CASE STUDY ZAGREB ELECTRIC TRAM

PMA Cable Protection Solutions for Light Rail

ABB cable protection helps shape new trams on one of the world's oldest operating tram systems

The Zagreb Electric Tram system and ABB forebear Brown Boveri were born in the same year — 1891. Today ABB is helping ZET put modern tram cars on the rails that are more comfortable and more reliable than ever before.

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01 Equipped with ABB's cable protection, ZET in Zagreb, Croatia transports more than 200 Million passengers each year.

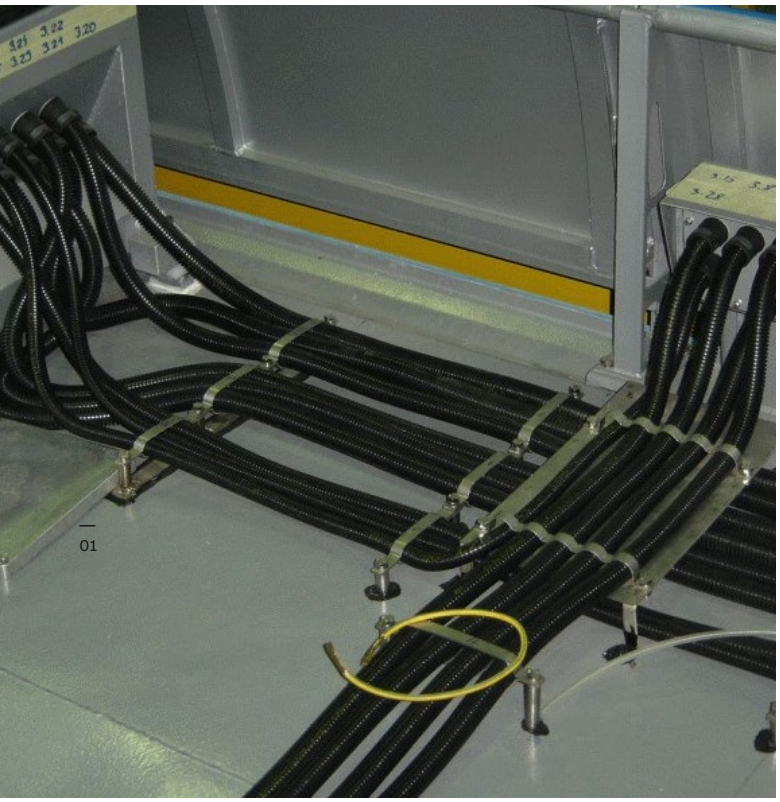
Operating on 117 kilometers of tracks, the ZET tram system is the soul of the highly developed transit system of Zagreb, Croatia. The system carries more than 500,000 passengers a day through the heart of a metro area of only 1.24 million people. At 200 million riders a year, the system about doubles the ridership of the Los Angeles County Metro Rail system in much larger Los Angeles, Calif.

Trams have operated continuously on the streets of Zagreb since 1891, but keeping them relevant and functional has required many updates. The most recent advance is one of the system's finest — the new, comfortable 100 percent low-floor TMK 2200. And to help bring the all-electric cars completely into the future, the primary builder of the TMK 2200, KONČAR Electric Vehicles, turned to a company that is helping to write the future throughout the world — ABB.

With an entrance height of only 300mm, the TMK 2200 provides a comfortable ride with air conditioning, ergonomic seats, rubber-cushioned wheels and a fine-tuned hydraulic suspension. The low-floor concept provides room for generous glazing, giving passengers a clear view of the picturesque streetfronts of Zagreb. In the control cabin, modern communication protocols connect the tram's key subsystems — the converters, brakes, suspension, doors and air conditioning — to an ergonomically designed, air-conditioned space, which results in a comfortable and user-friendly workspace for the driver.

Completely wiring a low-floor tram is a challenge. Cabling systems must be flexible, durable and weather resistant with casings that can squeeze into the tight confines of floors and ceilings and strong fittings that can reach flush mounted switches and indicators.

ORBAN TEHNIKA, a key distributor of electro-mechanical products to the rail and shipbuilding industries, helped KONČAR Electric Vehicles source PMA conduits and fittings from ABB to solve its key cabling needs.



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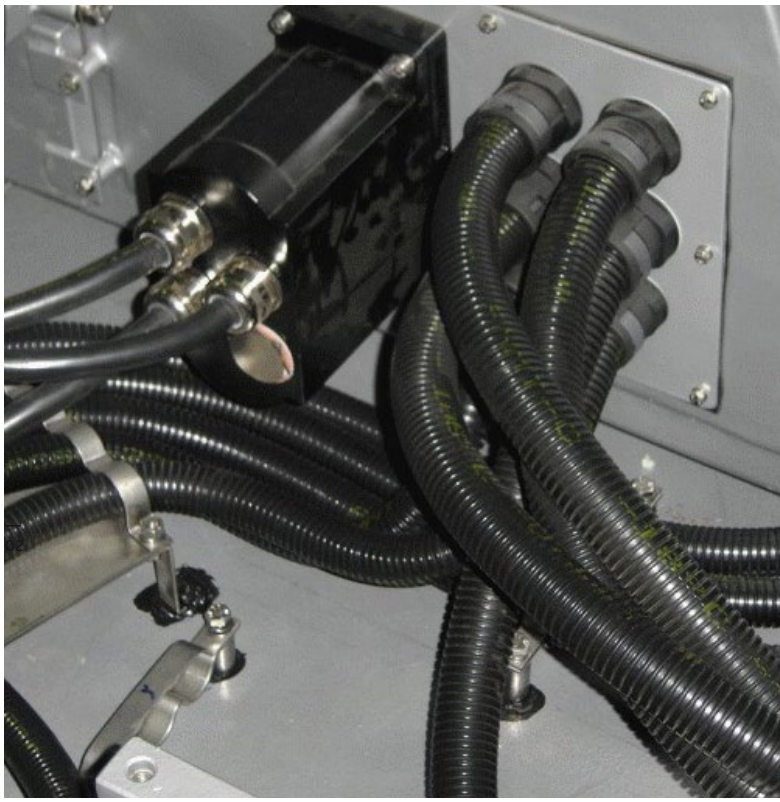

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01 Flexible PMA conduits fit easily on roof installations, and show a high weather resistance, especially against UV radiation.

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02 Outdoor connectors provide the highest grade of safety and sealing

As a result, tough PMAFLEX conduit with PMAFIX polyamide coated fittings are used for the roof and underframe applications of the TMK 2200, including connections that run through couplings to the bogie.

For the most exposed outdoor applications, the trams use PCS conduits from PMA with metal-threaded IP68 fittings for a tight grip.

Inside the cars, flexible yet strong VAML conduits carry the workload, aided by a wide range of connectors, Y and T pieces, supporters and accessories that have helped the tram's design engineers work their way through configuration issues.

"Low-floor tram cabling systems must be flexible, durable and weather resistant."

KONČAR requested a durability of at least 15 years for all products — a standard that ABB was able to meet or exceed.

Altogether, more than 126 km of PMA conduits and 51,000 fittings have been used to produce TMK 2200 trams for Zagreb's tram system. ZET ordered 140 five-car trams for delivery between 2005 and 2010, and shorter three-car trams are in the offing as well.

In projects ranging from the longest railway tunnel in the world to the mountain-climbing Rhaetian Railway line of the Swiss Alps, ABB's tough PMA cable protection systems are playing a key role in building the railways of the future.

From thousands of available PMA products, railroad design engineers can find solutions for a wide variety of tough

installation problems, ranging from wiring for outdoor signals to protecting railcar connection cables from grit, moisture, constant flexion and wide temperature variations. The quality and variety of the PMA product lines are backed further by ABB's reliable supply and exemplary technical support, all of which helps railroad engineers maintain their infrastructure efficiently and for the long term.

Products designed to withstand fire and ice
PMA polyamide-based cable protection systems offer superior protection against a variety of hazards. PMA products comply with all relevant fire prevention standards, including the new EN 45545 specifications. The flexible conduit lines resist chipping from ice or rock strikes, and some varieties are temperature tolerant down to – 50 degrees C.

"PMA conduits and related accessories from ABB proved their exceptional reliability during safety checks for more than 10 years," said Mr. Davorin Orban, managing director at ORBAN TEHNIKA, ABB distributor in Croatia.

"KONČAR Electric Vehicles, as producer of the low-floor tram TMK 2200, is extremely satisfied during the maintenance period of over 12 years with excellent PMA products' resistance to numerous environmental influences, particularly with its resistance to UV and cleaning agents," said Mr. Ivica Grskovic, head of the Electrical Control and Communications Division at KONČAR Electric Vehicles.

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01 PMA conduit is designed to withstand the constant flexion of tram car connections.
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02 Lower speed traction vehicles such as trams, metros and monorails are capital goods that need to be planned and evaluated for cost efficiency. Durable PMA cable protection minimizes the need for repairs and replacements.

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01 ABB offers a comprehensiv PMA cable protection portfolio of conduits, connectors, braids and accessories optimized in performance and cost

ABB and the Croation rail industry
KONČAR Electric Vehicles, Inc., is a leading Cr oatian and regional developer and manufacturer of low-floor tramcars, electric locomotives, and electric and diesel-electric multiple units. It is currently developing low-floor trams for wider tracks and extended temperature ranges, low-floor electric trains, diesel-electric trains, a multi-system electric locomotive and vehicle power systems with greater energy efficiency.

KONČAR attributes its decision to go with ABB for its conduit needs to two factors: The technical expertise and support offered by ORBAN TEHNIKA, combined with the quality and variety of ABB's products.

The working relationship between KONČAR and ORBAN TEHNIKA extends back more than 13 years and pr omises to continue into the future. Aided by the quality and ease-of-use of ABB products supplied to the TMK 2200 pr oject, ORBAN TEHNIKA plans to partner with KONČAR to help pr oduce 44 low-floor electric trains and diesel-electric trains for Croatian Railways, the national railway company of Croatia.

Facts about the Zagreb Electric Tram system
- **Location:** Zagreb, Croatia.
- **Population:** 790,000 city; 1.24 million metro area
- **Started:** First tram line opened Sept. 5, 1891
- **Distinguishing features:** One of the world's oldest continuously operating tram lines. Among the few that operates almost entirely curbside.
- **Size:** 117 km of tracks; 255 stations; 15 day lines; 4 night lines
- **Ridership:** About 500,000 passengers per day. Twice the ridership of Los Angeles County Metr o Rail in the U.S.
- **Power source:** Electric
- **Maximum speed:** 70 km/h or more, but in practice travel much slower on city streets
- **Rolling stock:** 137 older cars and 140 new low-floor TMK 2200 cars using ABB cable protection.

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