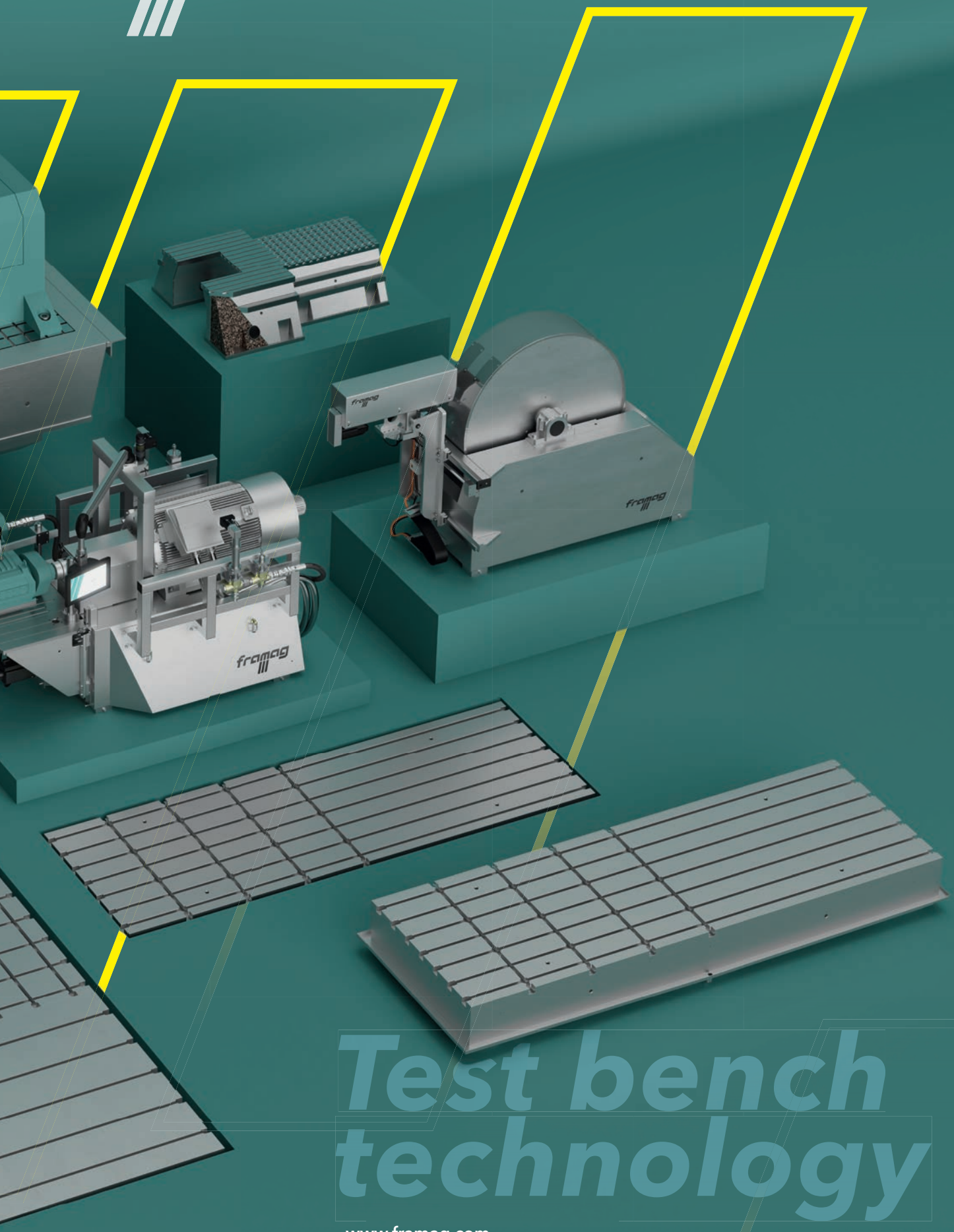
framag



# Test bench technology

www.framag.com

# Tradition & Innovation

**1979** Company foundation

**1986** Development machine beds

**1987** Development Hydropol®

**1989** Business unit sawing technology

**1996** Business unit torch cutting technology

**2020** Business unit test bench technology

## More than 40 years of company history, characterized by innovative developments

Worldwide success in industrial plant engineering - the history of framag begins in 1979 as a subsidiary of Lenzing AG. At the beginning, mainly machine and

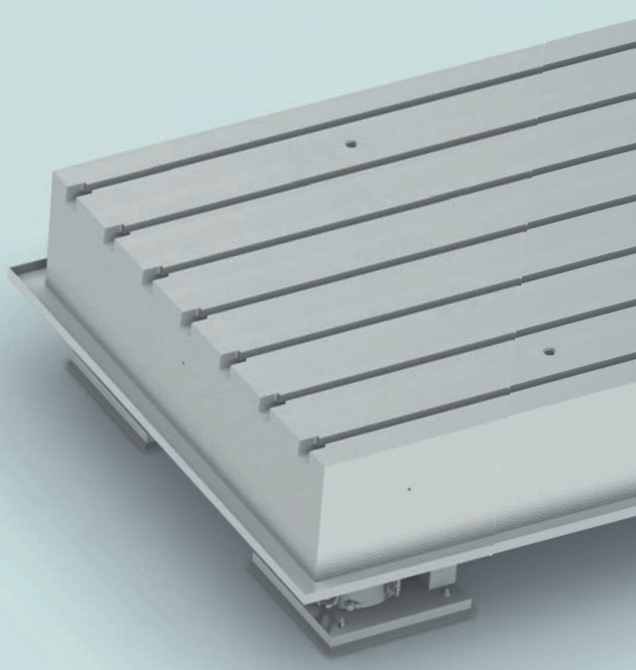
plant components were produced. Seven years later, the ambition to develop own products and to open up new business fields led to the development of foundations for machines. In addition, framag established itself in the plant engineering sector as a manufacturer of sawing and torch cutting systems for the global steel industry.

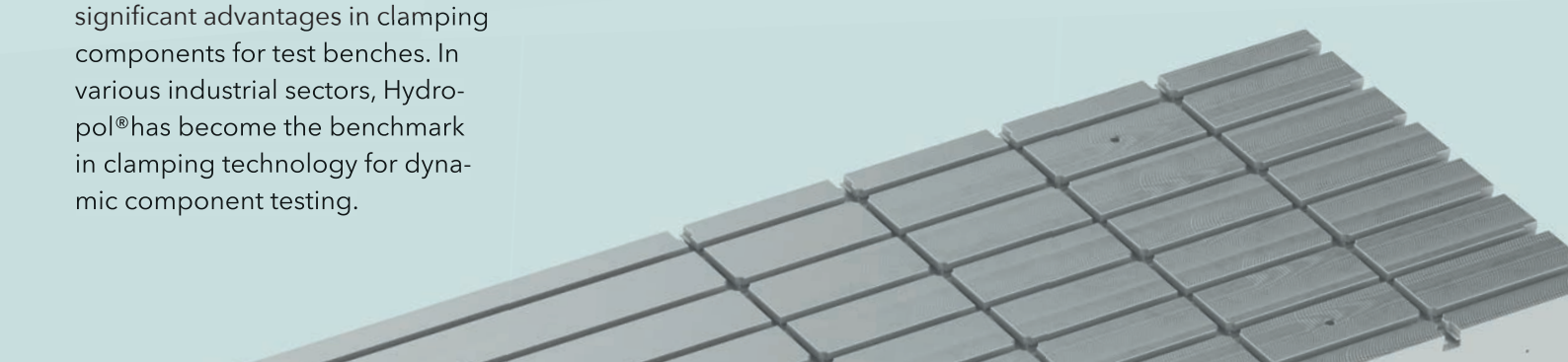
## More than 35 years of experience in vibration technology

The breakthrough in vibration technology was made with the development of the material Hydropol®, whose development is based on know-how in the production of machine foundations. In addition to its use in machine beds of metalworking machines, the damping properties also bring significant advantages in clamping components for test benches. In various industrial sectors, Hydropol®has become the benchmark in clamping technology for dynamic component testing.

## Test bench technology – the newest business unit

With the year 2020, the test bench technology was founded as an independent business segment. In addition to the production of individual components, framag offers the processing of subsystems as well as complete test systems as turn-key solutions. The high vertical range of manufacture at two European locations, an own software development team and more than 50 years of experience in the field of vibration technology make framag the perfect partner for all requirements of dynamic component testing.





# Hydro-pol®

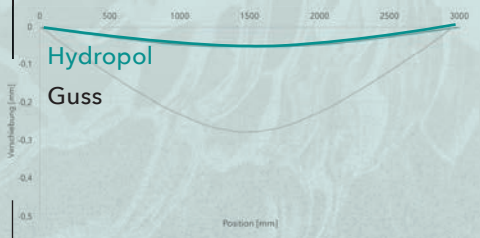
## Innovative material for machine beds and clamping components

- Up to 7 times higher damping than steel
- High dynamic stiffness
- Flexible model design
- Components up to 60t and 12m

Maximum precision is the decisive requirement in both test bench technology and mechanical engineering. Since its development in 1986, the Hydropol® composite material has been continuously refined in line with the requirements of the mechanical engineering and test bench industry. The structure of steel and a mineral filler ensures an optimized ratio of damping, stiffness and weight. The flexible model design and high performance make Hydropol® components the ideal material for clamping technology.

These components are completely individually adapted, designed and manufactured by framag to the test facility. Thereby, each Hydropol® component is specifically designed for the dynamic test application by FEM calculation methods, such as modal and frequency response analyses.

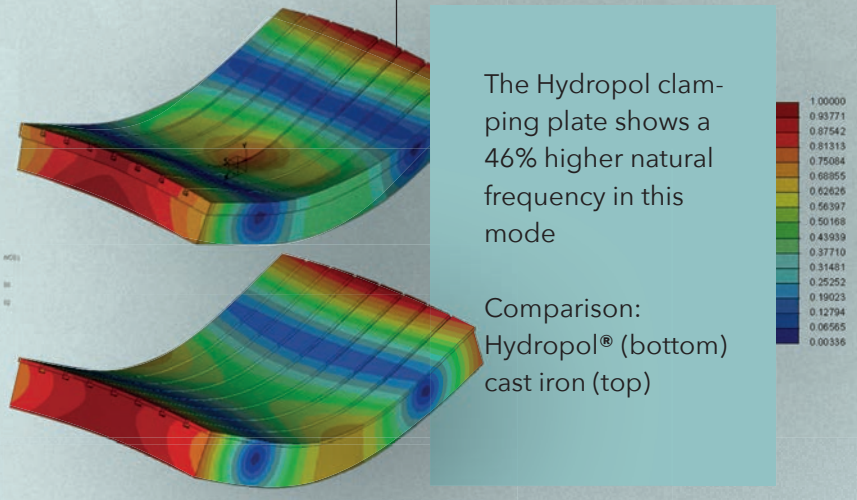
# Different fillers for individual requirements




The high flexibility of Hydropol® is supported by the selection of different fillers with specific density, compressive strength and stiffness. Different formulations allow a precise match between weight and damping, tailored to the application.

Deflection comparison of cast iron and Hydropol® clamping plates

- Load (workpiece): 10t - 750x1000mm
- Dimensions clamping plate: 2x3x0,35m
- Installation on 6 air springs



The Hydropol clamping plate shows a 46% higher natural frequency in this mode

Comparison: Hydropol® (bottom) cast iron (top)

## Sustainability is our standard

50% less $CO_2$ in production compared to cast components

Hydropol® components are 100% recyclable

No epoxy or polyester resins in the filler material

No formation of toxic gases when exposed to heat

## Hydropol®

Density
up to 2,500kg/m³

E-modulus
up to 60.000N/mm²

Compressive strength
up to 100N/mm²

## Hydropol® Medium

Density
up to 1.900kg/m³

E-modulus
up to 20.000N/mm²

Compressive strength
up to 30N/mm²

## Hydropol® Light

Density
up to 1.400 kg/m³

E-modulus
up to 15.000 N/mm²

Compressive strength
up to 16 N/mm²

## Hydropol® Superlight

Density
only approx. 800 kg/m³

E-modulus
up to 4.000N/mm²

Compressive strength
up to 10N/mm²

# Hydropol Hybrid design in detail - cross-section of an intermediate frame

The framag patented Hydropol® construction offers numerous advantages. The steel shell (so-called lost formwork) eliminates molding costs and allows highest model flexibility. Different filler formulations ensure individual tuning of the component, depending on the requirements for weight, stiffness and damping. In addition, shafts, lines, sensors, etc. can be integrated directly in the component.

**Function surface**
Hydropol® components can be machined up to a weight of 60t and a length of 12m with highest precision.

**Cables, shafts, sensors,**
etc. can be integrated directly in the component

**Steel casing and stiffeners**
ensure high rigidity and dimensional stability

**Hydropol® filler**
Depending on the requirements for weight, damping and stiffness, different materials are used (see table previous page)

## Sustainability by innovation

Innovative by tradition: The development of Hydropol® started already in 1986. We draw on more than 40 years of know-how - progressive ideas have history at framag. Through innovative developments, we are already taking the future into our own hands today

## Circular solutions

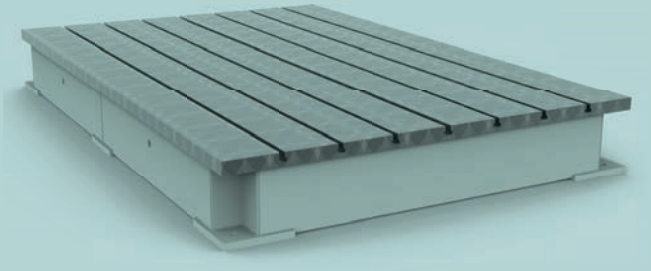
We perceive the challenges of this time as an opportunity and orient our company on the example of nature. Our products are designed for functioning cycles and are therefore 100% recyclable, for example for further use in road construction. In this way, valuable resources are utilized to the maximum, at every step.

# Test bench components

## Test bench components in hybrid design

## From simple clamping components to multi-part clamping plates.

From start-ups in test engineering to established OEMs in the automotive premium segment, numerous customers rely on our decades of experience in the design of test bench components. The range extends from standardized series products (ECOPOL) to complex customer-specific components (Hydropol®).

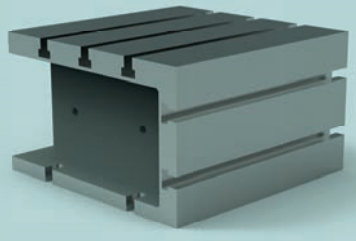


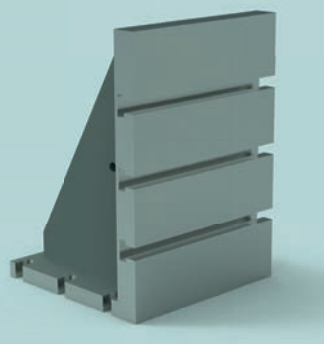
## Ecopol – Standardized, but better than standard

01

A large part of the testing applications is covered cost-efficiently by the modular range of the ECOPOL series. The components can be easily ordered as a series product and, thanks to their modular design, convince through extremely fast availability. A wide variety of clamping plate dimensions serve as the basis of the test setup. With additional clamping angles and cubes, a simple realization of different test fields is possible. ECOPOL offers the necessary flexibility to easily expand and adapt the setup.

- Modular serial/standard product
- Quick availability
- Individually machinable functional surfaces



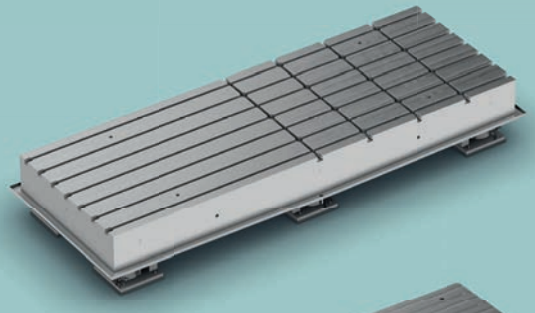


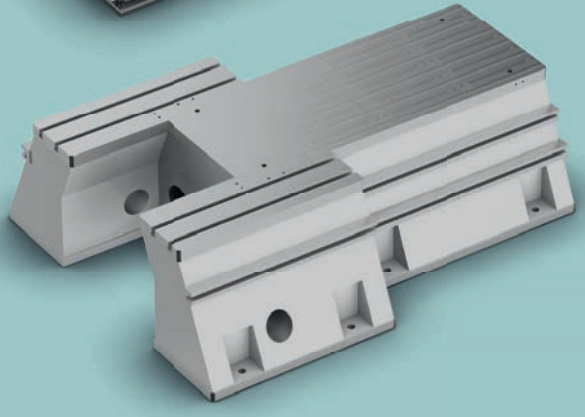
## Customized solutions with Hydropol®

02

For specific test setups that require individual solutions, the Hydropol® design offers full design freedom and targeted matching of components to the test application. Component dimensions and properties can be adapted over a wide range in terms of stiffness, weight, natural frequency and damping behavior. If required, supply lines, shafts or even sensors can be integrated directly into the component. Individual components up to 12m in length and weighing up to 60t can be realized.

- Various fillers with specific weights and E-modules
- Components up to 60t and 12m
- Lifting & fastening threads
- Empty pipework, penetrations and conduits





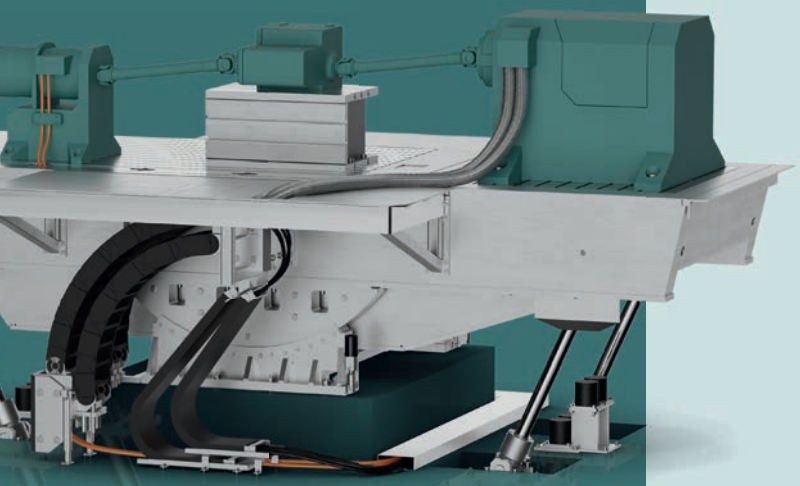
# Test bench subsystems


## Between single component and complete test system

framag takes over parts of your testing task as a reliable partner

In dynamic component testing there are often complex test stands consisting of different units. framag supports you in all areas of the test requirements by competences in mechanics, automation and software development. Subtasks of the test application are thus fully solved and integrated into the mechanical as well as the software environment of the test facility.

Since these subsystems can be assembled in different ways, two examples are described below:

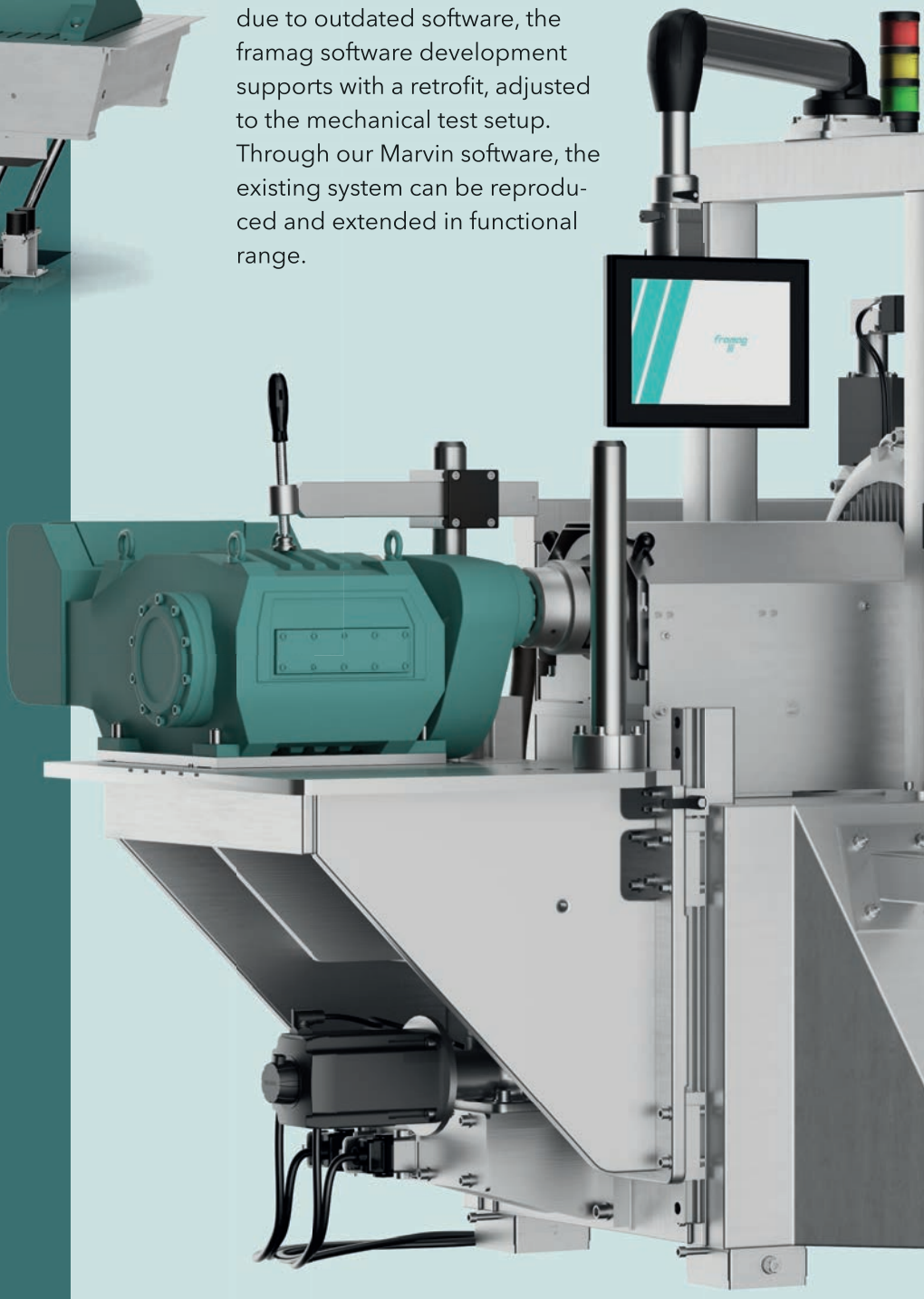


## Example - Inclination frame for powertrain test bench

Within the scope of a powertrain test facility, the inclination test stand (inclination frame) is taken over by framag. The design is based on the customer's specifications such as maximum inclination adjustment, angular velocity and load by superstructures. The subsystem „inclination test bench" is then integrated into the test facility for drive trains at the customer's site and integrated into the overall design as well as the software.

## Example - Software Retrofit

If a test system is mechanically still functional, but can no longer be operated to the desired extent due to outdated software, the framag software development supports with a retrofit, adjusted to the mechanical test setup. Through our Marvin software, the existing system can be reproduced and extended in functional range.



Our solutions are completely designed for the individual customer, from test requirement to evaluation. An overall concept is developed in close coordination and jointly defined for implementation.

# Complete test systems

## Everything from one source - test benches from framag

As complete test systems framag offers holistic solutions for test and validation requirements of your products, which go beyond the possibilities of conventional standard test benches.
These facilities include all components and systems including sensors, actuators, data acquisition systems, as well as control and evaluation software.

- Customized solutions for development test benches
- Series, in-line & end-of-line test benches in production
- Turnkey solutions (based on one-stop-shop principle)

For dynamic component testing, test equipment is used to evaluate the performance, durability and reliability of components and assemblies. Depending on the requirements, the test procedure can be designed very differently and can range from laboratory test benches to fully automated test systems for simulating real operating conditions.

## Software development starting at the beginning of a project

Our professionals at the test facilities software development are in close association with the department creating mechanical concepts, which includes control, data acquisition, evaluation and test sequence planning. Effective software development, in coordination with the mechanical test environment, helps to reduce the time and cost of performing tests and improves the reliability of results. Therefore, it is critical to integrate software development into the overall development of the test process and to permanently coordinate it with the overall process development.

- Support starting at a conceptual state
- Regular exchange during the developmental phase
- On-site training after successful implementation
- Service for test system hardware and software
- Remote maintenance & condition monitoring
- Extension of existing systems as required

## marvin - The intelligence of your test system

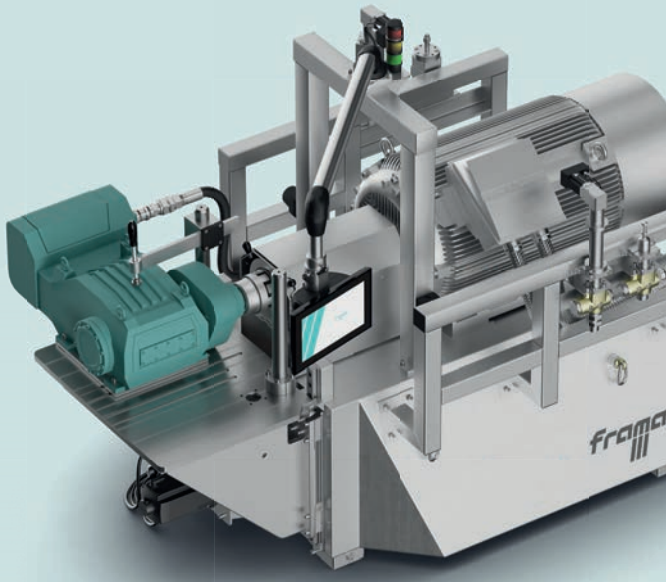
An essential part of every test stand is the software, which enables the automation of the test task, records and archives measurement data, as well as processes the acquired data and prepares it in a suitable way for the operator of the test stand in order to enable analyses and evaluations of the test.

Framag relies on MARVIN - a stand-alone software developed by framag, which provides all these functions in an easily accessible way. MARVIN has a modular structure, so that the most different inspection tasks can be flexibly integrated in one framework.

The functional scope ranges from the integration of a wide variety of sensors and actuators, data acquisition and archiving in databases to customer-specific visual display and evaluation of measurement results. Depending on the type of test, MARVIN thus enables a high degree of automation up to fully automatic test sequences and the execution of measurement series, always tailored to the customer's specific needs. A variety of standardized communication interfaces offers easy integration of the test stand into the customer's infrastructure.

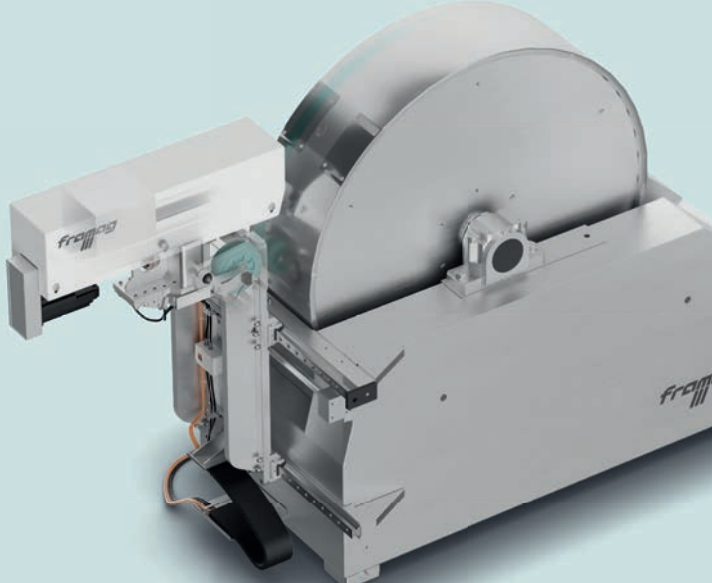
## Reference Project Pump Test Bench

End-of-line test stand for piston pumps to determine flow, pressure, temperature and torque of different pump variants. Test runs are automated and evaluated according to customer specifications.



## Reference project Roller Test Bench

Determination of the damping of track and guide rollers in a fully automated end-of-line test stand. Infinitely adjustable load on the test roller and adjustable obstacles on the raceways of the drum.



Hydropol®

## Subsystems for test facilities

- Clamping technology incl. decoupling
- Test bench automation
- Software solutions
- Test stand retrofit mechanical & digital
- Mechanical test setups

*framag takes over parts of your testing task completely and integrates the system into the existing environment*

The connecting element: Hydropol®technology. Read more in the brochure core.

## Complete test systems

- Customized development of test benches
- Series & In-Line / End-of-Line test benches
- Turnkey-Solutions (modeled after One-Stop- Shop principle)
- framag VECTOR Damper test benches

*Everything from a single source - from request to evaluation*

## Test bench components

- Complex components
- Customized developed
- FEM model for each component
- Natural frequency adjusted to test application

*Our patented hybrid design has impressed the mechanical engineering industry for 40 years*

## ECOPOL Series

- Standardized
- Quickly available
- Cost-efficient
- Modular design
- Based on Hydropol® technology

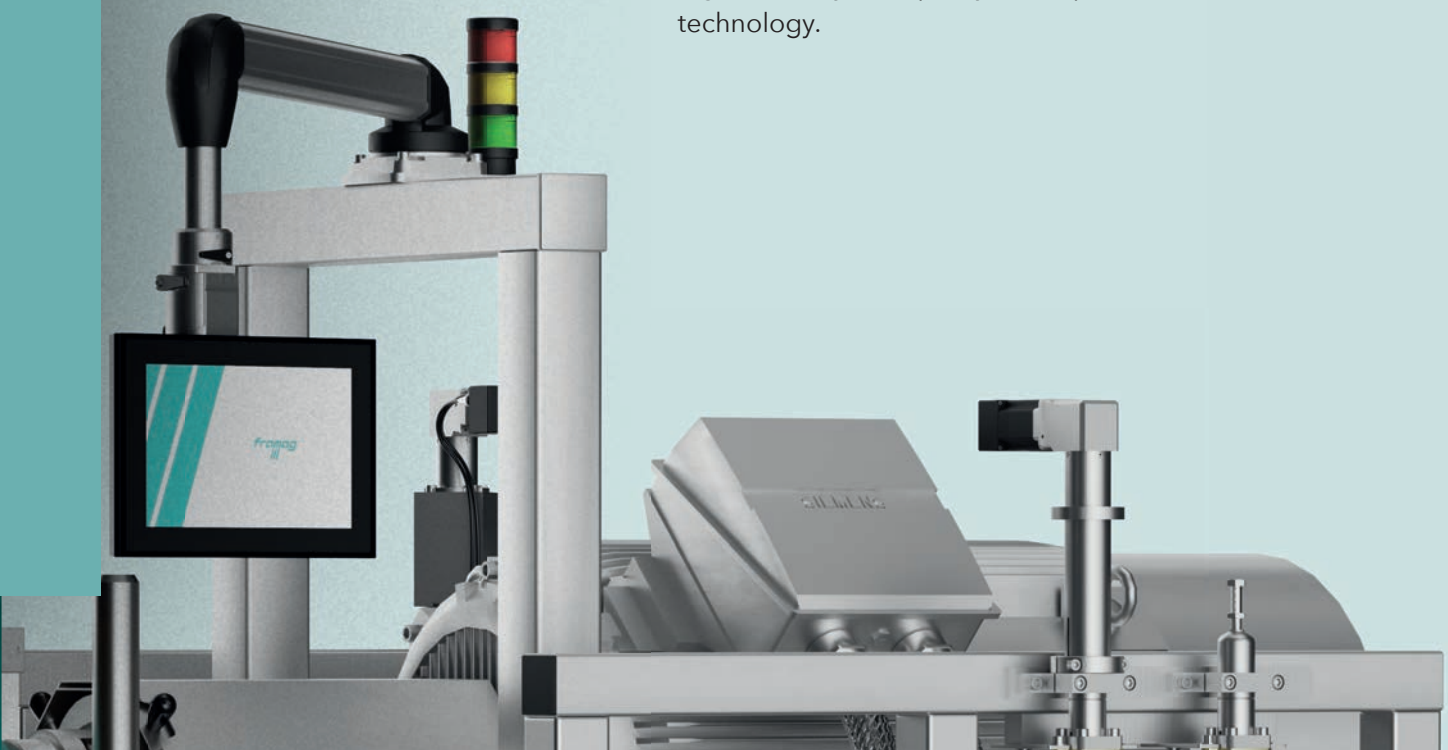
Overview

# Expertise at two locations

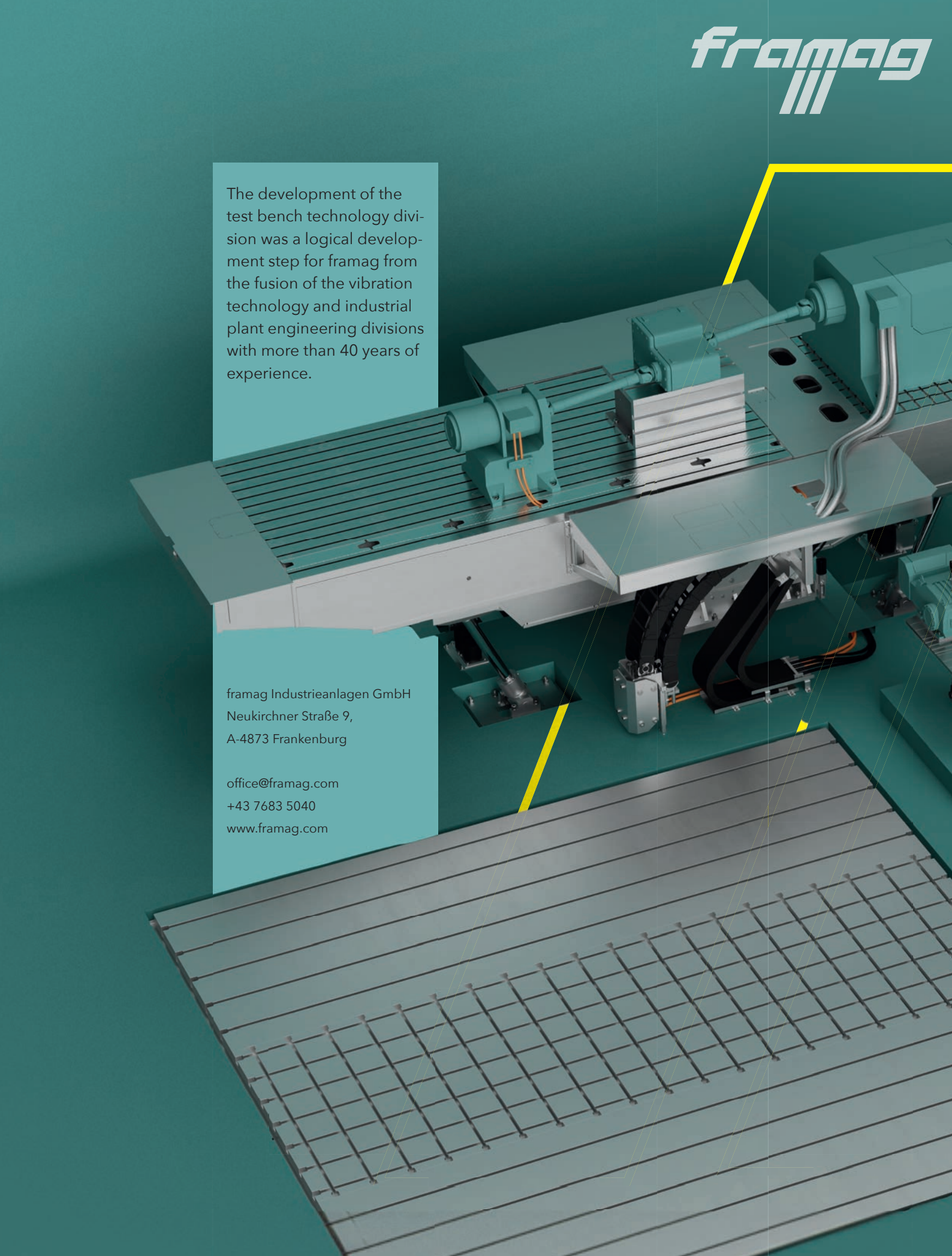
## One partner for your requirements in testing technology

Everything from one source: Due to the high manufacturing depth of framag, it is possible to guarantee a high flexibility over the entire value-added process. Due to the close cooperation of the mechanical developers with the software developers, as well as the mechanical manufacturing, interfaces between mechanical and electronic components can be integrated seamlessly.

All under one roof, from metal construction and mechanical manufacturing to software application. The mechanical development department is able to provide relevant information to the software developers already in the design phase and to coordinate it with the mechanical production. Customers of framag benefit by short development times, high flexibility and quality of the products in the test bench technology.



The development of the test bench technology division was a logical development step for framag from the fusion of the vibration technology and industrial plant engineering divisions with more than 40 years of experience.



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