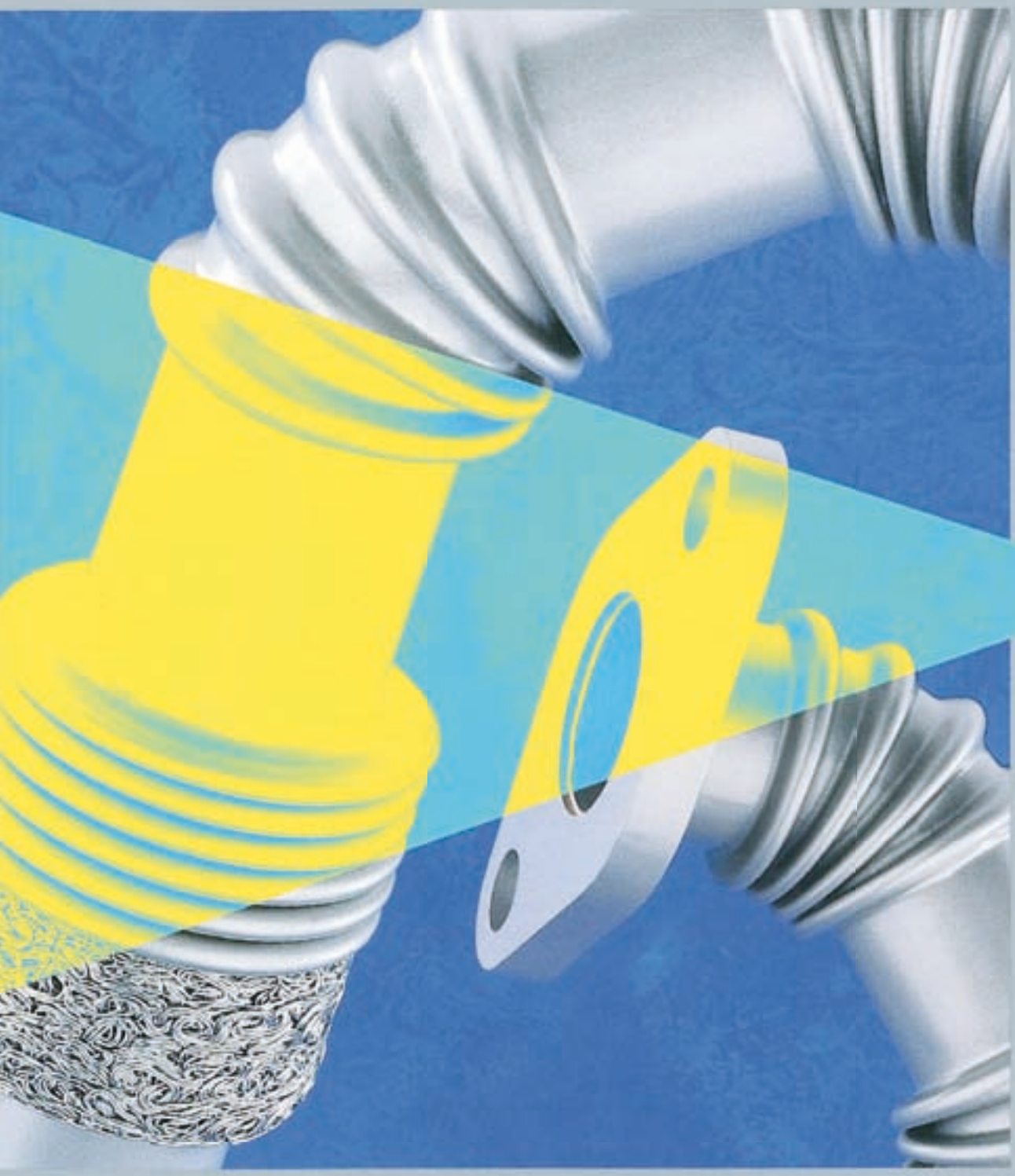
WAHLER



Pipes – Solutions To Measure

Tailor Made Pipes – Solutions For Engines And Vehicles

Wahler – partner for the international automotive industry

Wahler is a development and system partner for practically all major automotive manufacturers. With sharp focus on our core competence in temperature and exhaust management, Wahler activity is centred around engine heat management and EGR systems.

Integrating our own products into complex modules and spearheading technological progress with innovative concepts are the pillars of Wahler's future growth.
Unique quality aspirations, service flexibility and customer benefits have laid the foundation for Wahler's renown as an international brand: for customers all over the world in original equipment manufacturing and in the spare part business. Today and tomorrow.

Diversity in flexible metal pipes

Flexible metal pipes are acknowledged as one of Wahler's outstanding core competencies.
The outcome of decades of product experience, they are used today primarily as exhaust gas recirculation pipes.

The use of these pipes as filler pipes for fuel is a new development typical of Wahler innovation and recognition of environmental impact. Other attractive applications include oil return pipes, air pipes (e.g. injecting secondary air), exhaust isolating elements and expansion joints in the exhaust system.

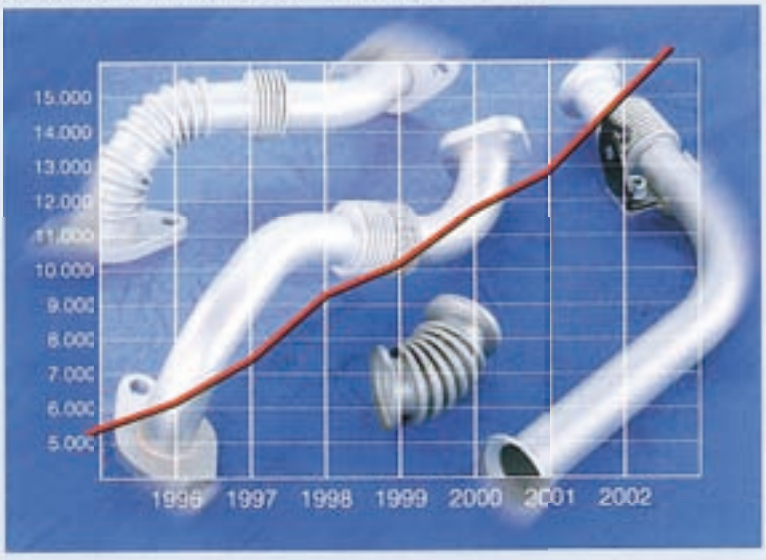
Wahler is your partner whenever you need to couple engine or vehicle parts together in order to:

- Compensate temperature differences,
- Compensate vibrations,
- Compensate assembly tolerances, or
- Withstand minimum deformations in the event of a crash.

Cutting edge powered by success

Backed up by several decades of experience in the development, design, prototype construction, trial and series production of EGR pipes, Wahler today is market leader in Germany and Europe in terms of technology, costs, quality and service.

Success is measurable – quantities per day



Complex Demands – Perfect Couplings

Exhaust gas recirculation pipes for passenger car diesel engines

EGR pipes

Exhaust gas recirculation pipes couple all the components of the exhaust gas recirculation system between the extraction point (e.g. the manifold or the cylinder head), the EGR cooler, the EGR flap, the EGR valve and the intake manifold.
Increasingly scarce space in the engine compartment means correspondingly complex piping arrangements.

Air pipes

Fuel filler pipes

In response to demands for zero emissions from parts that transport fuel, fuel tanks made of steel are encountered more and more frequently.

Flexible pipes from Wahler are the perfect choice for filling them: no emissions, deformability in the event of a crash and compensation of assembly tolerances.

Fuel filler pipes

Air pipes

Air pipes like those used to inject secondary air have to compensate vibrations, thermal expansion and assembly tolerances.

Expansion joints

Expansion joints are basic pipe elements. They are used in exhaust systems as isolating components. Also proven in a multitude of industrial applications.

Expansion joints

Oil return pipes

Oil return pipes

Oil return pipes return oil from the turbocharger to the engine. Wahler guarantees a combination of connection flexibility and optimum compensation of assembly tolerances.

The EGR Pipe – Limitless Diversity In Shape And Function

Acoustic and thermal insulation

Made-to-measure solutions – for the benefit of our customers

- Wahler design experience founded on more than 1000 product variants
- Solutions for even the most challenging installation environments thanks to the use of moulded pipes manufactured by internal high-pressure forming (IHU)
- Surrounding parts protected by a variety of insulating hoses
- Rigid pipes that are flexible nevertheless: special designs, manufactured to extremely tight tolerances, facilitate sealing with O-rings

The perfect couple

Just a few examples of our many design variants:

- Flange, stainless steel/steel, in fixed position
- Flange, sintered material, freely rotating
- Flange for V-band clamps
- Union nut with spherical bushing or compression-type fitting

- Special connections, e.g. for thermal isolation or for assembling O-rings
- Casting designs made of stainless steel or malleable cast iron

Compensation with "sliding seat on O-ring"

Wahler pipes with typical coupling elements

Designs with IHU moulded pipes

In-Depth Know-How – From Development To Production Readiness

Innovative designs founded on individual product solutions and flexible service structures are the characteristics of Wahler's engineering competence. In combination with extensive material know-how this means professional expertise from initial concept onwards. Wahler has been a development pioneer and serial production supplier of exhaust gas recirculation pipes since 1990.

Project management optimized to each product solution guarantees smooth workflows. Fill design studies are supervised on the basis of an internal feasibility study. The project team is empowered with a long range decision competence.

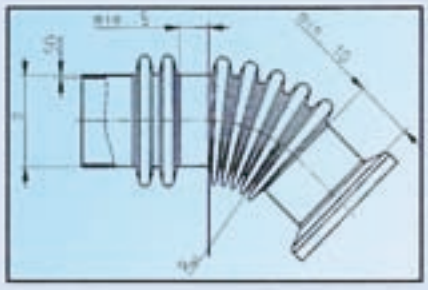
The outcome: excellent motivation, short distances, flexible and swift completion of tasks, systematic working and the reliability and quality for which Wahler is renowned.

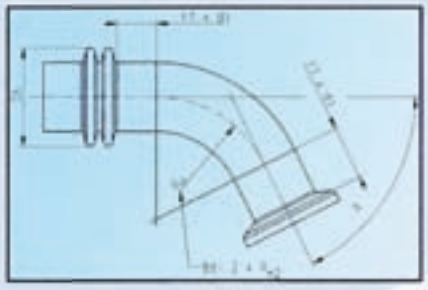
Efficient and flexible teamwork

Design (3D-CAD)

The customer's design specifications – from the preliminary drawing to the CAD data – provide us with our starting point and are supplemented by demands derived from the development requirements, such as temperatures, assembly tolerances or connections.

At the end of a remakeably short design phase, the customer is presented with the CAD model, built using standard 3D-CAD software.





Extract from the Wahler design guidelines for EGR pipes:

d mm	**SO** mm	**DA** mm	**Rm1** mm	**Rm2** mm	**a** deg
23.0	0.4	29 to 30	33	70	135
23.0	0.4	29 to 30	33	75	135
23.0	0.5	29 to 30	33	50	-
25.2	2x0.3	32.5 to 36.5	35	75	90
25.2	0.4	32.5 to 36.5	35	75	135
25.2	0.5	32.5 to 36.5	35	50/45	135
25.2	0.6	32.5 to 36.5	35	45/40	135
25.2	0.6	32.5 to 36.5	35	33	90
25.2	0.6	32.5 to 36.5	35	25	90
25.2	0.8	-	35	33	135
25.2	1.0	-	35	25	140
25.2	1.0	-	35	20	100
30.0	0.6	37 to 46	35	30	90
30.0	1.0	-	35	30	140
31.0	0.5	38 to 47	45	70	-

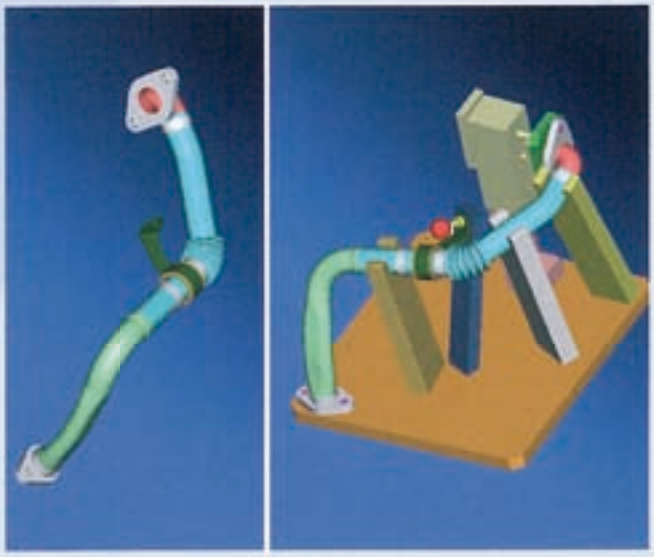
Module analysis of an EGR pipe

CAD solids: exhaust gas recirculation pipes, oil pipe, expansion joint

Sophisticated Engineering – Excellent Process Know-How

Once the CAD model has been approved by the customer, the prototype tools are designed and manufactured. Each tool is exactly tailored to the product in order to guarantee optimum precision.

A pipe is born...



Each tool is inspired by a product

Testing/ prototype manufacturing

A team of prototype engineers manufactures the prototypes swiftly and accurately.
Our specialists are featured with extensive experience in series production in the areas of bending, forming and welding.

They ensure that adequate account is taken of all quality requirements, even at a very early stage of the product development process.

Prototype bending machine

Sophisticated Engineering – Excellent Process Know-How

Our testing department is equipped with different examination and testing facilities. Realistic load tests are performed on the vibration rig or on the air-flow test bed.

Life time tests run on engine test benches, which additionally serve to verify compliance with the development order specification.

Pre-production phase

The stipulated quantities for the pilot and pre-production are manufactured entirely on production machines.

An unusually high level of vertical integration ensures optimised processes. In case of product modifications short distances are a distinct advantage.

All the required tools are designed internally, so that control of all the process steps remains in Wahler's hands.

Air-flow test bed

Engine test bench

Vibration rig

Flexibility And Quality In Series Production

Production phase: From small batches to mass production

Wahler can draw on several decades of experience in series and mass production of flexible metal pipes, enduring quality from development right through to mass production. Wahler has production lines for more than 100 different products with exceptionally short set-up times. We continue to pursue our goal of all-round customer satisfaction.

Pipe production line

Specially designed: the Wahler forming tool

Product Diversity And Product Reliability

Final inspection and testing stations

CNC bending machine

The benefits to you on one view:

- The competence of the market leader for flexible metal pipes
- The experience of the development pioneer in EGR pipes
- Know-how accumulated over several decades
- The traditional flexibility of a medium-sized enterprise
- Smooth production workflows as a result of a high level of vertical integration
- Unusually high quality aspirations
- An optimally coordinated project management strategy
- Production lines for more than 100 different products
- Outstanding materials competence
- Extensive mass-production experience
- Accelerated process chains as the outcome of sophisticated engineering
- A highly motivated project team empowered with long range decision competencies
- Short distances and clearly defined competencies for rapid project progress
- Engineering and design competence

Outlook

Increasingly stringent exhaust emissions limits also mean increasingly complex requirements for exhaust gas recirculation systems. Alongside higher temperatures and faster recirculation rates, new components such as EGR flaps, bypass pipes, EGR coolers, etc. are steadily gaining ground.

Exhaust gas recirculation systems will in future also penetrate the gasoline engine sector in addition to diesel engines. New challenges will emerge for pipes through the development of innovative materials with even better temperature resistance, facilitating:

- A wider choice of standard dimensions
- More design variants in terms of coupling technologies and connection alternatives
- Optimised production methods that cut costs while simultaneously boosting quantities

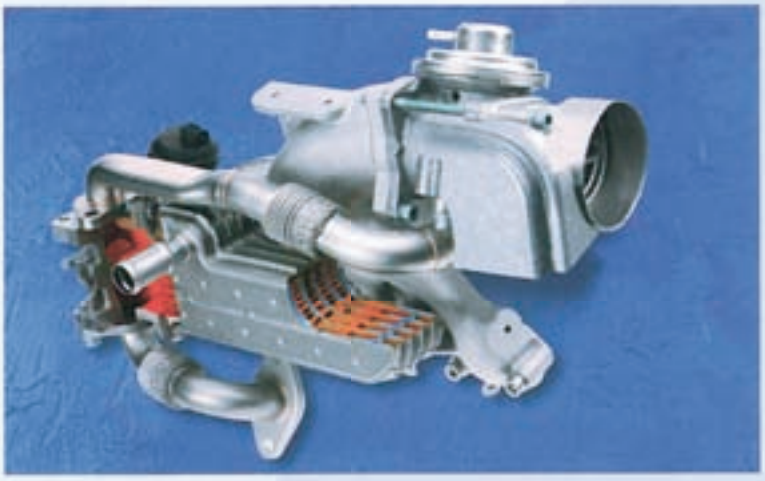
Application of the solder paste

Tacking robot in action

Final inspection:

- Geometry
- Pressure test
- Visual inspection
- 100% tested

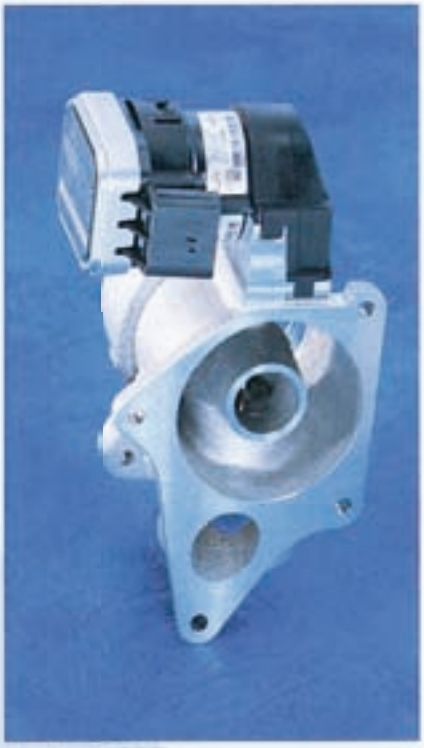
The Components Of The EGR System



Integrated exhaust gas recirculation system

- EGR valve with integrated shut-off flap
- EGR pipes
- Throttle flap
- EGR flap
- EGR cooler
- Intake manifold
- Know-how – all from Wahler

Some of the exhaust gas is extracted from the exhaust manifold, then routed through an EGR pipe and the EGR valve before being mixed – (if necessary, after cooling) – with fresh air in the intake system.



Electric EGR valve

The EGR valve may either be installed directly on the exhaust manifold (hot installation) or integrated in the intake module (cold installation).

Cold installation reduces thermal stressing of the valve. This requires the development of effective anti-sticking measures.

"Mixed housing", comprising a pneumatic EGR valve and an integrated shut-off flap

Exhaust flow in the EGR system

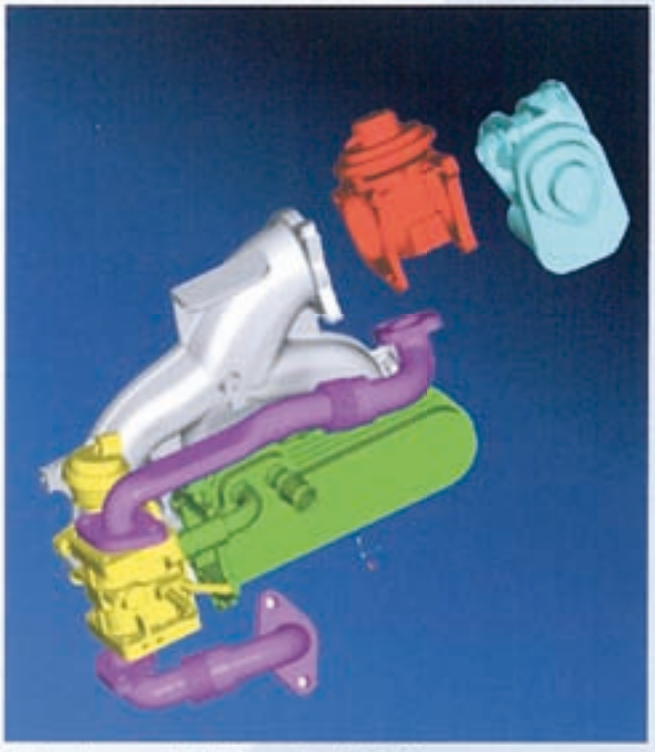
The exhaust gas takes his way from the exhaust manifold via the EEGR valve through the EGR cooler and along the EGR pipe to the intake manifold.

During the engine warm-up period, the EGR flap ensures, that the cold exhaust gases by pass the EGR cooler and are mixed with the fresh air. When operating temperature is reached, the EGR flap opens the passage through the EGR cooler. The exhaust gas is then supplied to the fresh air pre-cooled.

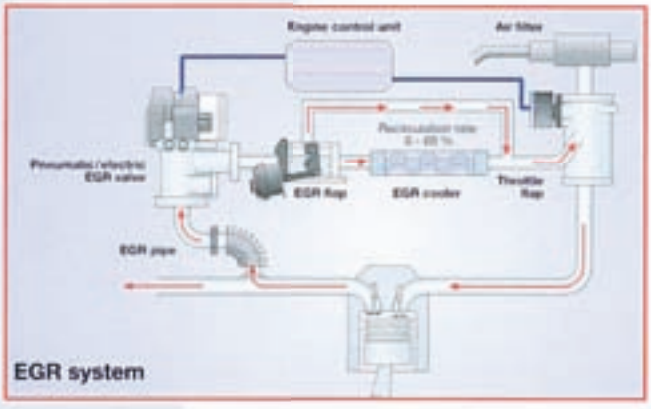
EGR flap

The electric throttle valve adjusts the pressure difference between the fresh air and the exhaust gas, so that there is always a defined pressure gradient to ensure that the exhaust is recirculated to the fresh air.

Electric throttle valve



Exhaust gas recirculation system (3D-CAD)



EGR system




Wahler – The Number One Choice For Temperature And Exhaust Management

EGR pipes

EGR valves

EGR systems

Thermostats

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