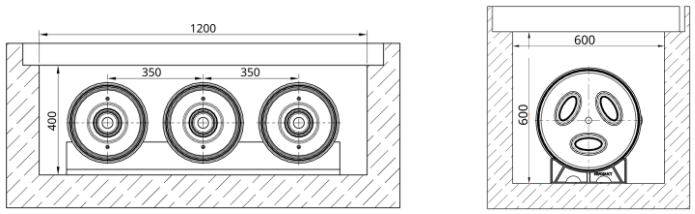
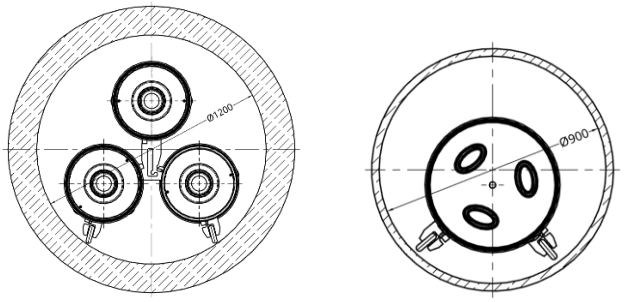
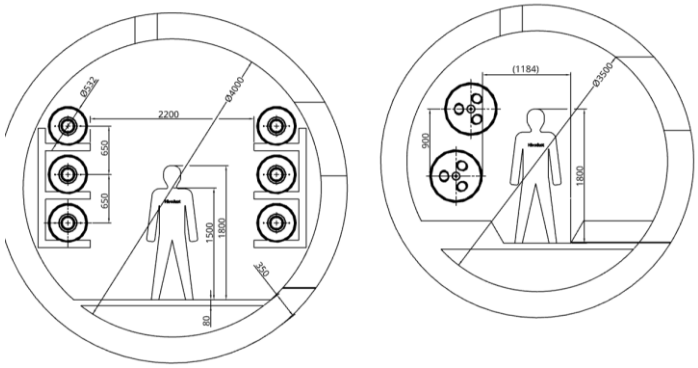
Pressurized air cables are versatile – therefore suitable engineering solutions for most project requirements can be found. The following table provides an overview of typical use cases.

		Single phase		Three phase	
Layout option	**Typical use case**	**1 System**	**2 Systems**	**1 System**	**2 Systems**
Along a wall, floor, ceiling, or structure	In substations and factories. Indoor and outdoor. Across a road. Usually elevated.				
In a walkable tunnel	Long-distance underground power lines. Below cities, through mountains. Gigawatt connections.				
In a concrete trench	Short- and medium distance power lines. On substations. In cities or factories.				
In a micro-tunnel	Short- and medium distance underground power lines. Below cities. Road and river crossings.				
In a drilled tunnel with lining	Short- and medium distance underground power lines. Below cities. Road and river crossings.				
In a pipe underground	Medium to long distance underground power lines. Rural. Dug trenches.				

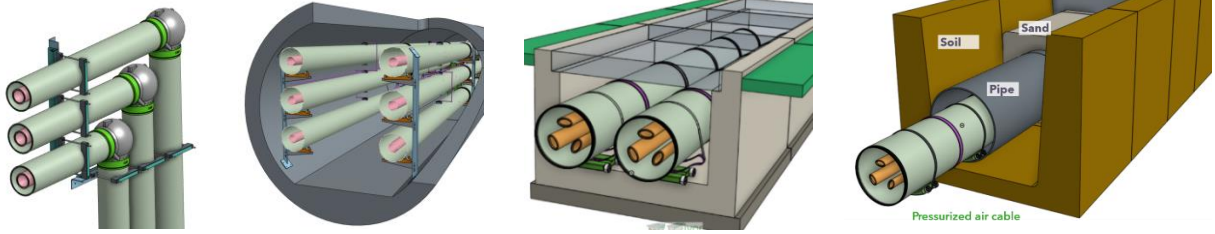
Minimum dimensions for typical layouts

Project specific requirements define the available dimensions for the placement of pressurized air cables. The minimum dimensions required by PAC depend on its ratings and

type of encapsulation (3 x 1ph or 1 x 3ph). The following overview provides minimum dimensions for typical voltage levels, current ratings, and layout options.

Layout option	Minimum construction dimensions
In trench, protective pipe: **52 kV, ≤3150 A. 3-ph** **Sn = 280 MW** **Sliding or on rollers** **Inside open CS: 0.12-0.2 m²** **CPD[1]: 350-500 MW/m**	
In trench, at wall: **145 kV, ≤3150 A** **Sn = 780 MW** **1-ph or 3-ph** **Fixed or on rollers** **Inside open CS: 0.36-0.48 m²** **CPD: 550 MW/m**	
In Pipe or Microtunnel: **245 kV, ≤4000 A** **Sn = 1600 MW** **Roller system** **1-ph or 3-ph** **Inside open CS: 0.63-1.13 m²** **CPD: 1000-1600 MW/m**	
In walkable tunnel **420 kV, ≤5000 A** **Sn = 3600 MW** **2 Systems** **1-ph or 3-ph** **Inside open CS: 0.12-0.2 m²** **CPD: 1500 -1800 MW/m**	

The actual layout including roller system, fixations, interfaces is always project specific. Here are some examples:



[1] CPD = Corridor Power density: Rated power per m width of the corridor.For comparison:
OHL: 2 systems 420 kV, 2 x 2000 MVA, 70 m corridor: **57 MW/m** !
XLPE cable: 2 systems 420 kV, 2 x 2000 MVA, 22 m corridor: **180 MW/m** !
Südlink: 2 x 525 kV DC: 2 x 2000 MVA, 22 m corridor: **180 MW/m**