

INDUSTRY

Vibration reduction for industrial plants

VIBRATION REDUCTION
SUPPORTING ACCORDING TO SPECIFICATIONS
VIBRATION CONTROL
INNOVATIVE TECHNOLOGIES
COMPREHENSIVE RANGE OF PRODUCTS
OPTIMUM, TAILORED SOLUTIONS
INTERNATIONAL STANDARDS
COMPREHENSIVE MANUFACTURING EXPERTISE
INDEPENDENT QUALITY MANAGEMENT
INTERDISCIPLINARY TEAMS
WIDE RANGE OF SERVICES
EXTENSIVE EXPERIENCE
GLOBAL PRESENCE
HIGH EFFICIENCY

VICODA

Your global partner for vibration and bearing technology

As a highly specialized company in vibration and structural bearing technology VICODA is engaged in the industrial, railway, structural engineering and bridge construction sectors.

The comprehensive range of products, consisting of spring elements, dampers, structural and bridge bearings as well as the global positioning of the group of companies are the basis to develop and provide efficient on site advice and the optimum and individual solution for the client.

Through utilization of our wholly owned manufacturing sites a high product quality is ensured and prompt delivery is guaranteed.

The VICODA group of companies does not only focus on one product technology but incorporates all important manufacturing and engineering methods within the group for the damping, limitation or isolation of unwanted vibrations.

Vibration control at industrial plants

From the problem analysis ...

To secure the ideal solution for a vibration problem a detailed engineering evaluation is necessary. As well as general consulting, VICODA offers the on-site measurement of vibrations through which the type and cause can be determined.

... to the definition of the solution and manufacturing of the products ...

The core competence of VICODA lies in the conceptual and detailed design of protective measures mitigating vibrations. Complex, static design calculations customized installation manuals and product manufacture complete our performance package.

... the installation and commissioning and ...

In addition to the provision of the necessary hardware, VICODA offers expert installation supervision or a complete installation service. Experienced engineers are available for the commissioning of all VICODA products performing on site result monitoring and final adjustments if necessary. Installation report, confirming "as built" characteristics, can be provided on request.

... the continuous control of operations.

The permissible range of operation of an industrial plant can be efficiently controlled through a monitoring system. For this purpose the applied products will be supplied with a corresponding sensor technology. This ensures early recognition of any change or damage to the system. Consequently service and maintenance programs can be planned and implemented based on the actual condition of the system.



Analysis



Solution finding
process



Product
selection



Product delivery



Installation
and startup



Vibration
monitoring

WORKFLOW

CONTINUOUS DEVELOPMENT
OF TOP QUALITY SERVICES
AND PRODUCTS



Technological expertise and product quality - a constant focus

Further development of innovative techniques

The continuous development of the product range is the essence of the VICODA corporate philosophy. This is ensured through a close collaboration with universities, design consultants, end users and the commitment of the VICODA experts in national and international committees.

In house testing expertise

Order related verifications or testing of new product developments can be performed in our own test laboratory. This is continuously enhanced according to developments in technical requirements. This asset ensures that functionally tests and material verifications can be rapidly completed.

Quality management in accordance with international standards

The global market requires compliance with a variety of different standards. This has been recognized in the development of the quality management system, thus ensuring that the appropriate documentation is always readily available.

The VICODA quality management system incorporates recognized procedures which comply with the quality requirements of the following established standards and technical codes:

- DIN EN (EU)
- VGB and KTA (DE)
- RCC-M (FR)
- MSS, ASME and ANSI (US)
- MITI and JEAG (JP)
- SPIR-O 2008 (RU)
- DIN EN ISO 9001
- ASME III Div. I Subs. NVA + NF
- KTA 1401
- RCCM-H

Comprehensive technical documentations can be provided upon request, e.g.:

- Certificates of compliance according to EN 10204-2.1
- Material documentations according to EN 10204-2.2
- Inspection certificates according to EN 10204-3.1/3.2
- Certificates of conformity
- Load calibration certificates

A close-up photograph of a hand with a finger pointing towards a metallic surface. The surface has a circular feature with the word 'HIGH' in large, bold, black letters. Below this, there is a black circular area with a white arrow pointing upwards and the words 'SERVICE LEVEL' in white, bold, sans-serif capital letters. A semi-transparent white box with blue text is overlaid on the image.

HIGH

OPTIMIZED PROCESSES, PRODUCTS
AND SERVICES GUARANTEE A HIGH
CUSTOMER SATISFACTION

SERVICE
LEVEL

Diverse vibration problems require customized solutions

Because of the size and complexity of industrial plants, the designer, plant manufacturer and operators are confronted with different vibration problems. These are caused by operating machines, the flow of different mediums through pipelines or external influences and require different solutions to control the vibration.

A solution aligned to the individual application can be developed through damping, isolating or tuning. Thereby the secure operation of the plant is ensured corresponding to legal and environmental requirements.

The following applications show exemplary different areas of industrial plants and the corresponding solution for the vibration problem.

SECURE SOLUTION
FOR THE MOST RIGOROUS
VIBRATION REQUIREMENTS



Rotating machinery does not always run smoothly

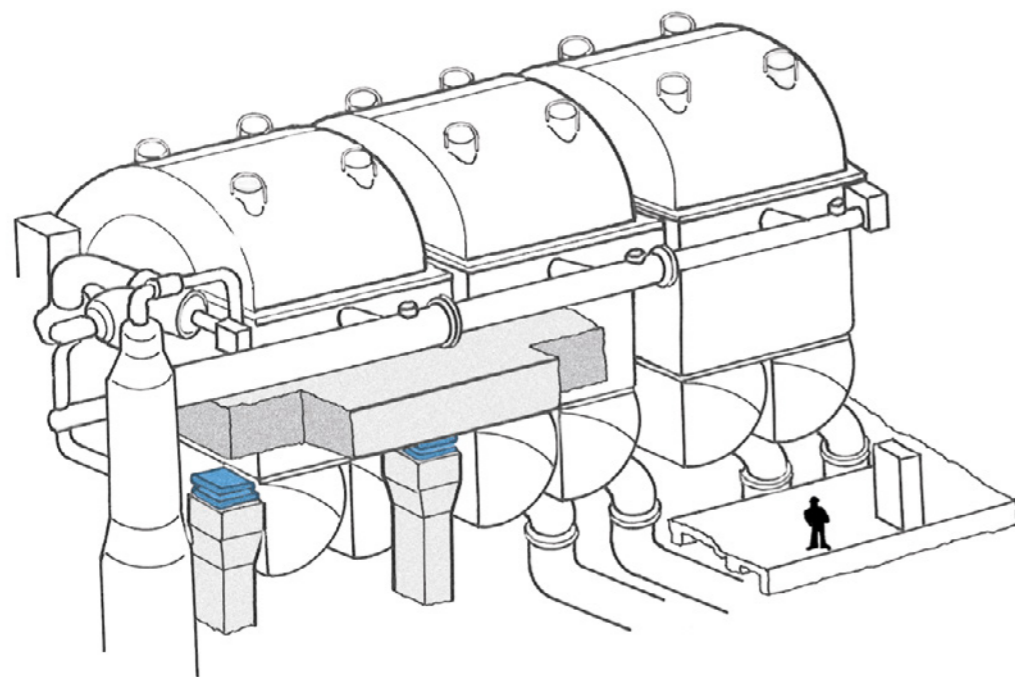
During the operation of a turbine or generator the rotational movement results in oscillating forces and torques that disturb the surrounding area. Exceptional cases like a blade fracture of a turbine or the bypass of a generator represent a special burden.

With pumps imbalances or rapid pressure changes, induced by operation, can lead to excessive vibrations in the whole piping system.

With axial and radial fans abrasion during operation can lead to imbalances, leading in the long run to vibrations in the surrounding area. These can spread to the connected pipelines and to the foundation.

The solution: vibration isolated support

To effectively reduce the spread of the vibration caused by the rotating machinery, a vibration isolated support is recommended. The resulting advantages will be depicted in an exemplary manner by the following industrial applications from the area of the power plant technology.



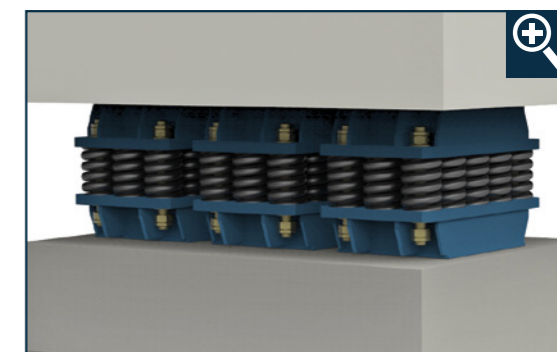
Foundation isolation of turbines and vibration protection



... of turbines

The vibration isolated support of turbines has the following advantages:

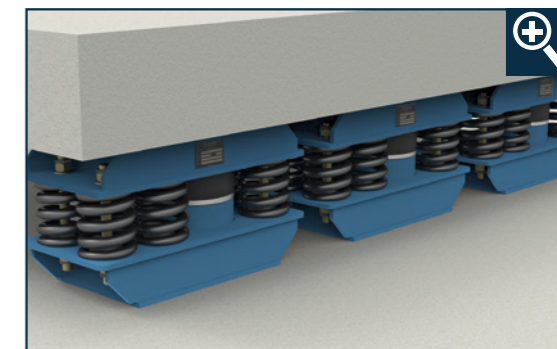
- Lower dynamic forces affecting the supporting structure and thereby smaller building component cross-sections can be used
- Larger space envelope for the installation of the surrounding capacitors and pipelines
- Easy, elastic compensation of unequal settlements
- Earthquake protection



... of pumps

The vibration isolated support of pumps has the following benefits:

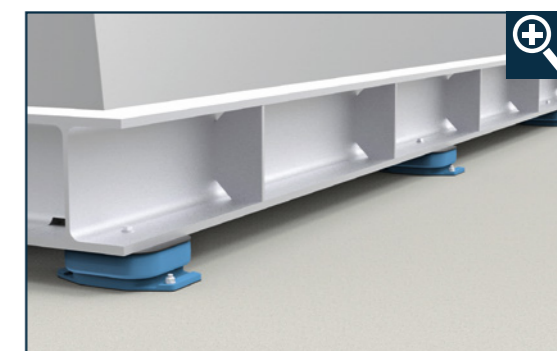
- Vibration reduction
- Easy, elastic compensation of unequal settlements
- Load redistribution
- Earthquake protection



... of fans

The vibration isolated support of fans has the following advantages:

- The possibility of direct bearing
- Reduction of induced dynamic forces into the ground and by that prevention of settlements
- Easy, elastic compensation of unequal settlements
- Easy leveling through shimming
- Defined damping of the fan through extra damping elements



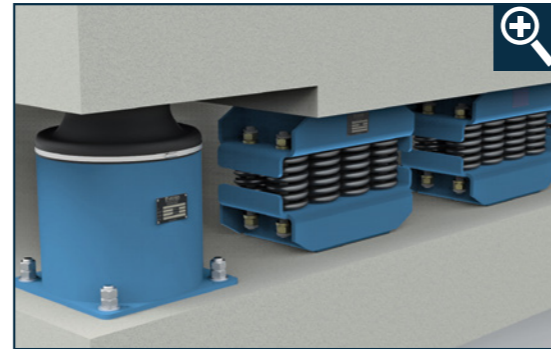
Source isolation of pumps and fans



... of coal mills

The vibration isolated positioning of coal mills provides:

- Noise and vibration protection for people, plants and surrounding building sections
- Reduced foundation costs
- Increased machine reliability and the operating performance
- Cost reduction because of reduced machine maintenance and through the prevention of downtime
- Elastic compensation of settlements in operation
- Earthquake protection



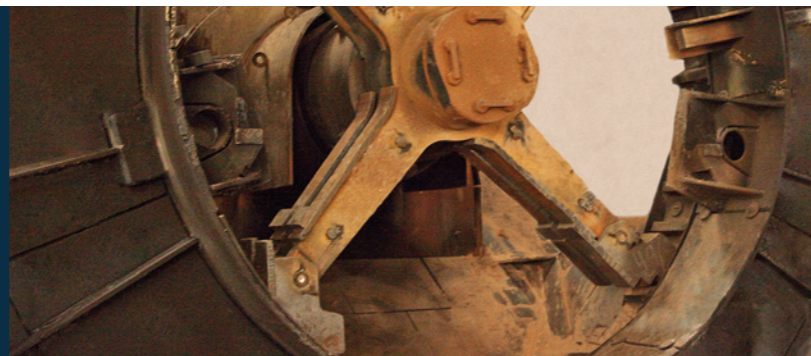
For the vibration isolation - a comprehensive spring element program

To facilitate vibration isolation of machines spring elements are incorporated. Specific series are available for a variety of different application scenarios. These are adjusted, manufactured and delivered according to the specific requirements. If necessary the spring elements will be equipped with a viscoelastic damper.

Product parameters

- Wide load range: 1 kN to 2,700 kN
- Fatigue strength in accordance with EC3
- Low natural frequency (1 Hz to 8 Hz) of the system and thereby the highest vibration isolation
- Horizontal spring rates from 20% to 130% of the vertical rate
- Can be preset and blocked so that a replacement is always possible
- Surface coating for corrosion categories up to C5 according to DIN EN ISO 12944
- Individual damping resistance with built-in dampers according to the requirements

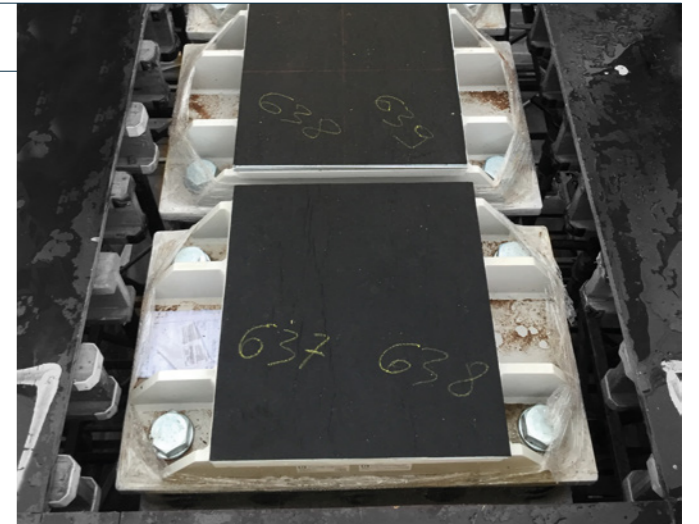
Reduced transfer
of vibration energy



Case study

Elastic support of a turbine

Plant type	Jaworzno Power Plant (910 MW)
Customer	Siemens AG
Country	Poland
Year	2015
Technical details	Turbine table m = 6,390 t, 910 MW
VICODA solution	Delivery and installation of 36 spring elements Load capacity per spring element max. 2,158 kN



Case study

Elastic support of an induced drought fan

Plant type	ENBW Kraftwerk RDK8 Karlsruhe (912 MW)
Customer	Howden Group Limited
Country	Germany
Year	2009
Technical details	Induced drought fan with a total weight of 500 t
VICODA solution	Delivery and installation of 28 spring elements, partly with integrated dampers Load capacity per spring element max. 412 kN



Optimal design for
challenging projects



Flow in pipelines leads to vibrations

Aside from vibrations caused by the machinery the flow of a medium through the pipeline can also lead to vibrations. This happens for example because of turbulent flow occurring with higher flow rates as well as through pressure shocks or water hammer induced by auxiliary equipment or startup of pumps or fans.

In the worst case vibrations could lead to a pipe fracture because (of high cycle fatigue) they reached the fatigue limit. Vibration control does not only pursue the target of a safe operation but also the maximization of the throughput of the medium and thereby the optimization of the productivity of the plant.

The solution: Damping or neutralizing

The reliability of the systems is more important when there are increased demands on efficiency, productivity and safety of plants and their pipelines. Consequently the dynamic properties of the pipelines play an important role. To reduce undesirable vibrations to a permissible level viscoelastic dampers, active damping devices (ADD) or tuned mass dampers (TMD) are used.

For damping - proven product series of viscoelastic dampers

Whenever a pipeline system cannot be isolated from the source of vibration, damping is an option to reduce the movement of the pipeline to a permissible degree. Through the movement of a piston within a viscous fluid kinetic energy is dissipated i.e. transferred into heat during operation. The absorption of static loads is not possible through a viscoelastic damper. For efficient damping they are installed in an upright position and normally in pairs located at those points where the highest amplitudes of oscillation occur. Because of the functional principle a rigid counter bearing is necessary. The dampers as well as the adjacent components can be customized designed, manufactured and delivered by VICODA.

Effective vibration reduction and damping



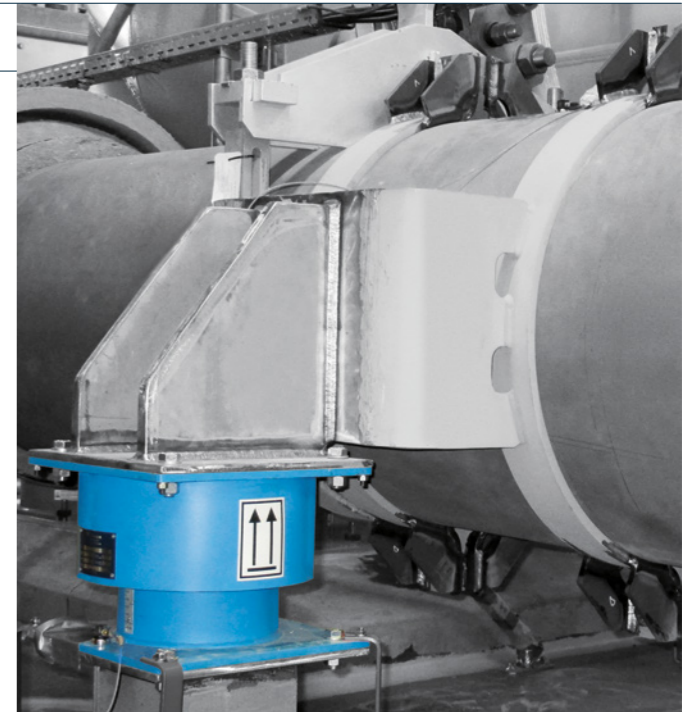
Product parameters

- Three kinds of viscoelastic mediums for different damping and temperature ranges
- Thermal expansion of 30, 40 and 50 mm
- Damping parameters can be adjustable over a wide operating range

Case study

Damping of an condensation line

Plant type	CHP
Customer	Kraftanlagen München GmbH
Country	Germany
Year	2016
Technical details	Deficiencies at the valves of the condensation line, because of cracks at the welding seams Inadmissible vibration velocities considerably above the permissible limits
VICODA solution	Vibration measurement Selection of the applicable viscoelastic damper Design and manufacture of the supporting steel structure Vibration reduction by a factor of 6



Development and implementation of an economical solution



For neutralization and damping - tuned mass dampers

Tuned mass dampers (TMD) are installed directly to the pipeline and require, in comparison to viscoelastic dampers, no rigid abutment. The application of a TMD is viable when a stationary excitation is present which lies primarily in the area of the system natural frequency. The TMDs are tuned to the applicable frequency and are in the position to reduce those vibrations. The effectiveness is primarily defined through the mass ratio between the mass of the TMD and the moving mass of the pipeline.

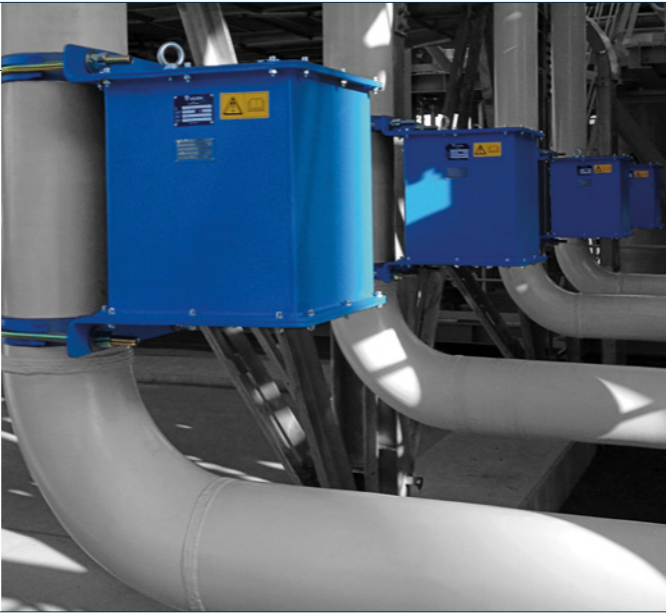
- VICODA TMDs can be equipped with innovative eddy currant dampers which have a number of advantages compared to conventional damping elements:
- Damping characteristics independent of external influences (especially temperature)
 - Damping characteristics independent of the shape of the vibrations and thus applicable in different operating states
 - High durability, free maintenance and proven reliability due to the contact-free energy transmission

- Product parameters
- Vibration reduction in one or two directions
 - Modal mass and damping individually selectable
 - No rigid abutment necessary
 - Easy installation

Case study

Passive neutralizing of a compressor aftercooler pipeline

Plant type	Chemical plant
Customer	Origin Energy Limited
Country	Australia
Year	2015
Technical details	Significant vibrations of a compressor aftercooler pipeline (DN250)
VICODA solution	Installation of TMDs Mass 350 kg Natural frequency 6.4 Hz (5.9 Hz) Damping 20% of the critical damping Vibration amplitude ± 9 mm



Ideal reduction of vibration through tuned mass dampers



Case study

Passive neutralizing of stacks

Plant type	Gas and steam power plant
Customer	General Electric International, Inc.
Country	Saudi Arabia
Year	2016
Technical details	Damping of wind-induced vibrations through vortex shedding on steel stacks
VICODA solution	Installation of passive TMDs Total mass 2.5 t Natural frequency 1.5 Hz



Active vibration reduction

Whenever there are excitations of different natural frequencies in a pipeline system e.g. in case of different operating conditions of a plant, an active damping device is the ideal solution.

Active damping devices consist of an inertial mass, connected to the pipeline by an actuator. The vibrations of the pipeline are recorded by a sensor and processed by the control unit. The actuator performs, with the help of the inertial mass, a countermovement thus reducing the vibration.

- Product parameters
- Eligible for multi frequency excitations respectively complex performance requirements
 - Effective for frequencies up to 200 Hz
 - For each module vibration control in one direction
 - Modules simultaneously applicable
 - No counter bearings necessary
 - Low tuning mass

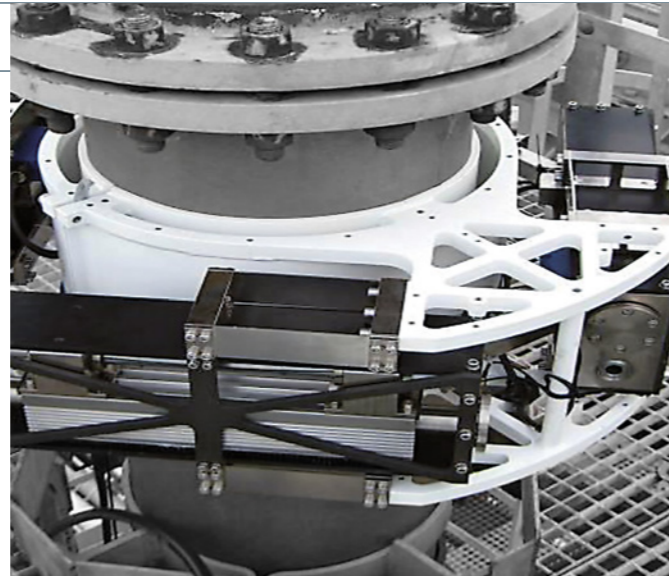
Compensating vibrations through opposite inertia forces



Case study

Active neutralization of a pipeline

Plant type	Chemical plant
Customer	Dow Deutschland Anlagengesellschaft mbH
Country	Germany
Year	2014
Technical details	Vibrations excitation of the pipeline through the ascending medium
VICODA solution	Installation of an active damping device Total mass 147 kg Frequency range 1-200 Hz



Seismic protection - a demanding task

Industrial plants located in earthquake areas require special protective measures, otherwise in case of a seismic event there is the possibility of impairment or even the destruction of the plant and the plant components. For effective protection and to prevent an expensive malfunction of the plant, VICODA has developed a technical solution preventing seismic impacts on the foundation. Customized solutions are designed, manufactured and installed depending on the application.

The advantages of these solutions are:

- A passive, permanent seismic protection
- The durability and an almost maintenance free system
- The effectiveness in all directions in space

Efficient safety concepts
to resist seismic loads



Reference projects (summary of the reference list)



Spring elements and viscoelastic dampers for vibration isolation

- Turbine table, pulp mill 200 MW, Uruguay, 2006, customer: Siemens AG
- Turbine table, processing plant for phosphates 660 MW, Morocco, 2007, customer: Siemens AG
- Turbine table, hydropower plant 230 MW, Germany, 2008, customer: Siemens AG
- Fan, steam plant, Germany, 2010, customer: Howden Group Limited
- Turbine table, thermal power plant 544 MW, Latvia, 2012, customer: Siemens AG
- Coal mill, coal power plant, Germany, 2013, customer: RWE AG
- Turbine table, heating and power plant 339 MW, Denmark, 2015, customer: Siemens AG
- Feed water pump, nuclear power plant 1330 MW, France, 2015, customer: EDF Group
- Turbine table, thermal power plant 910 MW, Poland, 2015, customer: Siemens AG
- Coal mill, coal power plant, Turkey, 2016, customer: Celikler Holding
- Feed water pump, coal power plant 600 MW, Thailand, 2017, customer: General Electric International, Inc.

Pipelines

- New Caledonia, 2015, customer: MH Wirth
- The Philippines, 2015, customer: Siemens AG
- Germany, 2016, customer: Stadtwerke München GmbH
- France, 2016, customer: ENGIE
- Greece, 2016, customer: Hellenic Petroleum SA
- Refinery, Qatar, 2016, customer: Qatargas Operating Company Limited
- Turkey, 2016, customer: Celikler Holding
- Belgium, 2016, customer: SVEX nv
- Coal power plant, Australia, 2016, customer: EnergyAustralia
- Coal power plant, Australia, 2016, customer: AGL Energy
- LNG, Qatar, 2016, customer: ASU Oil
- Coal power plant, Thailand, 2017, customer: General Electric International, Inc.



Active and passive tuned mass dampers

- Frequency range: 1 – 200 Hz, mass: 147 kg, pipelines, chemical plant, Germany, 2014, customer: Dow Deutschland Anlagengesellschaft mbH
- Frequency: 6 Hz, mass: 350 kg, pipelines, LNG, Australia, 2015, customer: Origin Energy Limited
- Frequencies: 6, 12 and 19 Hz, mass: 350 kg, pipelines, chemical plant, Germany, 2015, customer: Dow Chemical
- Frequency: 1.5 Hz, mass: 2500 kg, stacks, Saudi Arabia, 2016, customer: General Electric International, Inc.
- Frequency: 4 Hz, mass: 80 kg, pipelines, Refinery, Greece, 2016, customer: Hellenic Petroleum SA

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