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Engineering GREAT solutions through people, products, innovation and service

IMI Precision Engineering is a world-leader in fluid and motion control. Building close, collaborative relationships with our customers, we gain a deep understanding of their engineering needs and then mobilise our resources and expertise to deliver distinctive products and solutions.

Wherever precision, speed and engineering reliability are essential, our global footprint, problem-solving capability and portfolio of high performance products enables us to deliver GREAT solutions which help customers tackle the world's most demanding engineering challenges.

> **Reliability**

We deliver and support our high quality products through our global service network.

> **High performance products**

Calling on a world-class portfolio of fluid and motion control products including IMI Norgren, IMI Buschjost, IMI FAS, IMI Herion and IMI Maxseal. We can supply these singly, or combined in powerful customised solutions to improve performance and productivity.

> **Partnership & Problem Solving**

We get closer to our customers to understand their exact challenges.



Global reach and local service

We are committed to helping customers achieve their goals by working with them as a partner, not just a supplier. We create unique, high-performance products based on proven automotive technology. Our customised solutions, specific to each customer, reduce space claim, while our world-class quality maximises vehicle uptime.

With an established network offering exceptional local service in 75 countries, we have the reach and capability to support customers in complex, global projects or simple, local spare part supply. Our dedicated commercial vehicle team is also globally connected, ensuring continuity of support for large customers.



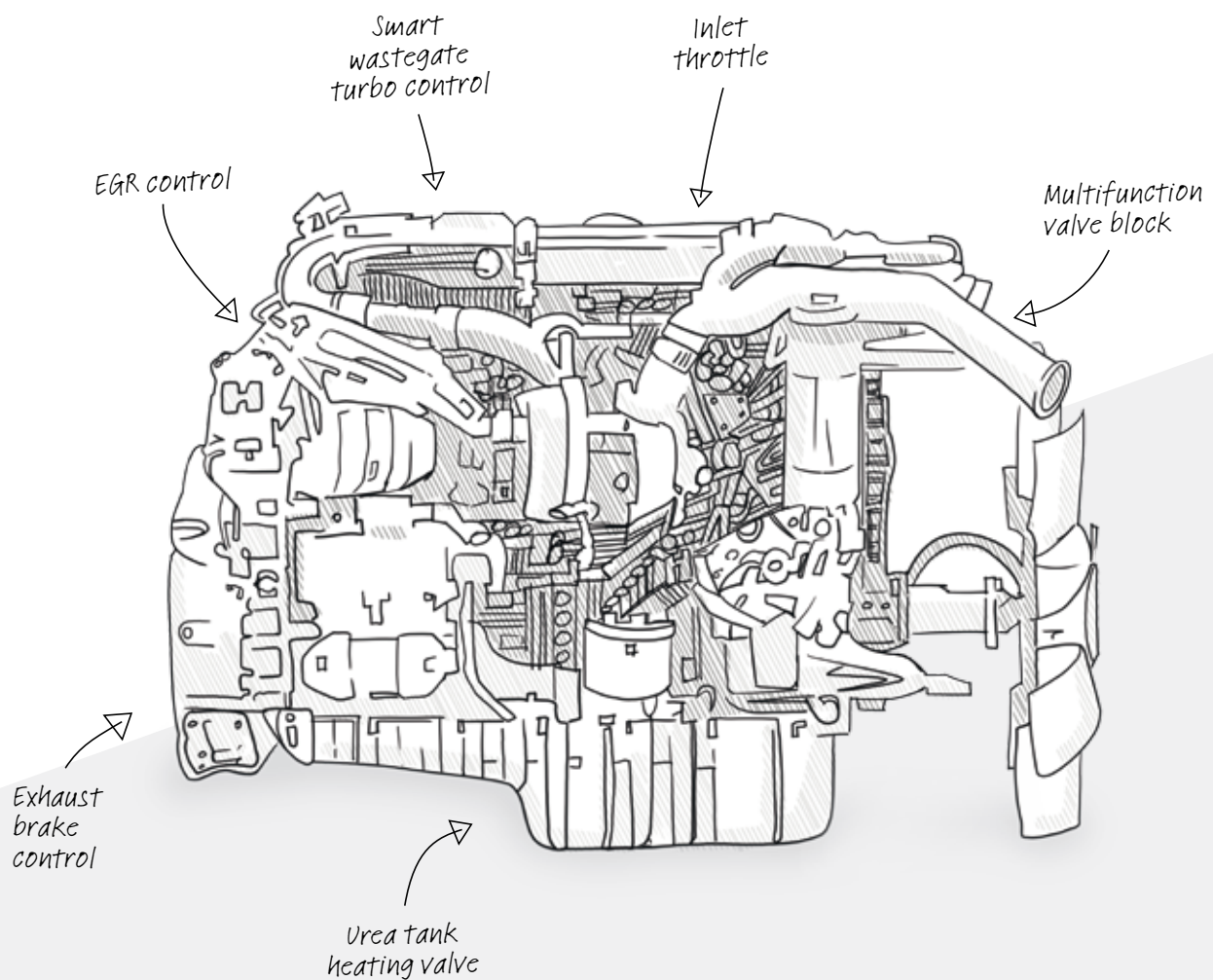
Sales & Service in 75 countries

-  Technical centres
-  Manufacturing locations

Powertrain engine

IMI Precision Engineering provides high-performance pneumatic and electric control using innovative valve and actuation technology for all current and future engine control requirements.

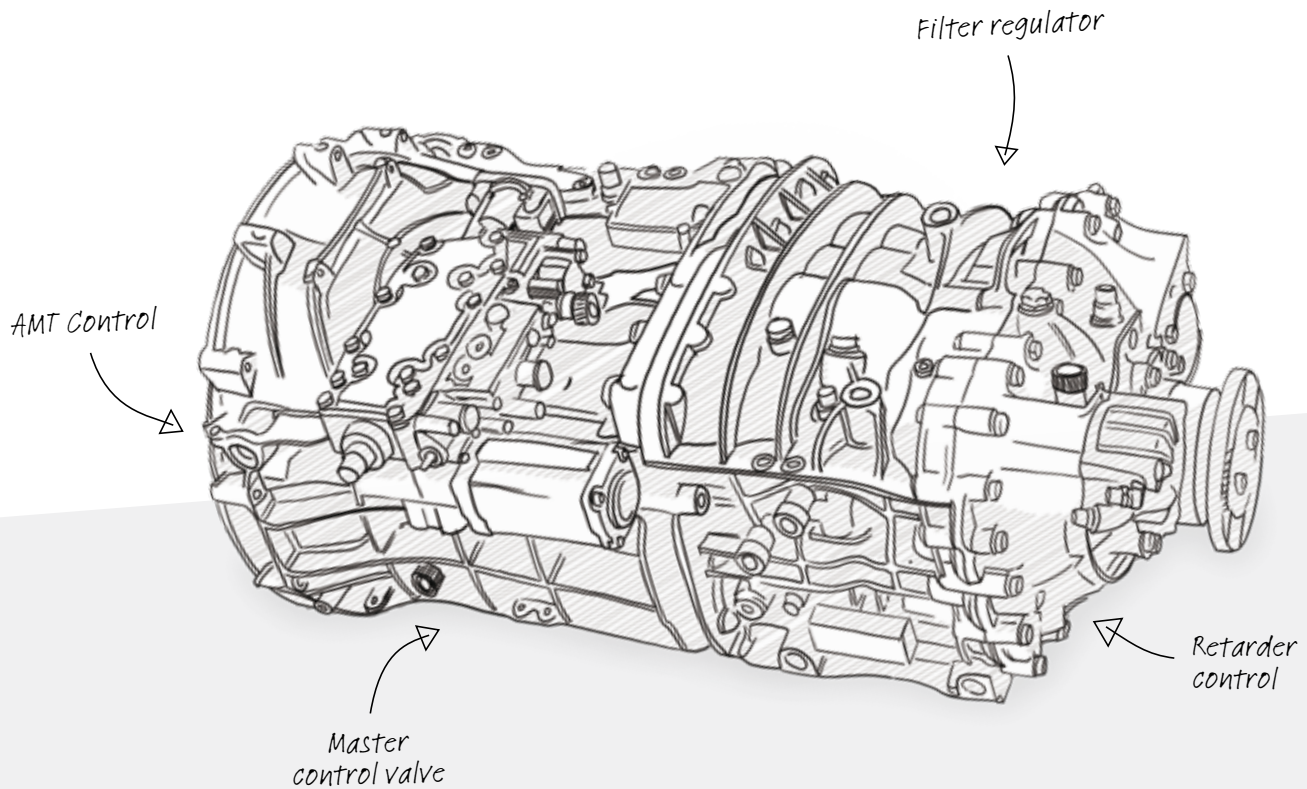
Solutions that meet the challenging temperature and vibration requirements of today's heavy duty trucks and off-highway engines.



Powertrain transmission

Modular or standard version, our transmission products are built to be reliable, robust and reduce weight.

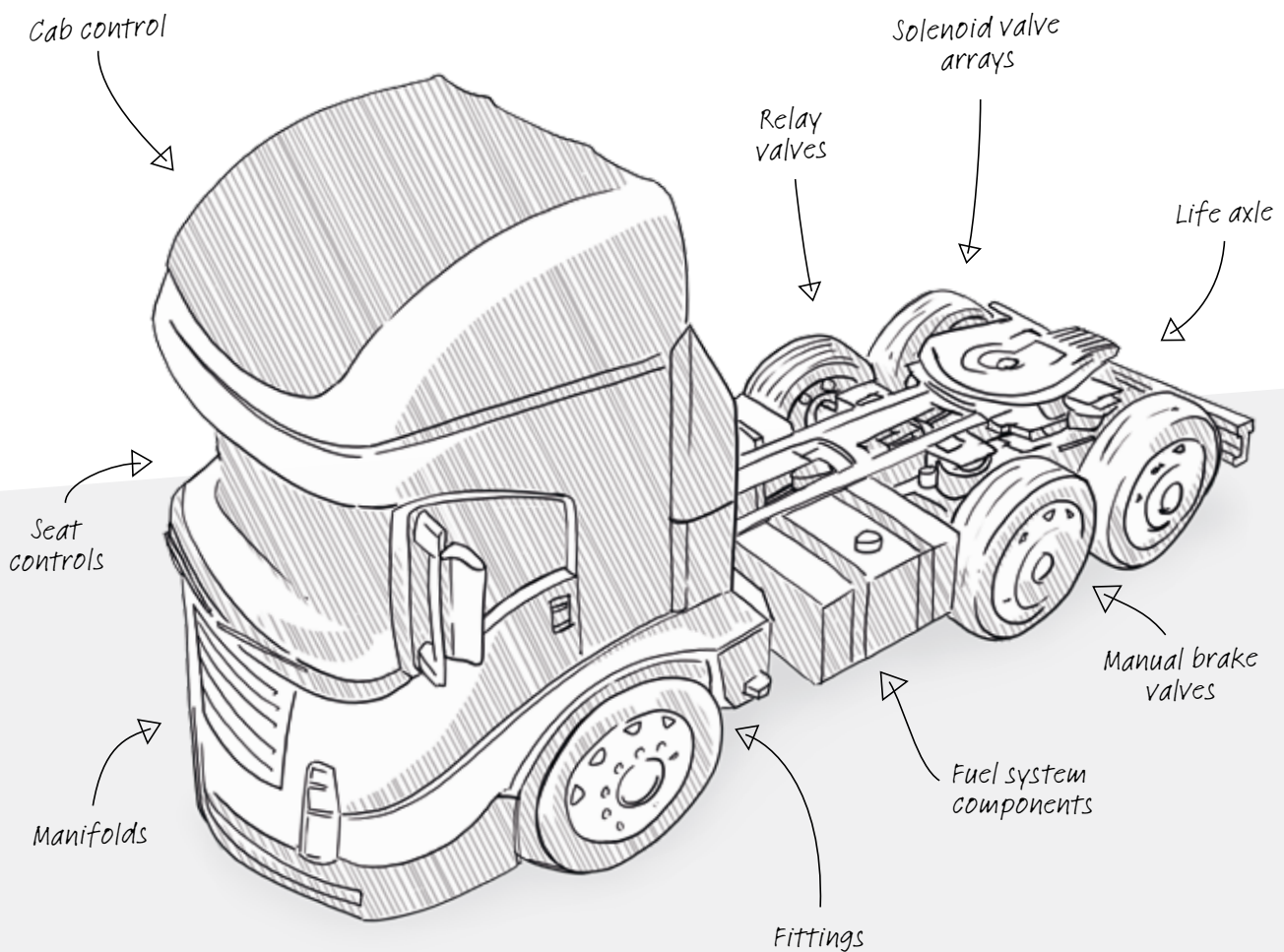
Solutions providing pneumatic assistance on manual transmissions and high performance solenoid valve technology for automated manual transmission (AMT).



Chassis / CAB

Both standard and customised pneumatic control solutions that comply with all regulatory requirements for use in primary and auxiliary applications, reducing leakage, improving reliability and lowering total cost of ownership.

High performance, stackable solenoid valves have a single air supply when mounted in multi array, while manifolds reduce the overall weight and footprint.

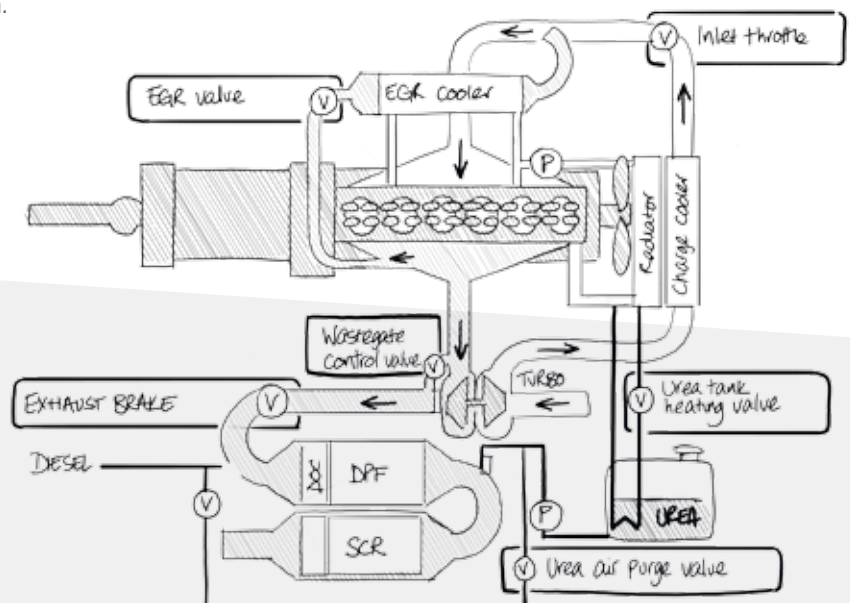




Powertrain Engine Solutions

Our proven valve and actuation technology has helped OEMs reach the highest regional emission standards.

We have developed a core set of products and technologies to assist with systems such as EGR, SCR, enhanced wastegate and diesel particulate filtration.

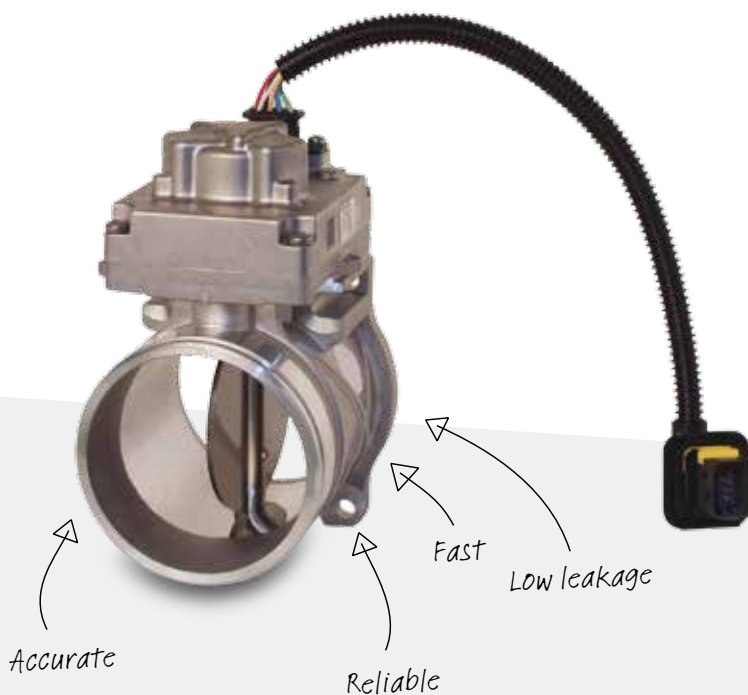




Inlet throttles

This high-performance product provides EGR assistance, maintains elevated exhaust temperature and enables rapid engine shutdown:

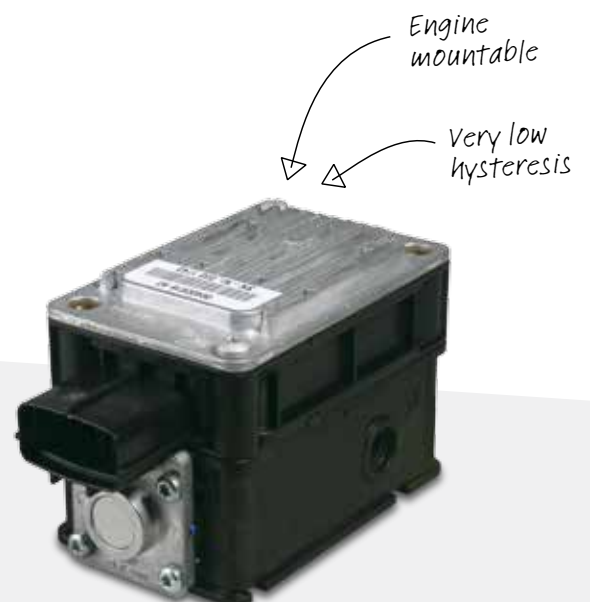
- > High-durability brushless DC actuator
- > Pipe-mounted, die-cast aluminium housing
- > Stainless steel flap and shaft
- > CAN J1939 smart actuator, 12V and 24V
- > Safety spring return to normally open
- > Compact direct drive



Variable-geometry turbocharger control

We offer high-performance, advanced pneumatic control for Variable Geometry Turbochargers (VGT) – a fully integrated closed loop control system that includes an ECU, pressure sensor and a proportional valve:

- > Communication with the engine and / or the vehicle ECU is possible
- > Available with pressure or displacement feedback, and with PWM or CAN control
- > Suitable for use with Euro IV, V, VI, EPA requirements, or Tier 4 final applications
- > IP6K9K-rated enclosures



Engine control multifunction valve block

This high-performance product integrates two waste gates for two-stage turbo and exhaust brake functions into one module:

- > Integrated pressure regulator and exhaust back pressure sensor
- > Utilises production-proven solenoids
- > Reduces total cost of ownership
- > Single air connection, single electrical connection

EGR Control

Our customised EGR solutions provide precise pneumatic proportional control for 'hot side' EGR valves:

- > Proven product with years of medium and heavy-duty diesel engine usage
- > Suitable for EPA requirements, Tier 4 Final and Euro IV, V and VI solutions

Single wastegate version



High cycle life



Single air inlet

Single electrical connection

Accurate



Compact



Engine exhaust brake control

Fully proportional control of exhaust brake with integrated exhaust back pressure sensor provides savings in weight, footprint and component count:

- > Precise pneumatic control of the exhaust brake
- > Directly driven, improving response speed by approximately 30%
- > Single standard mounting needed for installation
- > Durable design capable of surviving under-hood temperatures and vibration environments

SCR system ad-blue tank heating

Utilising engine coolant circuit for medium and heavy duty truck engines, the Urea Tank Heating Valve (UTHV) regulates the flow of coolant to the Ad-Blue / urea holding tank:

- > "Poka-yoke" application-specific fittings allow for easy installation
- > Regulates temperature in cold ambient environments, protecting it against freezing
- > Reducing unit weight by 200g, it delivers more efficient fuel consumption
- > Effective on or off highway, it performs with all engine applications
- > Designed specifically for colder operating conditions, it ensures uninterrupted operation
- > Use of high-performance materials minimises maintenance

Closed loop design



Compact

Engine mountable

Robust



Multiple fitting options



Lightweight

Low power consumption



Valves help Indian engine manufacturer satisfy emissions legislation **case study**

Ashok Leyland, a manufacturer of world-class trucks, buses and engines, is designing cleaner engines. Having worked in emissions control for many years, we were ideally placed to co-operate on its latest generation of engines.

IMI Precision Engineering designed an innovative proportional valve solution that controls the engine's exhaust gas recirculation valve, which cools the combustion process and prevents the formation of nitrogen oxide.

IMI Precision Engineering's solution is resistant to both shock and vibration, and delivers reliable performance – reflecting our expertise in taking a product and integrating all the components, which has reduced installation time and enabled Ashok Leyland to cut their number of sub-suppliers.

Ashok Leyland now has an engine that is compliant and a high-technology, high-performance solution that's reliable in application.

↖
Euro IV

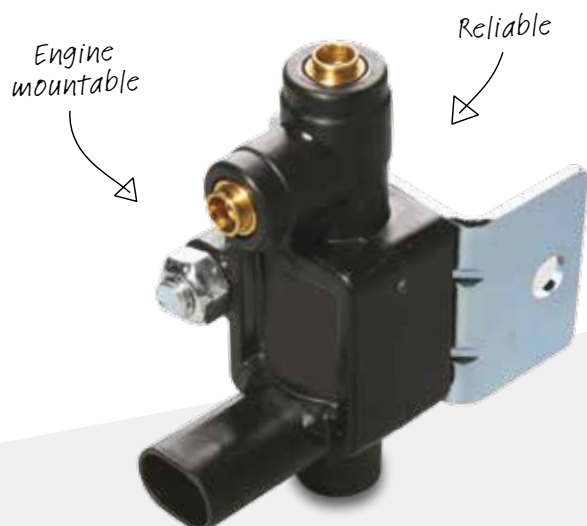


Pneumatic and Hydraulic Fan Clutch Control

A durable solution designed to withstand engine mounting and the harsh environment found under the hood, this control is a result of designs proven through years of heavy-duty commercial vehicle experience.

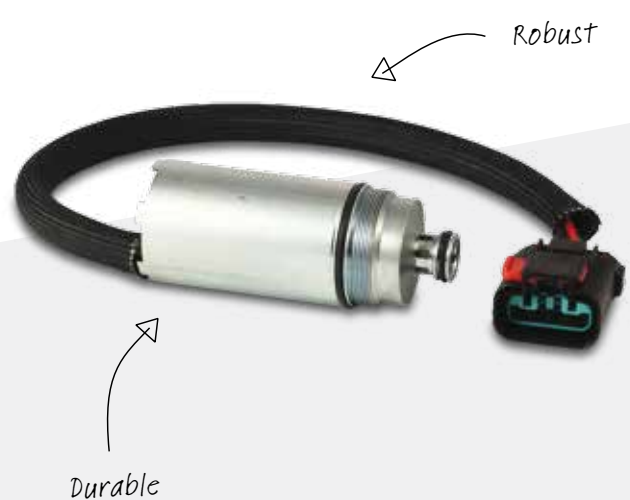
Pneumatic control of coolant fan clutch:

- > Integrated electrical and pneumatic connections
- > Available with or without bracket
- > Overmoulded construction provides excellent environmental protection



Hydraulic multi-speed fan clutch control solenoid:

- > Integrated directly into the fan drive shaft
- > Proportional control for multi-speed requirements
- > Thermal protection and over-pressure protection





↙ Euro VI

Innovating in inlets – new technologies to meet emissions legislation for heavy diesel engines **case study**

Our technical innovation is clearly showcased in new air throttle technology which assists EGR by helping manage exhaust temperatures and with minimal impact on fuel consumption.

Air inlet throttle technologies for passenger cars are unable to meet the more severe operating conditions required by heavy duty engine applications. IMI Precision Engineering's latest innovations in air inlet throttles are 'smart', meaning they incorporate local control and condition monitoring and communicate with the vehicle network via CAN. Using a proven DC brushless motor, directly coupled to a throttle body and air control flap, they have already appeared in 'incentive engines' within vehicles to be purchased by early adopters of the Euro VI standard.

What the air throttle delivers –and how it works.

Our inlet throttle optimises the pressure gradient driving EGR, allowing the best 'in cylinder' combustion conditions

under a wide range of operating modes. The throttle assists in the cold start of emissions components, reducing the amount of oxygen available to them. By forcing immediate shutdown on key off, the throttle eliminates the 'run-on' which is commonly found in modern high-compression engines. To avoid shutting off the engine unintentionally, the throttle automatically returns to the open position under its own spring force in the event of any potential failure.

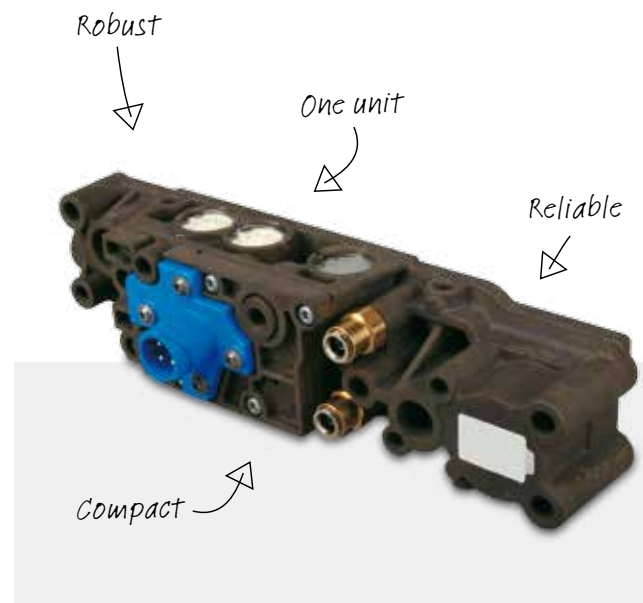
In delivering these benefits, the inlet throttle meets a number of key design parameters including speed, resolution, repeatability, durability and sealing capacity. The performance level demanded of these systems requires the use of a compact and durable motor with a very high power density.

Powertrain transmission technologies

Transmission gearshifting control module

A compact unit that incorporates all pneumatic functions into one module for assisted transmission control:

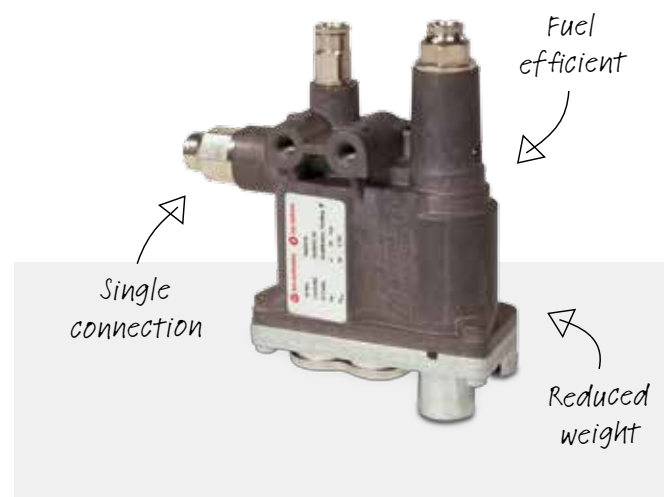
- > Based upon our approved cartridge solenoid valve system
- > Central power supply – pneumatic and electric
- > Direct mount to customer's specific footprint



Retarder control valves

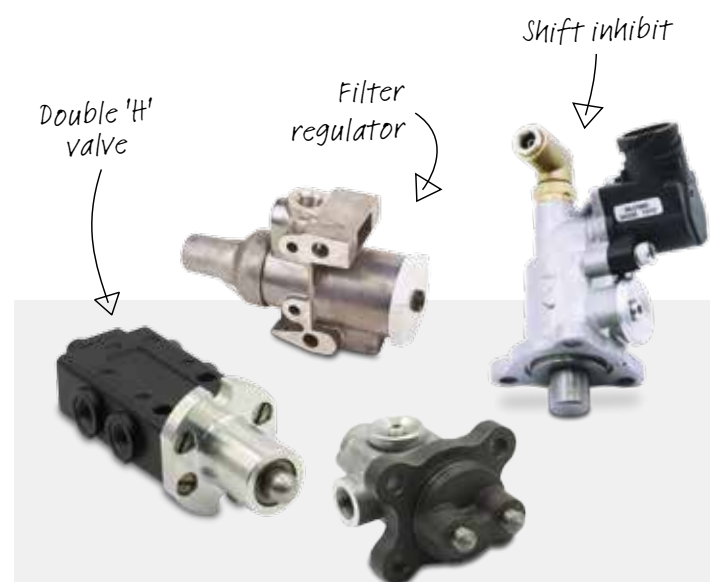
Our pneumatic control unit for retarder features a compact integrated design, comprising proportional control valve, pressure sensor, safety shut-off valve and single connector – all in one high-performance, high-technology unit:

- > Reduced customer assembly time
- > Direct mount to customer's specific footprints
- > Design is fully integrated into the retarder



Manual transmission control

- > Shift inhibit: Protects transmission from driver abuse and prevents down shifting at the incorrect RPM
- > Filter regulator: Regulates chassis air for use on the transmission
- > Double 'H' valve: assists gear shift between high/low range and can be mounted directly on the transmission



Integrated solution prevents gearbox damage case study

A division of Tata Motors, TML Drivelines, is currently the market leader in axles and transmissions for medium and heavy commercial vehicles in India. It sought to introduce a new nine-speed planetary range gearbox with high and low ranges. In order to prevent the destructive and potentially life-threatening effects of the abusive shift of such transmissions caused by drivers shifting to low range whilst driving at higher speed, a solution was needed to block the range shift when running above a set speed.

IMI Precision Engineering was asked to provide components for a solution designed in-house by Tata. However, by applying our commercial vehicle expertise we were able to propose an integrated solution combining solenoid valve, actuator, fitting and silencer in a compact single unit.

Controlled by a new electronic control unit specifically designed by Tata to meet the application requirements, the IMI Precision Engineering solution offers Tata a robust, life-of-vehicle product, as well as reducing assembly time, sourcing and logistics costs.



Cab

Pneumatic and electronic controls for the cabs of commercial vehicles

Precision engineered for functionality, durability and reliability, our compact designs occupy minimal space behind the dashboard, blending with the overall design of the dashboard and interior with custom-designed graphics and lighting options available.

Innovative features include push-to-connect fittings, non-contact electrical switching and microprocessor-based functions.

- > Air horn valves
- > Steering column release valve
- > Pneumatic switches
- > Customised transmission shift control
- > Wiper controls



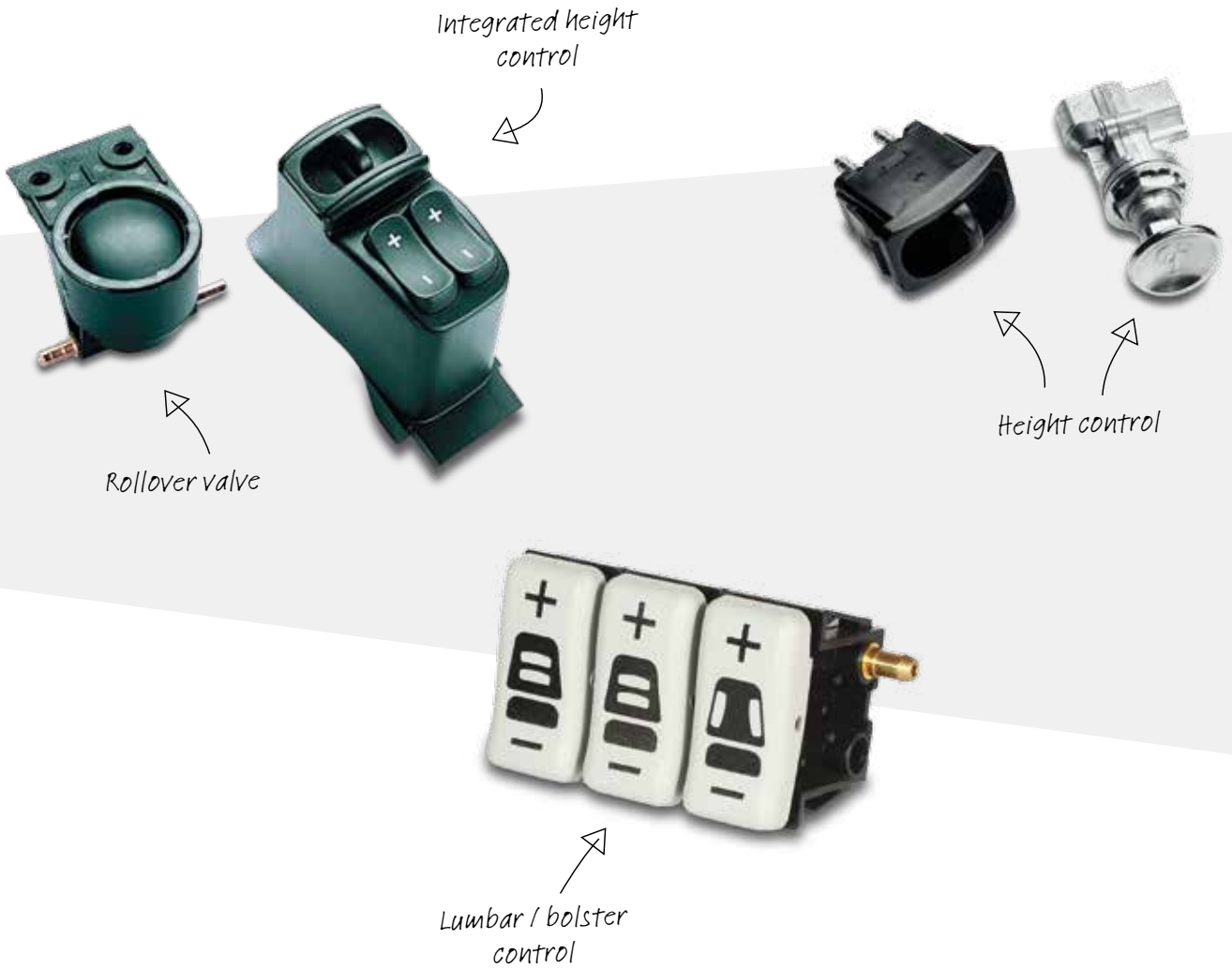
Cab

Seat Control Systems

IMI Precision Engineering's advanced pneumatic systems are becoming the Industry's preferred option due to higher functionality, higher performance, and ease of integration without the costs associated with electrically-controlled designs.

We provide a variety of solutions available for controlling functions such as height, lumbar, electro-pneumatic damper control, and auto-memory:

- > Tip-over safety valves allow easy exit in the event of a partial or complete rollover
- > High-specification memory can store the preferred seat position of several different drivers
- > Levelling systems offer automatic leakage compensation
- > Rapid dump valve quickly deflates the seat's air bag for easier ingress and egress



Manual Pneumatic Control Valves

With customised designs to meet individual ergonomic requirements, our valves are capable of withstanding aggressive environments and continued operation, with integrated tube connections to reduce costs, air usage and assembly time:

- > Trailer brake custom designed proportional control valve
- > Part brake interlock to prevent accidental release
- > Work brake provides energy efficient solution for demanding application

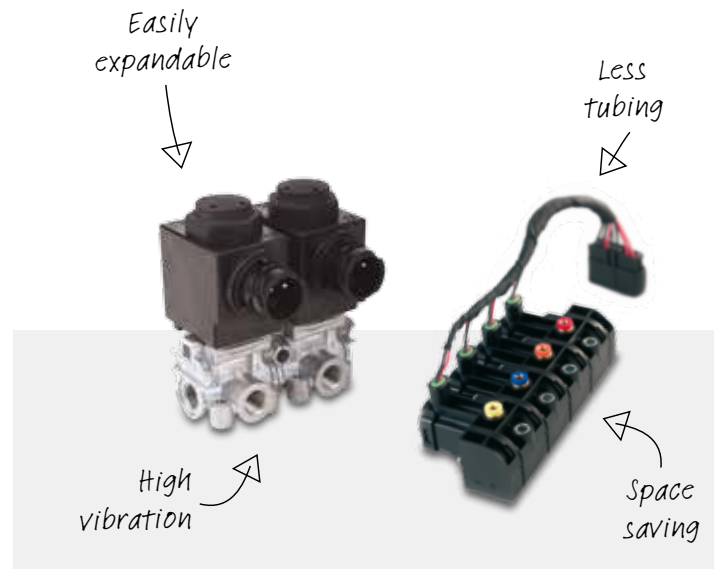


Chassis

Solenoid valves and valve arrays

Chassis-mounted, high-performance solenoid valves with 'twist and lock' stackable features that have a single air supply when mounted in multi array. Valves are remotely actuated from electric switches mounted in the dashboard, and connected via standard electrical harnesses:

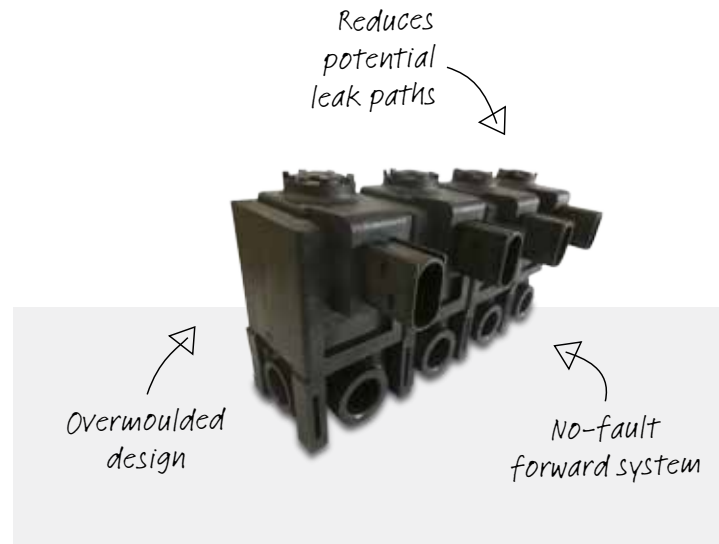
- > Differential lock
- > Exhaust brake
- > Horn signal
- > Lift axle
- > Power take-off
- > Split / range



Next generation of solenoid valve array

Designed for ease of assembly, a chassis-mounted, high-performance, integrated 3/2NC solenoid valve that controls key functions such as the exhaust brake and differential lock:

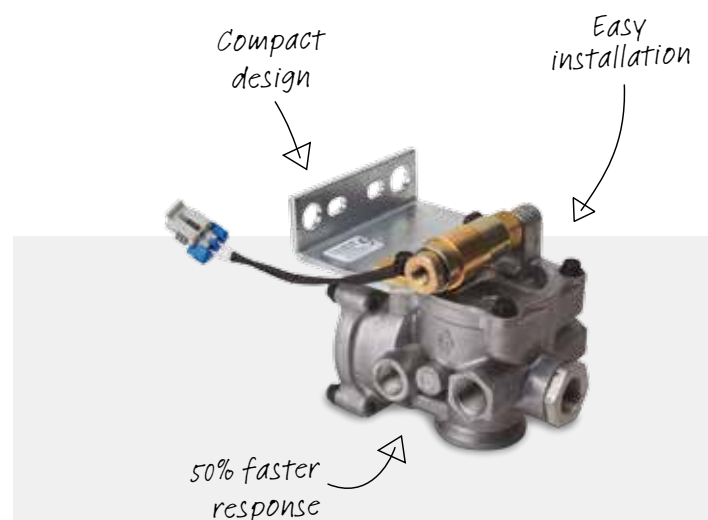
- > Fewer components than standard models, all housed in one sealed, corrosion-resistant unit
- > 10% lighter and 30% smaller than typical chassis array valve systems
- > Suitable for retrofit, 12v or 24v models available
- > Operating temperature range -40°C with options up to +125°C
- > Excellent environmental protection and vibration resistance



Lift Axle Control

Chassis-mounted lift axle control module for heavy duty trucks and trailers integrates two industry-proven, brake-style relay valves in a single unit:

- > Excellent flow capability for rapid axle actuation
- > Available with option of either electrical or air-pilot operation and can be mounted directly on the transmission



Space-saving Time-saving



Manifolds

Designed for the passing of air in and out of the cab, the manifold creates a distribution point for multiple air connections and a single installation point for pressure switches. Integrated tube connections provide increased productivity and reliability, reducing leak paths, overall weight and footprint. Each manifold is created specifically to the customer's needs.

Pass through manifolds:

High-performance devices to pass air through bulkhead plates.

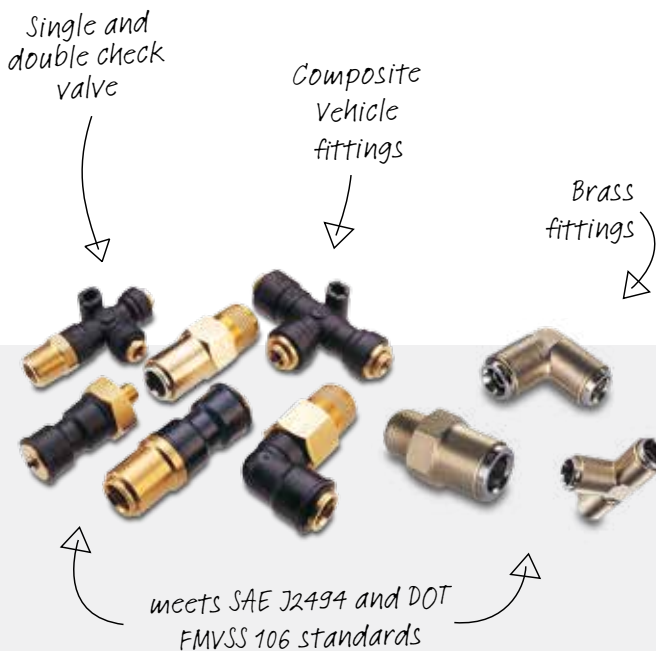
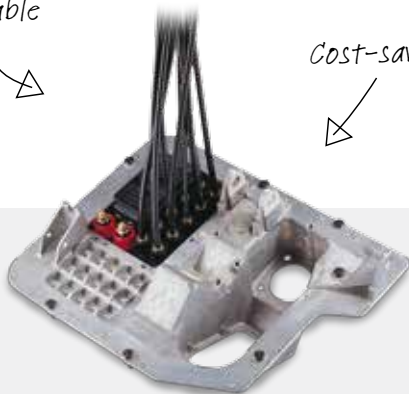
Air switch manifolds:

Incorporates a pneumatic connection to the electrical system for operating warning and brake lights.

Distribution manifolds:

A compact solution integrating multiple functionalities, such as check valves solenoid valve, pressure sensors / switches and pressure protection valves.

Reliable Cost-saving



Fittings and accessories

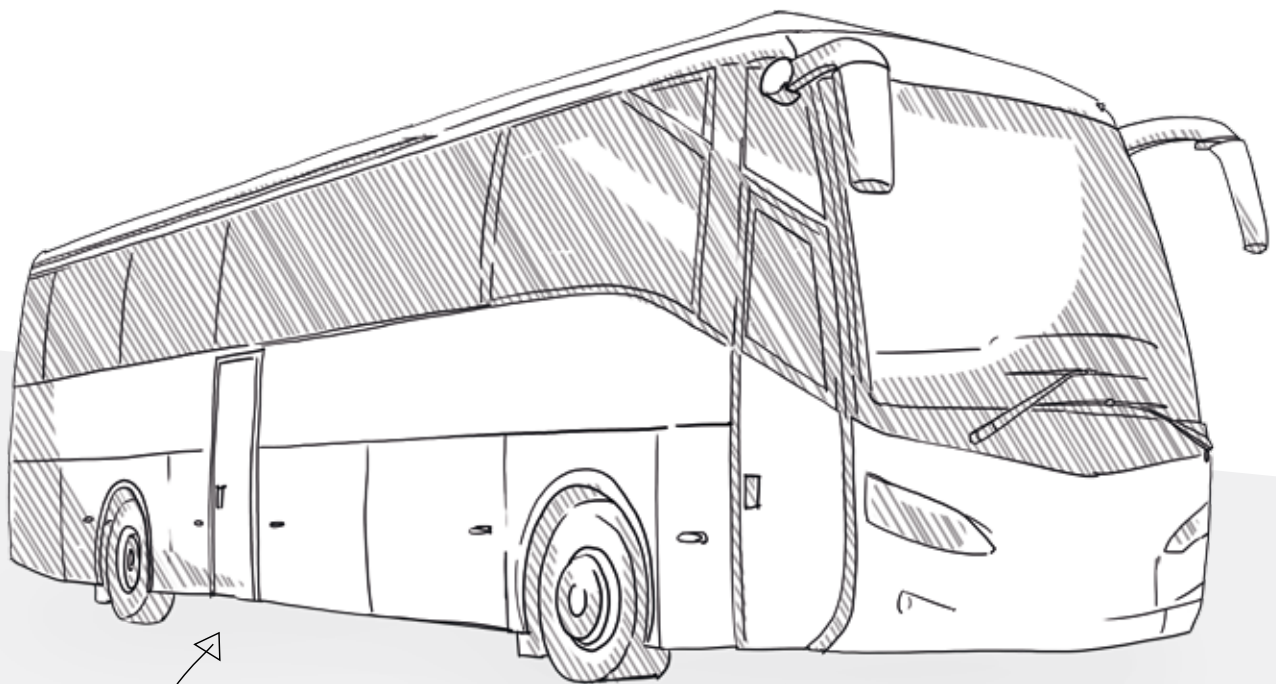
Unique push-to-connect designs allow air brake and auxiliary tubing connections to be made in seconds. Our fittings fully complement our other vehicle solutions, leading to reduced end-of-line leakage, and improving productivity and fuel economy:

- > Robust design proven over the last 30 years onboard vehicles used in airbrake, auxiliary and powertrain applications
- > Multi-tooth collet and rigid tube support to maximise grip in extreme temperatures
- > Pre-applied thread sealant and metric straight thread 'O' ring options available
- > Brass fittings - suitable for use under extreme conditions of pressure and temperature
- > Composite Vehicle Fittings - lightweight and corrosion resistant
- > Single and double check Valves - available with multiple port sizes to various cartridge and threaded bases
- > Integral tube connection and high flow characteristics

Bus

IMI Precision Engineering understands the need to provide a comfortable passenger environment, irrespective of the weather conditions outside.

On door opening systems, automatic obstacle detection and manual override options increase safety.



Door opening systems

Climate control

Door opening systems

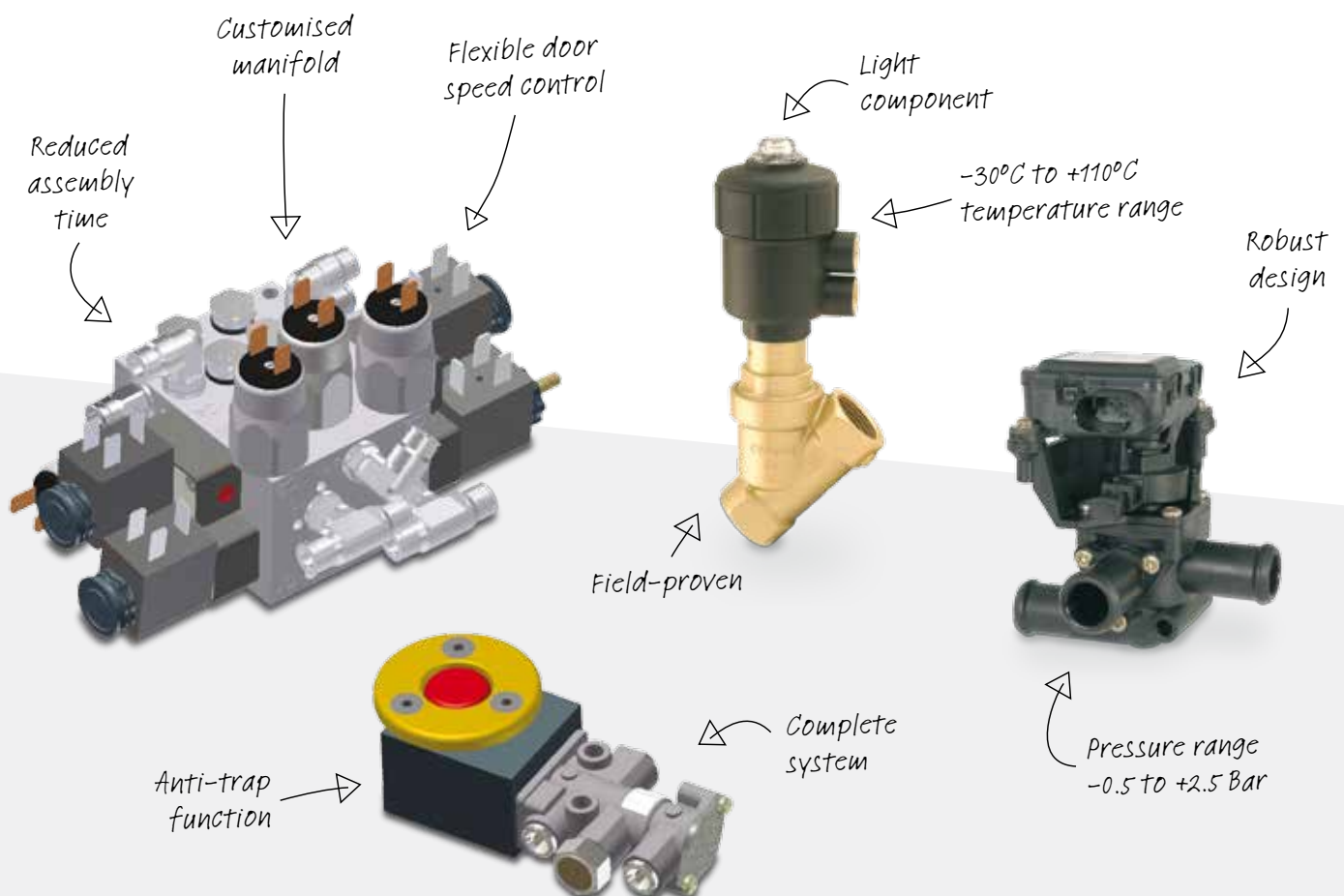
Our pioneering pneumatic control door-opening system for buses and coaches offers:

- > A complete, customised system built from three basic components: emergency valves, door-opening block and pneumatic cylinders
- > Integrated safety functions, including a manual override option and an automatic reverse function for obstacle detection

Climate control valves

Our high performance climate control valves offer motorised proportional and digital control of engine coolant, enhancing temperature control for passengers in buses and coaches. Features include:

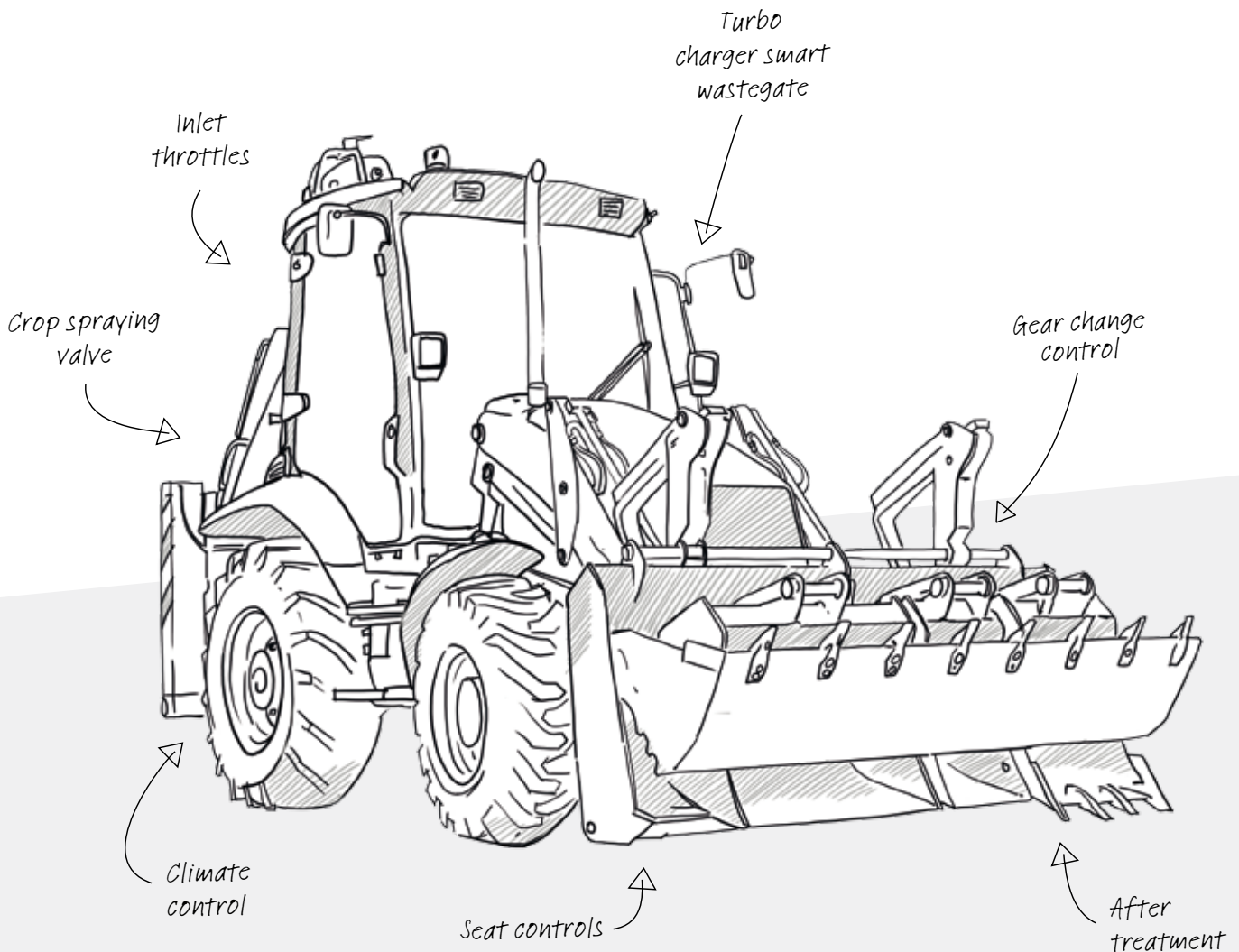
- > Digital control - damped closing reduces pressure shock to the coolant system and puts less strain on the radiator
- > Motorised proportional valve delivers constant flow and reduces pressure shock on the radiator, while power consumption closes off when a set point is reached
- > Ceramic discs are resistant to dirt and variation of temperature, ensuring a more reliable performance
- > Motor drive for flap control – EMV resistant and built to high IP classification (IP6K9K), it includes a gold plated pin contact to deliver high torque with minimal back lash
- > Coolant control valves for the temperature control of hybrid battery packs.



Off highway

IMI Precision Engineering's innovation has been delivering Engineering Advantage into heavy duty engines for over 35 years. All over the world, our products and local expertise have kept equipment functioning efficiently in even the most challenging environments, whether caused by extreme temperatures and vibration, or dirty and caustic conditions.

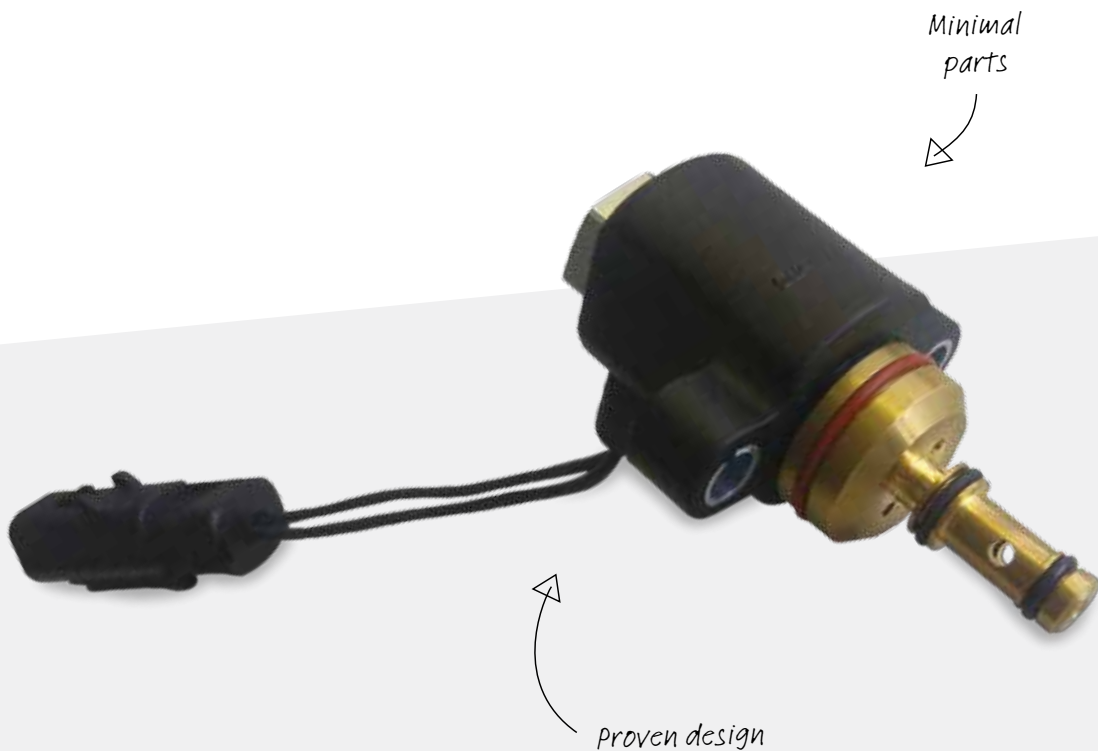
We have proven expertise of enhancing performance in tough applications, including heavy duty engines, rail, off-shore drilling and chemical processing.



Turbo charger smart waste gate

An integrated solenoid controlled via varying electrical signals from the ECU, which allows for the proportional control of the turbo wastegate. Our high-performance, innovative solution can be customised for each application:

- > Increased tuning flexibility to more easily achieve emission levels - Wastegate can be controlled to achieve required emission standards at emission measure points
- > Momentary over boost can be controlled
- > Optimised control for part load engine conditions
- > Absolute boost pressure accurately maintained at high altitude driving conditions
- > Uses boost air so does not require a separate air supply
- > Directly mounts on the turbocharger or remote mount on engine
- > Can assist in the improvement of fuel economy





Tractor control system increases driver comfort while improving productivity **case study**

When at work, tractors change direction and gear ratio regularly. Depending on the size of the field and the type of process, the gear is changed every few seconds. In order to improve driver comfort, a solution was required to allow automatic shifting and direction changes.

Using proven core valve technology, imi precision engineering designed a modular system that electro-hydraulically controls the clutches and gearbox, allowing smooth gear and direction changes. Tractors equipped with this system can be controlled semi, or fully automatically depending on selected configuration. There are two main systems, which can be used or combined:

Powershuttle

Changing drive direction “under the load”

The smooth forward and reverse movement in all temperature conditions increases driver comfort and allows the driver to focus on other tasks such as loading. Customisable to specific requirements, the power shuttle consists of a hydraulic valve block, electronic clutch pedal position sensor and transmission control unit.

Powershift

Changing gears “by the wire”

The quick and easy gear shifting helps the driver to focus on their tasks. The shifting can be done automatically when powershift is combined with the powershuttle system, which brings the biggest advantage for customers. Customisable to specific requirements, the power shift consists of a hydraulic valve block, hydraulic actuators and transmission control unit.



The future... is already here

IMI Precision Engineering understands the importance of both fuel efficiency and CO₂ reduction for our truck customers. That's why we are committed to developing pioneering exhaust heat recovery (EHR) solutions to enable OEMs to be compliant with emerging legislation and save fuel.

Mira technology park

Since 2012, our dedicated EHR team has been based at the mira technology park – the UK centre for transport technology.

Development requires unique test capabilities, including access to state-of-the-art facilities and independent industry expertise, making mira the ideal base.

The future is... exhaust heat recovery

Legislation to both reduce truck CO₂ output and improve fuel efficiency is unfolding. In response, engine and vehicle OEMs are developing technology that recovers exhaust heat, using it to boil a working fluid. The vapour generated is expanded to produce additional power for every litre of fuel consumed.

Our EHR fluid control experts are developing unique valve solutions to control the flow of liquid, vapour, exhaust gases and coolant in Rankine Cycle heat recovery systems – which will become standard fit on long haul trucks and high usage engines in the near future.

Working within a number of OEM development programmes, we have supplied 1st generation valves for use with both water and ethanol working fluids. These valves are unique in the industry, being:

- > Sealed for life
- > Inherently safe
- > Proportional
- > Multi-functional
- > High performance
- > Designed for truck applications

The designs enable more energy to be recovered than with existing valves. With the next generation in development, size, cost and weight are reduced whilst performance characteristics and durability are improved.

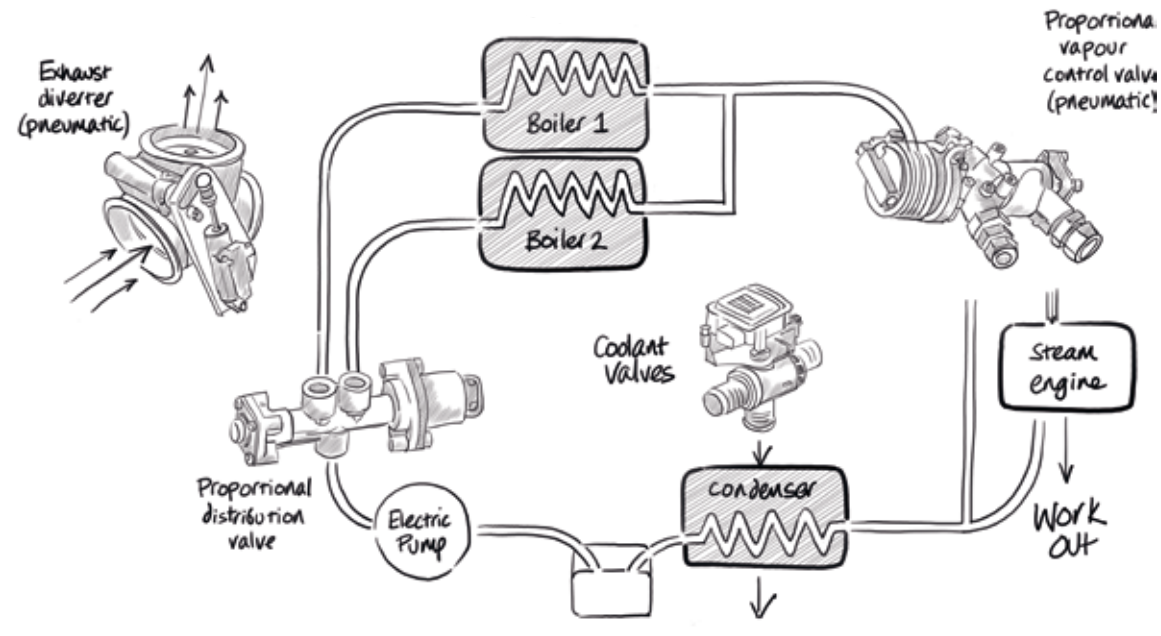
Our success is the result of extensive investment in both people and ethanol-capable facilities. Late in 2014, a bespoke Rankine System test cell was unveiled, linked with a state-of-the-art simulation model, the cell enables components to be tested and characterised, whilst validating the additional system performance benefits of using our valves.



Rankine heat cycle

The Rankine cycle utilizes a working fluid which goes through a phase change to recoup either mechanical or electrical energy from exhaust heat that would normally be lost to atmosphere.

With the IMI Precision Engineering control valve designs, the vapour conditions can be controlled and optimised to such an extent that energy can be recovered from previously inaccessible areas of a truck drive cycle. Crucially, our control valves also improve the performance of other Rankine system components.



Proportional vapour control valve



Various working fluids

Proportional steam control

Zero external leakage

The future is... natural gas (NG) technologies

Over the next few years, natural gas will penetrate the diesel market. Our market-leading product ranges create an extensive range of high-performance components and complete system solutions to meet the specific requirements of the natural gas industry:

Cryogenic valves

With its high energy density, liquefied natural gas (LNG) is fast becoming an alternative fuel of choice for medium and heavy duty vehicles as well as for high horsepower applications.

The performance and reliability of valves used in LNG applications is vital to the whole system. Since the temperature required to liquefy natural gas is -162°C , most valves need to meet cryogenic temperatures of -168°C to -198°C .

When compared to ball valves, our cryogenic solenoid valves help simplify your system design since they do not require instrument air. As a result, they reduce the amount of piping required as well as potential leak paths.

High
pressure
integrity



Improved
safety



- > Increasing energy efficiency
- > Improving the environment by simplifying the delivery of NG into vehicles and eliminating wastage
- > Improving the safety of NG delivery systems

It is predicted that, by 2020, 20% of commercial vehicles manufactured will be powered by natural gas.

- > Sizes from 3/8" to 2"
- > Connections: NPT or BSP threads, ASME 16.5 150 lb/sq. flange, others on request
- > Can handle temperatures as low as -200°C
- > Rated for working pressures of up to 100 bar

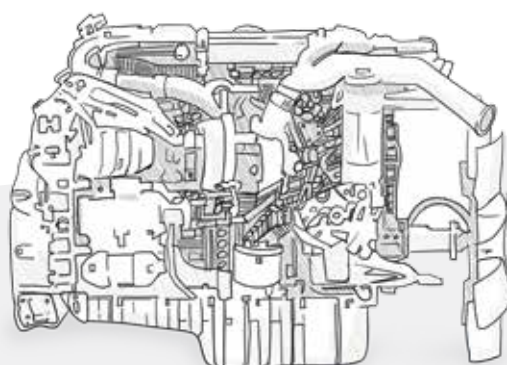
Gas conditioning modules

- > Filters
- > High/low pressure regulators

Systems Solutions

- > Integrated fuel conditioning and supply module

Fuel conditioning



Proportional
wastegate
control

Inlet





The future is... air suspension control

Building on our proven track-record in the automotive sector, we are currently developing pneumatic control for SUV and light truck air suspension.

This features innovative new valve technology which eliminates two valve blocks and the associated tubing and electrical connections, creating a more compact product and simpler installation. In addition, the valves are fitted directly into air spring as well as manifold blocks with integrated sensor for rear levelling and four corner ride height. The end result is increased passenger safety and comfort, plus improved stability and control for off-road performance.

*Integrated
solenoid
valve manifold*



IMI Precision Engineering operates four global centres of technical excellence and a sales and service network in 75 countries, as well as manufacturing capability in the USA, Germany, China, UK, Switzerland, Czech Republic, Mexico and Brazil.

For information on all IMI Precision Engineering companies visit www.imi-precision.com

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