eddylab

2025/26

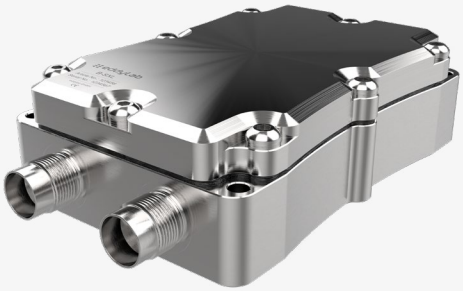
exhibition magazine

Inductive LVDT and eddy current sensors
precise position measurement in extreme environment

Nuclear-grade components
suitable for K1 and K3 environment

Qualification of sensor systems
for nuclear applications

displacement sensors & components for nuclear applications



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- eddylab - sensors built to perform

eddylab - we are an innovative company passionately dedicated to the development, design and production of sensors for displacement measurement, connectors, terminal boxes and protected cable connections up to complete system solutions. In addition to readily available products for a wide range of industrial applications, our strength lies in the development of customised sensor technology with subsequent nuclear qualification. In close cooperation with our customers, we perform all tests for the qualification process, such as EMC, seismic, radiation and LOCA test and prepare all the necessary documentation.

For many years, eddylab sensors have made an important contribution to nuclear power plant safety. Thousands of sensors in many countries detect critical movements of cooling and steam pipes through steam pipe monitoring.

Our portfolio includes sensors and components that can be qualified for use inside or outside the containment vessel in accordance with RCC-E or IEEE standards. eddylab follows a holistic approach providing the complete measurement chain up to the control room outside the containment vessel.

The design of each component is tailored for robustness and durability. Inside the containment building, all products are consistently designed inorganic and hermetically sealed. eddylab's range of nuclear-grade components withstand all environmental stresses and guarantee a long service life of up to 60 years.

Michael Reiter
CEO EDDYLAB GMBH

Engineering for safety-critical applications

OUR EXPERIENCE

eddylab's greatest competence is the development of inductive sensors (LVDT) and eddy current sensors and their adaptation to demanding customer applications. With over 25 years of experience in displacement and position measurement as well as hundreds of customized designs across all industrial fields, we offer wide expertise regarding sensor integration into technical facilities and nuclear power plants. In close cooperation with our customer, we develop sensors for displacement measurement, connectors, terminal boxes and protected cable connections as well as the necessary driver electronics including evaluation software.

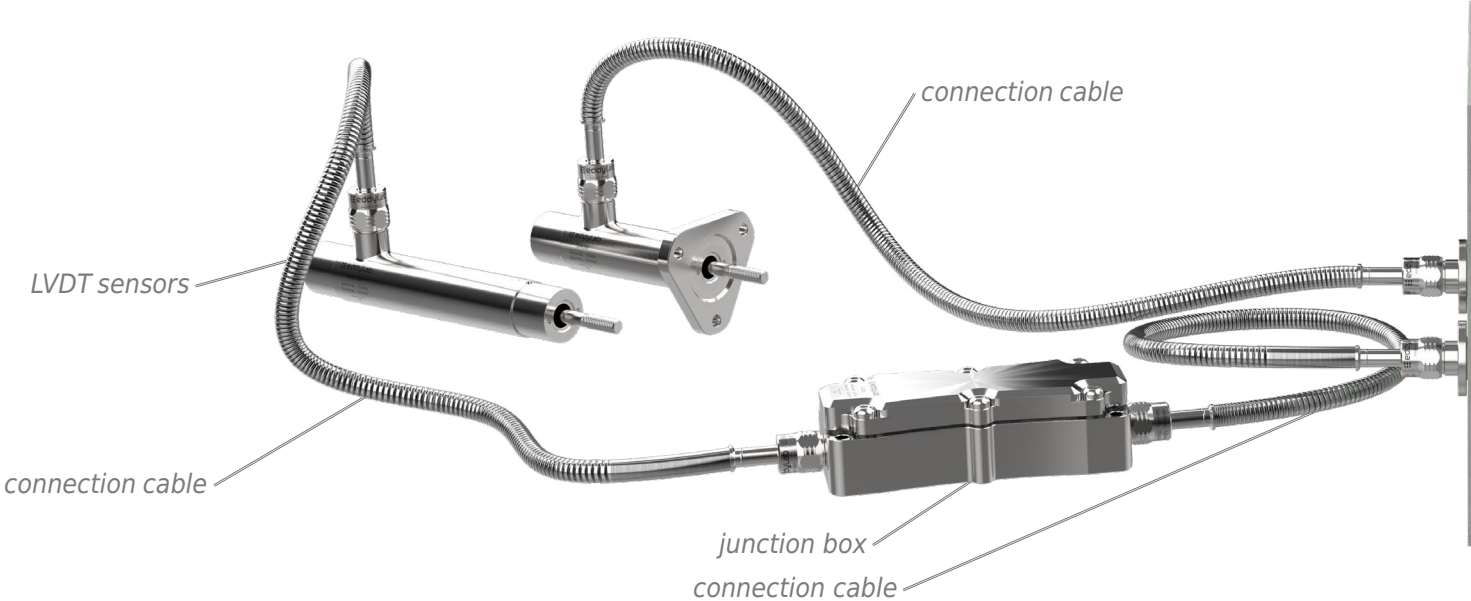
SPECIAL FEATURES OF NUCLEAR-GRADE PRODUCTS

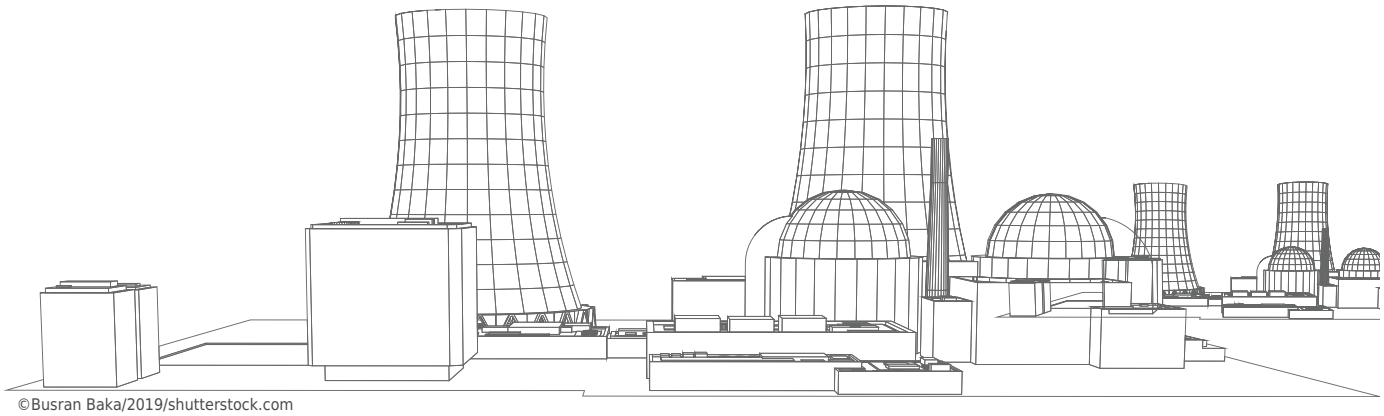
We at eddylab aim to eliminate limitations caused by environmental conditions. All our products are designed for a service life up to 60 years. This is achieved through the careful selection of suitable materials and the use of innovative manufacturing techniques. Products intended for “inside containment use” are made entirely of inorganic materials and withstand extreme conditions as

RADIATION > 850 kGy

TEMPERATURE > 400°C (750°F)

SEISMIC STRESS >6g ZPA

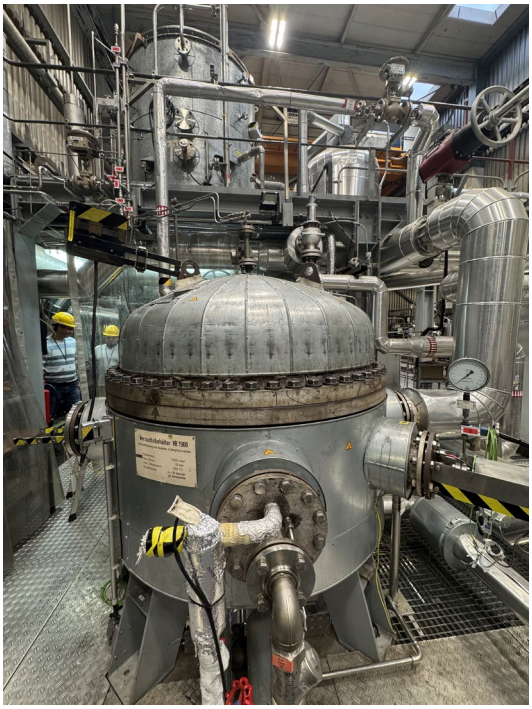




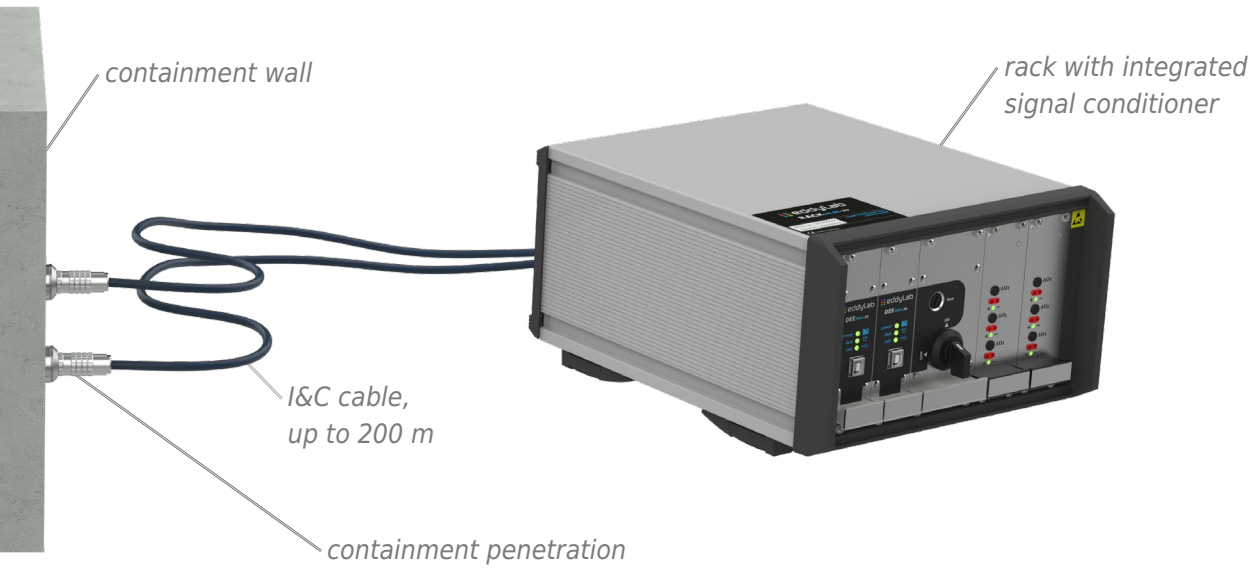
As a result, eddylab sensors do not undergo aging due to radiation or high temperatures. Thanks to their rugged design, our products withstand operational stresses such as severe accident conditions and seismic loads caused by earthquakes. Development, manufacturing and documentation are carried out in strict accordance with the nuclear RCC-E and IEEE standards.

NUCLEAR QUALIFICATION

eddylab qualifies nuclear-grade products for use inside and outside containment in accordance with RCC-E and IEEE standards. Rely on eddylab's extensive experience in developing sensor systems for challenging applications. To ensure full qualification, eddylab collaborates with a wide range of renowned testing laboratories to carry out all necessary tests.



LOCA test rig, Framatome, Karlstein



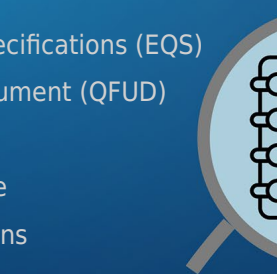
Qualification Process for K1 environment

REFERENCE TEST

- Visual inspection
- Dielectric tests
- Insulation resistance

QUALIFICATION DOCUMENTATION AND PRODUCTION

- Qualification Program (QP)
- Equipment Qualification Specifications (EQS)
- Qualification Follow-Up Document (QFUD)
- Reference File
- Equipment Identification File
- Manufacturing test specimens



PRE-TESTS

- Performing user-oriented tests
- Preliminary tests related to qualification

DEVELOPMENT OF FINAL SOLUTION

- Design and simulation
- Construction and testing of prototypes
- Creation of detailed drawings

CONCEPT PHASE

- Identification of requirements
- Outline of design, functions and technical components
- Development and evaluation of various solutions

LIMITS OF FUNCTIONAL USE

- IP protection
- Supply variation
- Electrical continuity
- Influence of temperature and humidity
- EMC testing according to IEC61000 and RCC-E

BEHAVIOR OVER TIME

- Temperature resistance, 600 cycles, wear aging 300 cycles
- Plugging and unplugging tests
- Mechanical vibrations
- Radiation aging
- Climatic tests: fast temperature variation, dry heat, damp heat, cold, prolonged operation

ACCIDENT AMBIENT CONDITIONS

- Seismic resistance tests
- Accidental radiation
- LOCA (loss of coolant accident)
- Post-LOCA-Test

FINAL REFERENCE TEST

- Visual inspection
- Insulation resistance
- Dielectric test
- Check of functional features

QUALIFICATION RESULTS & FINAL DOCUMENTATION

- Qualification Program (QP)
- Identification File (IF)
- Equipment Qualification Specification (EQS)
- Equipment Reference File (RF)
- Qualification Follow-Up Document (QFUD)
- Test Reports (TR)
- Qualification Summary Report (QSR/NSQ)
- Qualification File (QF)
- Qualification Preservation Report (FMQ)

ultra precise in extreme environment

INORGANIC LVDT-SENSORS

LVDT - INDUCTIVE TRANSDUCERS

LVDT displacement transducers from eddylab GmbH are inductive full bridges that work wear-free and have a theoretically unlimited mechanical service life. The differential measuring principle of our LVDTs ensures minimum temperature and EMC effects on the measurement results.

The LVDTs are characterized by their exceptional ruggedness and reliability under harsh conditions, despite their high resolution and repeatability. The sensors cover measuring ranges from 10 to 400 mm.

Most common nuclear applications are steam pipe monitoring of the primary and secondary circuit, structural health monitoring SHM, measuring positions of actuators, valves, hydraulic cylinders, shock absorbers of steam generators and pumps as well as position and diameter of nuclear fuel rods.
Our nuclear-grade sensors combine exceptional durability with innovative design. Their fully inorganic construction ensures excellent radiation resistance, while the robust design provides high resistance to vibration, shock, and seismic loads. Operation is highly reliably at temperatures up to 400 °C and feature hermetic sealing, including our patented connector system for maximum safety and long-term performance in the most demanding nuclear environments.

The differential measuring principle of LVDT sensors allows cable lengths of more than 200 m between sensor and signal conditioner without any loss of precision or reliability.
The electronics are installed separately and in a protected area outside the containment e.g. K3 environment.

KEY FEATURES | LVDT SENSORS

- **measuring ranges**
  10 - 400 mm
- **temperature resistance**
  up to 400 °C
- **construction**
  stainless steel housing, hermetically sealed, fully inorganic construction
- **high resolution and noise immunity**

high performance & maximum precision

EDDY CURRENT SENSORS

EDDY CURRENT SENSORS

Eddy current sensors detect the distance to metal objects without contact, dynamically and extremely accurate in a range of 0,5 to 40 mm.
The sensors are highly resistant to media such as oil, water, and dust within the measurement gap and are extremely versatile, making them ideal for applications involving high temperatures, vibration or underwater use.
For extreme applications eddylab offers the CT-series. In contrast to our standard eddy current probes, these sensors consists of a ceramic sensing element that is flush-mounted in a perfectly sealed stainless steel housing. Furthermore, a pressure resistant hose reliably protects the coaxial cable from mechanical damage. While conventional pressure resistant sensors solely resist pressurized media on their front side, the CT-series can withstand high pressures also on the cable connection of the sensor. Therefore, the sensor can be installed randomly.

KEY FEATURES | EDDY CURRENT

- **measuring range**
  0,5 - 40 mm
- **high precision, non-contact measurement**
- **high resolution (submicrometer)**
- **material housing**
  stainless-steel and ceramic housing
- **pressure-proof design**

Most common applications are measuring vibration or lubricant film thickness of rotating shafts, like turbines and pumps. In principle, eddylab´s eddy current sensors are suitable for all small movements of metallic objects that need to be detected precisely.

The digital TX signal conditioner is specially adapted to the sensor behavior and calculates an analogue and digital output signal proportional to the distance. The temperature coefficient of less than 0.015%/°C is unique for this type of sensor technology. Maximum performance is achieved thanks to the fast digital signal processor for highly dynamic measurements with excellent linearity of less than 0.1%.

Cabling Solutions
flexible, inorganic, reliable

CABLING SOLUTIONS FOR K1 ENVIRONMENT

eddylab offers cabling solutions that can be qualified for use inside containment (K1 environment). Cable lengths and connector configurations can be customized according to specific customer requirements.

Both the connector housings and the double-walled protective conduit are made of stainless steel. Thanks to eddylab's patented connector design, hermetic sealing is ensured — without the use of metallic o-rings or organic sealing materials, providing exceptional serviceability, minimal maintenance and long-term reliability.

The innovative design of the double-walled protective conduit ensures not only hermetic sealing but also prevents kinking or damage, maintaining the functionality of the cable system even under demanding conditions.

Preassembled and fully wired connection cables are available. Cable ends can be equipped with connectors or open leads.

CONSTRUCTION:

- Housing: Stainless steel
- Insulator: Ceramic
- Conductors: Nickel wires with inorganic insulation
- Contacts: Gold-plated bronze

KEY FEATURES | CABLE SYSTEMS

- **flexible and inorganic, double-walled metal conduit**
- **operating temperatures**
  up to 400°C
- **cable lengths**
  up to 50 m
- **pins**
  4-30
- **no mineral-isolated (MI) cables**
- **hexagonal nut**
  for quick coupling

Hermetically sealed Junction Boxes

for extreme environments

JUNCTION BOXES

Inside the reactor building, it is often necessary to connect or extend cables from sensors, safety equipment, and other instrumentation devices to reach the containment penetration or the control room. For this purpose, eddylab offers robust, hermetically sealed stainless steel junction boxes designed for demanding environments. The boxes have up to four cable inlets, allowing two cables to be connected.

Inside, there are temperature- and radiation-resistant ceramic terminal blocks. These junction boxes can be qualified up to K1 classification. Their construction is entirely inorganic, ensuring excellent resistance to radiation and high temperatures — continuous operation at temperatures up to 180 °C poses no problem.
Cable entry is achieved using eddylab's patented hermetically sealed connectors. Alternatively, customer-specific solutions or cable glands can be integrated upon request.

KEY FEATURES | JUNCTION BOXES

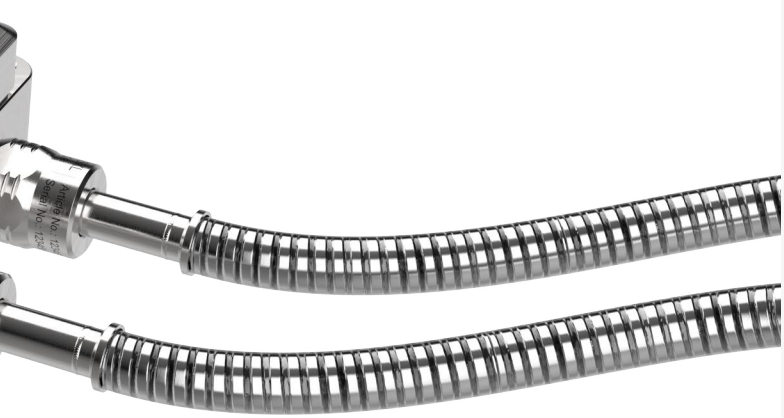
- completely inorganic construction
- connecting 1 or 2 cables inside containment
- features 2 or 4 cable inlets
- stainless steel housing
- inorganic components like ceramic terminal blocks and sealing
- hermetically sealed
- easy and quick connector system
- customized versions available
- permissible cross-section of wires: 0,5...6 mm²

eddylab´s junction boxes

secure sealing of critical connections

Junction Box A-SXL

Junction Box B-SXL



»With the DEEneo-3U, we've set a new milestone in signal processing technology.
It was developed for use even in demanding K3-safety areas and combines reliability with exceptional user-friendliness. Thanks to simple commissioning and configuration, the DEEneo-3U can be perfectly adapted to any measurement application, making it the ideal choice for modern LVDT measurement systems.«

Michael Reiter
CEO EDDYLAB GMBH

DEEneo

The DEEneo signal conditioner was developed for operating inductive LVDT sensors (full bridge). The electronics supply the sensor and convert the sensor signal into a standardized, analogue output signal with the help of a microcontroller.
The linearization of the sensor signal enables maximum precision. Installation and commissioning are effortless thanks to the USB connection and configuration software. For example, long cable lengths or installation tolerances can be compensated in seconds, and user-specific measuring ranges can be easily set.

KEY FEATURES | DEEneo

- fully temperature compensation
- digital signal processing
- high resolution, 16 bit
- easy configuration by software
- linearisation
- seismic-proof design for 19" rack integration
- cable break detection
- alarm and switching outputs

Signal Conditioner

digital signal processing

Powerful. Precise. Plug-and-Play

TX ELECTRONICS

The digital TX signal conditioner is specially designed for operating eddy current sensors. Thanks to fully digital signal processing by a powerful microcontroller, sampling rates of up to 140 kS/s are possible. The TX measuring system is characterized by excellent linearity of below 0.10 % and extremely high resolution of up to 30 nm. It comes with analogue and digital outputs as well as the eddyMOTION software for configuration, data logging, visualization and analysis of mechanical motion. The TX signal conditioner enables the customer to perform a traceable calibration of their sensors on site - a unique feature of the eddylab TX measurement system.

RACK INTEGRATION

DEEneo-3U was designed for installation in 19“ racks with a seismic-proof design. This allows the system to be qualified for K3 environment.

These racks can accommodate up to 8 DEEneo-3U signal conditioners as a cost-effective and space-saving solution. To increase reliability, the racks have their own redundant power supply, either 24 VDC or 230 VAC.

The cable connections for power, sensor and signals are located on an easily accessible backplane and are designed with spring-loaded terminals for maximum reliability.

Desktop versions are available, see illustration.

Out of the Containment

Hermetical cable feedthrough

CABLE FEEDTHROUGH

The eddylab cable feedthroughs allow electrical signals of sensor, control and instrumentation cables to be safely transmitted through a structure, out of a severe environment. At the same time, they serve as a gas-tight and leak-proof barrier. The cable penetration is made of a stainless-steel housing and contains a ceramic contact insert. For applications completely within the containment, eddylab uses its patented connector on both sides to ensure hermetic sealing. In case of a classic containment feed-through, the second side is outside critical environmental conditions and various technical solutions are available for the installation of cable glands or commercially available connectors.
All components are inorganic, high temperature, radiation, and pressure resistant – and therefore non-aging, making it a superior choice to withstand challenging accidental conditions.

POSSIBLE APPLICATIONS

Feedthroughs are often used to route cables through the wall of the containment or the lid of the reactor pressure vessel.
The design is highly customizable to suit local conditions. Length, diameter, and number of poles can be modified as required. The non-critical side of the penetration can also be equipped with a thread so that a cable gland or connector of the customer´s choice can be installed.

KEY FEATURES | CABLE FEEDTHROUGH

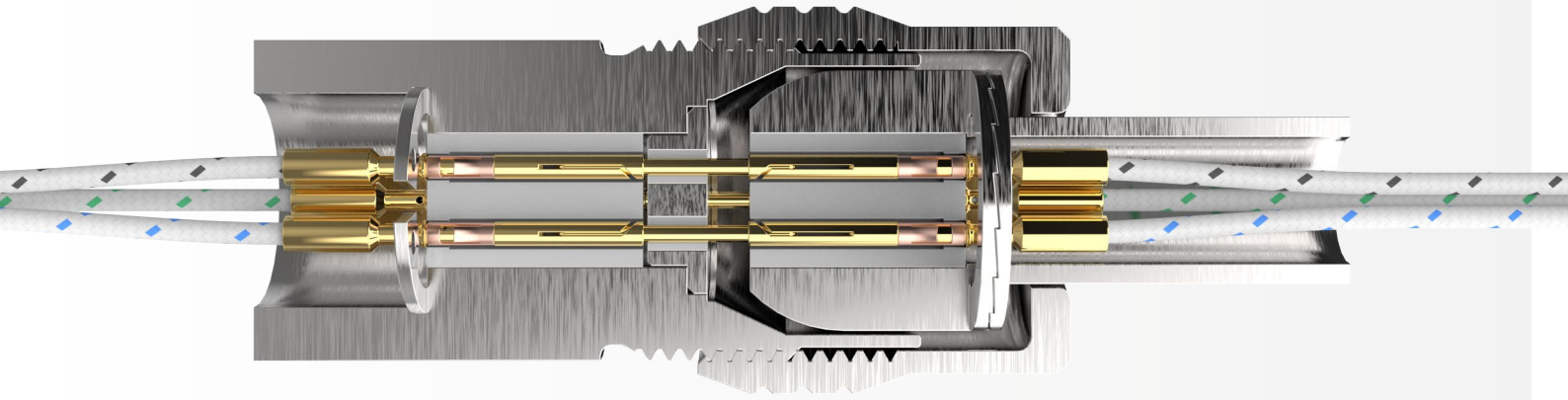
- customizable design
- containment side with patented connector
- second side according to requirements
- hermetically sealed
- ceramic-metal bonding
- inorganic construction
- high temperature, radiation and pressure resistance

Connector Systems

guaranteed hermetic sealed

CONNECTOR SYSTEMS

eddylab offers connectors that are suitable for high temperature or high radiation environments due to inorganic construction. They are available in different sizes and various number of poles. The patented connection for “inside containment use” provides maximum safety through hermetic sealing without any use of additional sealing materials, reduces installation effort to a minimum, and increases service life.
The ball-cone connection between the plug and mating connector enables hermetic sealing without an additional sealing element and forms a detachable plug connection. The pin insert is hermetically sealed by welded connections. The signal-carrying pin contacts are installed in the connecting element with a ceramic insulator. The connection is hermetically sealed in both plugged and unplugged states.



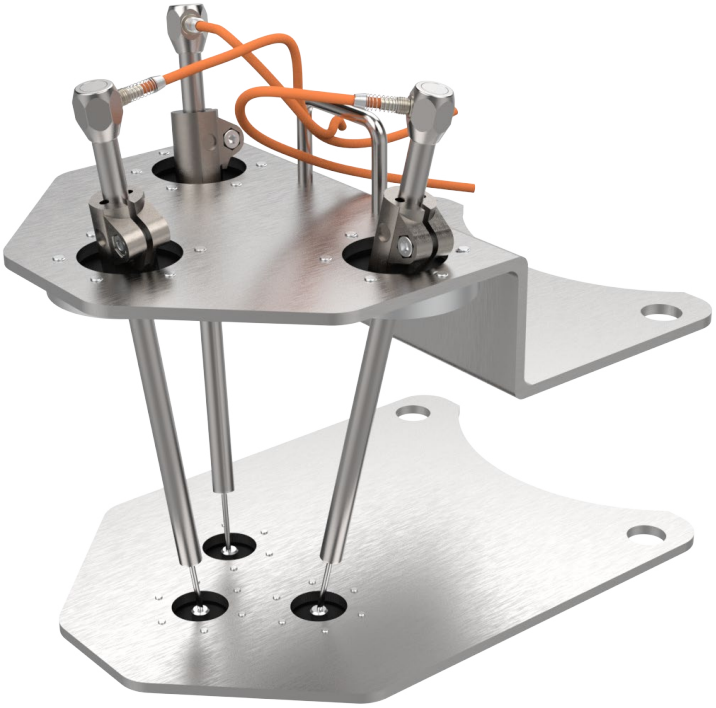
KEY FEATURES | CONNECTOR SYSTEMS

- patented sealing system
- inorganic construction
- high temperature and radiation resistance
- easy locking system with hexagonal nut
- guaranteed hermetic connections
- maintenance free
- anti-loosening protection by self-locking washer

Steam Pipe Monitoring

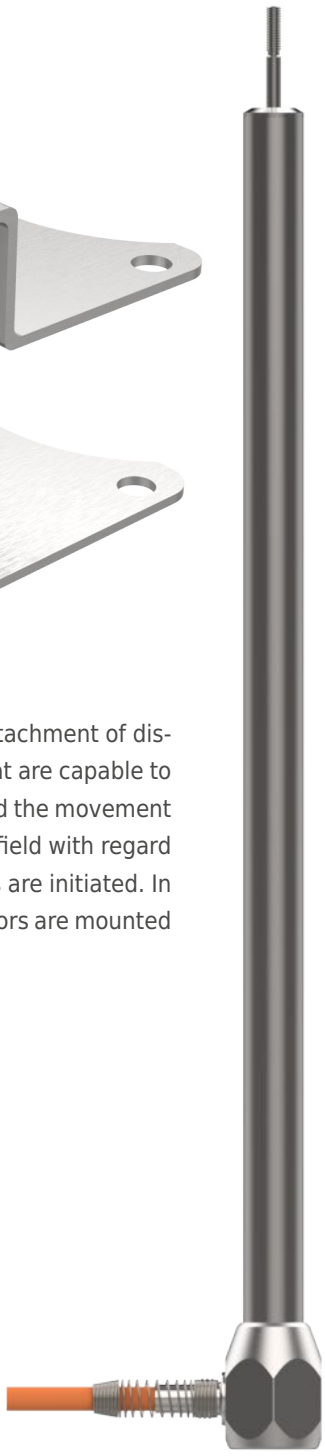
SAFETY FIRST

LOCA describes a loss-of-coolant accident in a nuclear reactor that can be caused by a damaged piping system. The initiating causes can be various, such as earthquakes, aircraft crashes, tsunamis or water hammer effects.
Due to catastrophes like Fukushima in 2011, safety installations have become more important and existing nuclear power plants are going to be upgraded.



FUNCTIONALITY

The result of the above-mentioned causes can be a deformation or even a burst of the steam pipes, a critical component that ensures cooling of the reactor core. Therefore, it is mandatory to constantly monitor safety-relevant plant components such as pipelines for coolant and superheated steam and, if necessary, to be able to shut them off immediately by closing safety valves. An effective and well-proven safety solution consists of the attachment of displacement transducers to the pipeline system. This is done preferably by the use of LVDT sensors that are capable to withstand challenging LOCA-conditions. The inductive displacement sensor transmits the position and the movement of the pipeline as a signal to the control station. If a value exceeds the previously defined tolerance field with regard to the maximum permissible pipe displacement, an alarm is activated and further safety procedures are initiated. In order to reduce the movement of pipelines, shock absorbers are installed at critical points. LVDT sensors are mounted parallel to the absorber cylinders and measure their travel range continuously.



KEY FEATURES | STEAM PIPE MONITORING

- well-proved: thousands of sensors installed in NPPs around the world
- LOCA-proof design, laser-welded sensor housing
- measuring ranges 50...300 mm
- operating temperatures up to 200°C
- pressure resistant up to 10 bar
- cable length between sensor and signal conditioner up to 200 m

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