



# axial control valve

streamlined flow path design for demanding applications

# Innovate to meet



**The early days** Mokveld was founded in 1922 in Gouda in The Netherlands, as a small machine repair shop. In the mid-fifties we started making valves, a development which accelerated when the Nederlandse Aardolie Maatschappij B.V. (joint venture between Shell and ExxonMobil) discovered the Groningen gas field in 1959. Mokveld started delivering valves for the production of the billions of cubic meters of gas and over the years was challenged to respond to constant changes with respect to safety, noise and emissions. By adapting and responding efficiently to the changes of the gas and oil industry our organisation has gained an excellent reputation as an international supplier of quality valve products.

# industry demands

## Industry challenges

Mokveld is committed to contribute to safe, reliable and sustainable development of the world's energy and water resources. Our track record of satisfied customers shows our capability for selecting control solutions, designing safety systems and managing projects successfully. The integrated control valve systems described in this brochure will help to meet your industry and project challenges.

## Worldwide experience

Mokveld has extensive experience in designing and manufacturing valves for the gas and oil industry worldwide. The product portfolio comprises a wide range of valve products, tailor-made to application and customer specifications;

### control products

- axial control valves
- axial choke valves
- angle choke valves

### safety products

- axial on-off valves (for HIPPS)
- axial surge-relief valves
- axial check valves

In addition a full range of pneumatic and hydraulic actuators with tailored control arrangements are available for accurate control and reliable operation of your process.

## Successful innovation

Regular contact with end-users and our familiarity with a wide variety of applications provide us with all the elements required for innovation. In cooperation with its customers Mokveld developed stand-alone HIPPS and axial choke valves. Recently we have engineered and successfully applied novel trim designs, subsea check valves and a new actuator line. Mokveld has extensive expertise in the field of noise reduction. This expertise is translated into up-to-date low noise technology solutions, which are tested in our high-pressure flow facilities and subsequently proven in the field.



### **Mokveld headquarters**

*The headquarters and high tech production facilities, are located in Gouda, The Netherlands (area 14 000 m<sup>2</sup> or 150 000 ft<sup>2</sup>)*



### **High-pressure flow facilities**

*Unique R&D high-pressure flow facilities are available for noise testing of innovative valve solutions*

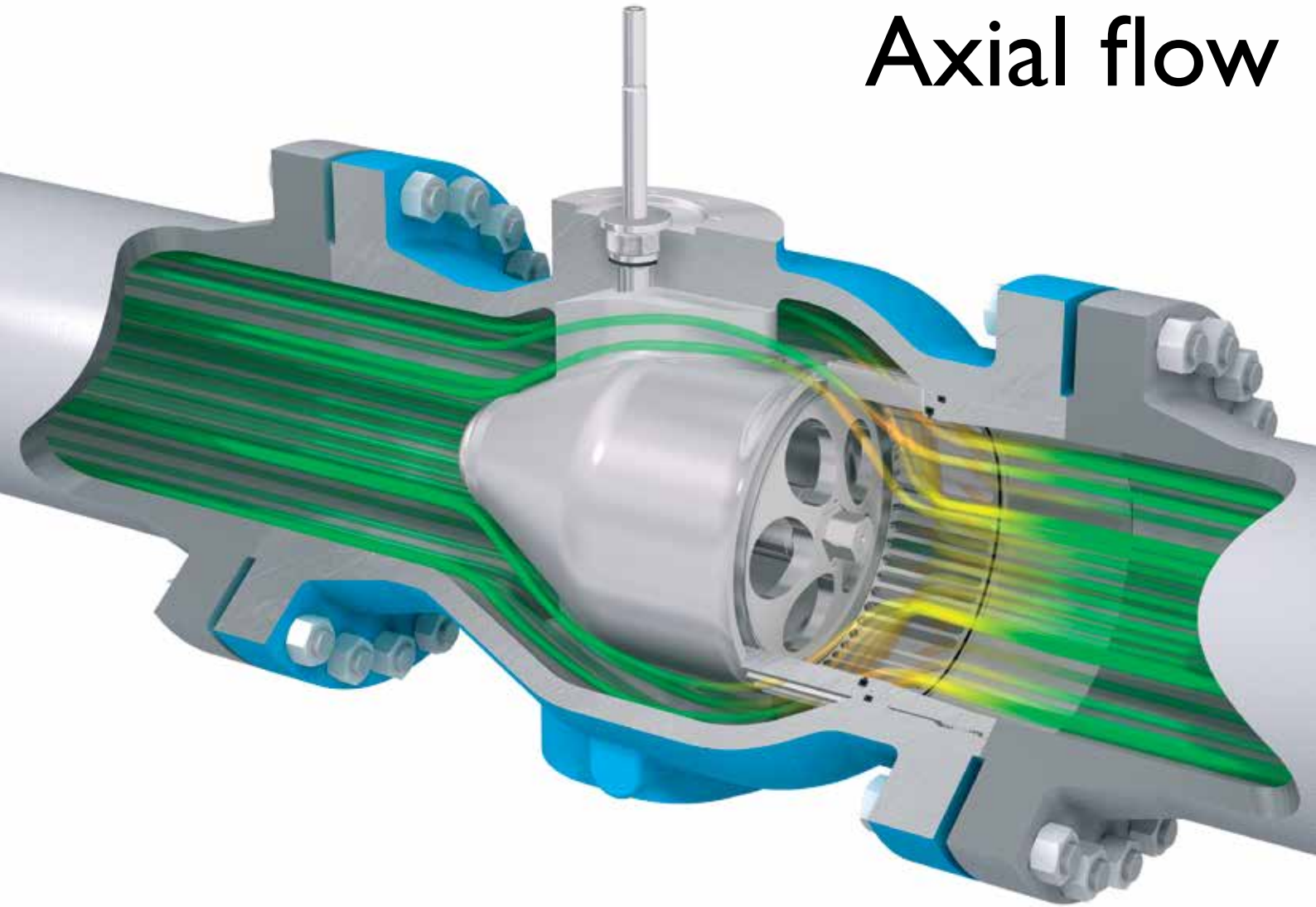


### **Dutch quality products**

*All engineered valve systems are tailor-made, produced and quality checked in The Netherlands*



# Axial flow



## A unique concept

Since the early 1900's an exceptional valve concept was used in hydro power plants: the axial flow valve. Axial flow refers to the streamlined symmetrical and unrestricted flow path between the valve inner and outer body. In the 1950's Mokveld acknowledged the unique advantages and adopted the concept into their control valves designs. Over the last decades our axial control valve has captured a strong position across the full range of gas and oil segments; production, processing, transmission, storage and distribution. The design has also proven to be the preferred solution for special water applications.

# a unique concept

## World class valves based on axial excellence

### A mature solution

By nature of design the axial control valve has unique benefits that make the valve specifically suitable for the more special and severe service control applications. Furthermore, Mokveld's engineering specialists added innovative trim technology, excellent sealing, fully pressure balanced piston and most vital; the unique Total Velocity Management® concept. The axial control valve solutions that we offer today are the evolution of all the valves that have been developed over the past fifty years. Axial flow has evolved from a unique concept to a mature design.

### Realise long-term benefits

Control valve selection is often based on outdated design philosophies and capital expenditure (valve price). However, control valves are critical elements in a process loop. Malfunction or failure of a control valve can seriously affect plant operation, the environment and your bottom line. Valve selection should be based on sound technical and economical arguments and long-term perspectives. Selecting Mokveld axial control valves with proven reliable performance will help to reduce costly maintenance and lost production time; the selection to ensure safe and reliable operation of your plant.



**8" / ASME 600 Axial Control Valve**

Application : Underground Gas Storage

Challenge : Accurate control

Location : Hajdúszoboszló (Hungary, 2001)



**24" / ASME 1500 Axial Control Valve**

Application : Distribution and Metering

Challenge : High turndown and high capacity

Location : Sleipner Riser (Norway, 2005)



**16" / ASME 600 Axial Control Valve**

Application : Anti Surge Control

Challenge : Fast stroking at -60 °C (-76 °F)

Location : Stepnovskaya (Russia, 1996)



# Total Velocity Management<sup>®</sup>

## Availability

Streamlined flow path through full-port body avoids turbulence and prevents erosion and vibration. Process downtime is minimized.

## Operational benefits

## Accurate control

Static and dynamic forces on the control element (piston) are minimized. Accurate control - also with minimum opening - is achieved.

## High capacity

The inherent capacity of the axial valve is extremely high. Consequently, special trim features or reduced valve size can be selected.

## Environmental benefits

## Silent

Streamlined flow path avoids turbulence and energy conversion in the valve body itself. Pressure drop is taken over trim only. Dynamic body noise is minimized.

## Low emission

The absence of a bonnet and the excellent sealing system ensure compliance with all international standards for fugitive emission.

## Low energy lifecycle

Fabrication energy requirement is minimal due to low weight casting. Pressure balanced design results in additional energy savings during operation.



# key to reliability



**Significant  
cost savings**

## **Compact**

The one-piece valve body provides 20% to 70% weight reduction compared to globe valves. In combination with small actuators the installation footprint is small.

## **High turndown**

Accurate control features make the valve suitable for applications that require high turndown providing a one-valve solution for the full process envelope.

## **Reliability**

Axial flow and Total Velocity Management® are vital for reliable control valve operation. Total cost of ownership is reduced and unplanned process downtime is avoided.



# Increased reliability and

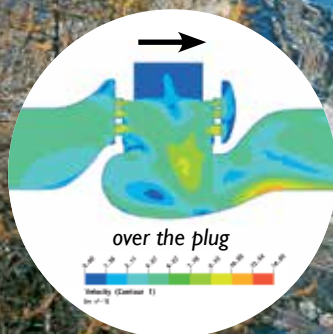
## Mokveld's Total Velocity Management® concept

Local high fluid velocities due to preferential flow paths are the prime source of noise, erosion, vibration and malfunction resulting from unbalanced forces. Prevention is better than cure. Mokveld Total Velocity Management® concept is an intelligent valve design that carefully manages fluid velocity in all areas of the valve (trim and body) by smart engineering of the relevant valve parts. Source treatment by Total Velocity Management® is the key to reliability.

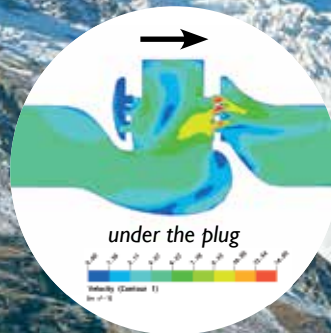
## Axially shaped for demanding applications

In the Mokveld axial flow design the streamlined annular flow path - and the evenly distributed flow through the cage - reduce high local velocities, turbulence and impacts of flow jets and particles. This is fundamental for reliable valve performance because vibration, erosion and unbalanced flow and forces are avoided.

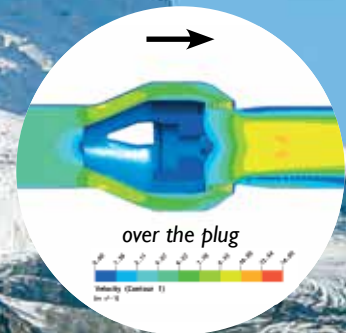
With a minimum of turbulence and change of the fluid velocity, there is no energy conversion in the valve body itself. Pressure drop is taken over the trim only, which has been specifically designed for this task. For extremely severe conditions the valve is often used as axial choke valve with - for instance - Tungsten Carbide material used for cage and piston.



**Conventional Globe Valve**  
Turbulence and high velocity at outlet wall give risk of vibration induced failures.



**Conventional Globe Valve**  
Preferential flow deteriorates trim performance and leads to unbalanced trim forces.

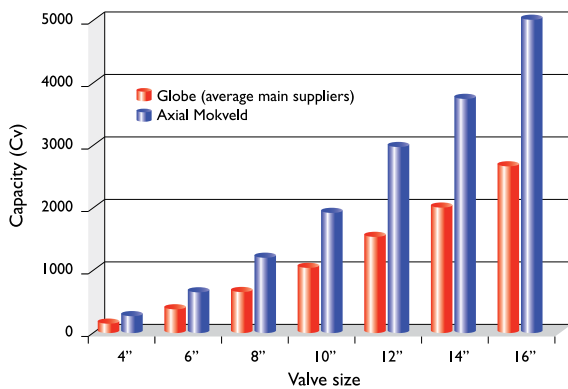


**Axial Control Valve**  
Axial flow and source treatment by Total Velocity Management® are the key to reliability.



# reduced operational costs

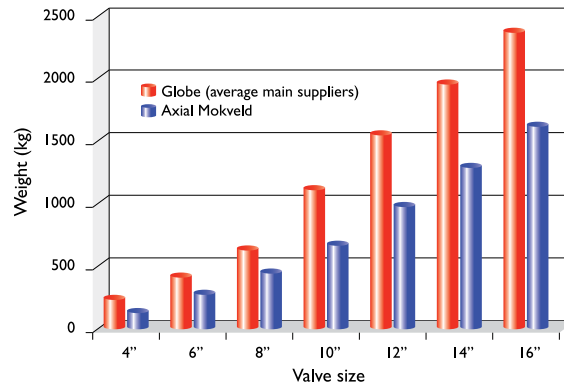
Capacity comparison between axial and conventional globe control valves (ASME 600)



## High capacity

The inherent capacity of the Mokveld axial control valve is very high compared to conventional globe control valve designs and enables the selection of a smaller valve size. Alternatively the higher capacity can be used to minimize pressure drop over the valve or to provide for special features, such as a modified control characteristic, additional noise abatement, anti-cavitation or a wider operating envelope for future process changes.

Weight comparison between axial and conventional globe control valves (ASME 900)



## A compact and low weight design

The axial flow valve is a rugged design and provides - especially in combination with relatively small actuators - a very compact and low weight solution. The benefits increase with increasing valve size and pressure rating and are of particular interest to the offshore industry. The compact and low weight design not only provides a small footprint, it also results in a more flexible installation as well as reduced handling risks and reduced costs for installation and support.

## Low emission and fire safe

The high integrity valve body is an integral casting, without any welds or bolted parts and no leak paths to atmosphere other than the stem conduit. A redundant stem seal is provided to prevent emission to atmosphere in case of leakage of the primary piston rod seals inside the inner body. The excellent sealing system ensures compliance with all international standards for fugitive emission. Periodic adjustment of stem packing is not required providing a low emission and outstanding solution for buried (underground) service. Furthermore the valve is inherently fire-safe.



# Setting the tone

## Silent

A control valve in operation is an integrated unit with several different possible sources of noise:

1. Noise generated by energy conversion over the trim
2. Noise generated by turbulence or cavitating flow through the valve body
3. Mechanical noise generated by vibrations and resonance of components

Over the past decades Mokveld has continuously improved its valve designs and was able to reduce valve noise significantly. The TotalVelocity Management® concept combats noise sources in all the above areas.

The axial control valve body is of a high pressure-recovery design (low FI-value) which means that the energy conversion exists within the trim only. This as opposed to the conventional globe valve, where a portion of energy conversion is uncontrolled within the valve body itself. As a result of the evenly distributed flow through the axial cage - full surround flow - the trim noise abatement technology is used efficiently (source 1).

The body flow noise is low since by nature of design the axial control valve minimizes turbulence. Also the ribs supporting the inner body - breaking vanes - are streamlined and contribute to minimum turbulence and flow induced noise (source 2).

Mechanical noise is initiated by vibrations, which - again - are minimized as a result of the streamlined flow path (source 3).

# for special control



## Trim selection

A wide variety of trims for gas or liquid are available, ranging from single-stage cages with high capacity and low-noise capabilities to multi-stage labyrinth-style cages offering very high noise abatement and/or high anti-cavitation coefficients. All trims can be provided with linear or equal% control characteristics.

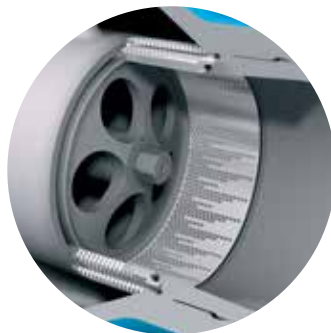
## Custom-designed trim

Depending on the process envelope we can design an application-specific trim to optimise control characteristic and valve size. For a pump application the trim could typically consist of multi- and single-stage sections with Kc and Cv characteristic to suit the specific applications.



### Selection of single-stage trims

Suitable for low to moderate pressure drops offering - dependent on type selection - very high capacity and considerable noise abatement.



### Selection of multi-stage gas trims

Ultra-low noise trims specifically designed for moderate to high pressure-drop gas applications.

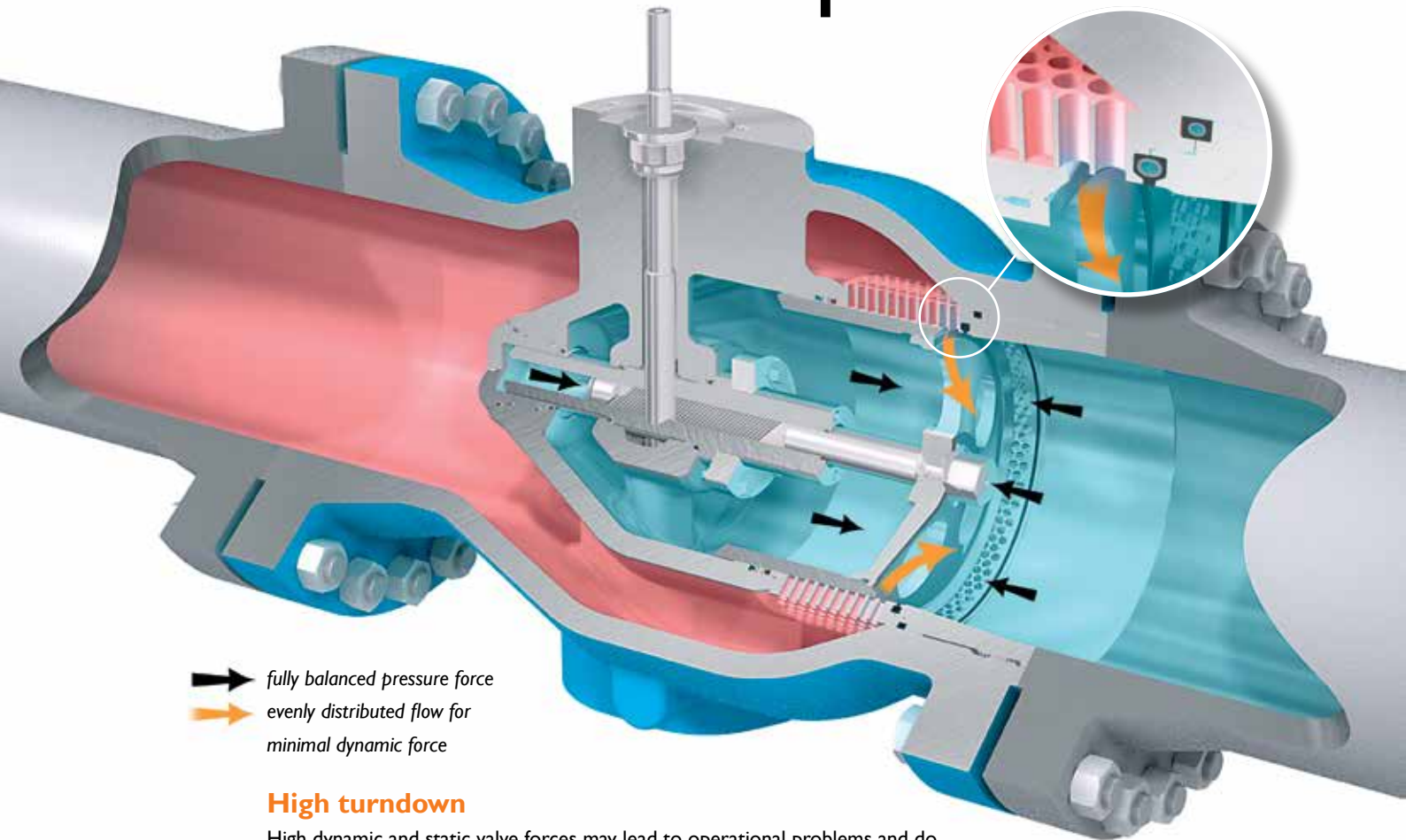


### Selection of multi-stage liquid trims

Designed to avoid cavitation at moderate to high pressure-drop liquid applications. Suitable for two-phase applications as well.



# Accurate and quick control



- ➔ fully balanced pressure force
- ➔ evenly distributed flow for minimal dynamic force

## High turndown

High dynamic and static valve forces may lead to operational problems and do require large size actuators. As a result of the evenly distributed flow through the cage, the dynamic forces on piston operation are negligible. Mokveld axial control valves are fitted with a fully pressure balanced piston assembly. The operating thrust is virtually independent of the differential pressure across the valve.

Fast response and short stroking times, as typically required for compressor surge control, are achieved with relatively small actuators. Reliable and maintenance free spring return actuators can be used up to very large valve sizes. The Mokveld axial control valve can control stable and accurately between 2 - 100% of the valve stroke. This means an increased rangeability (or turndown) and operating envelope (650 : 1). Large valves do not require an additional small bypass control valve.

# with small actuators

## Reliable transmission

The linear actuating forces are transferred from the valve stem to the piston rod by means of a 90° toothrack transmission system, which is a very accurate and rugged mechanism. Multiple teeth are continuously engaged which means that dead band and hysteresis are eliminated, which adds to the reliability of the valve. The same transmission system is used for High Integrity Pressure Protection Systems with superb and proven dependability. No maintenance is required.

## Bi-directional tight (Class VI) shut-off

Our patented main seal design provides for bi-directional tight (Class VI) shut-off. The control valve is also very suitable for normally closed control applications such as anti-surge, pump recycle, blow down and dump applications. Absence of leakage over the closed valve gives increased efficiency for compressors or pumps and minimizes erosion or cavitation damage to the piston and seat. In addition this provides the customer with a more flexible operation and the option of bi-directional flow. It also saves on investment in additional on-off valves.

## Integrated actuator and control systems

A full range of matching Mokveld pneumatic and hydraulic actuators with tailored control arrangements is available for accurate control and reliable operation of your installation. Electric and electro-hydraulic actuation is also available. Depending on functional requirements a variety of control arrangements can be engineered with components such as solenoid valves, quick exhaust valves, filter regulators, lock-up valves and volume boosters.

All our control valve products are fully integrated, operational systems. Each component is carefully selected and then tested during the various stages of a project to ensure balanced and trouble free start-up and operation.



### Patented seal design

Reliable and bi-directional tight shut-off is achieved by means of the patented seal design.



### Integrated control arrangements

Each control valve will be supplied with integrated fit-for-purpose control arrangement.



### Small actuators

Accurate and quick control with small actuators is possible because dynamic and static forces on piston are negligible.



# Comprehensive scope

## Valve range

Our range of valve designs covers the ASME, API and DIN ratings that are commonly applied in the gas and oil industry, up to API 10000 (690 bar design pressure) with related temperature ratings. For the -60 °C to 200 °C (-76 °F to 390 °F) temperature range we offer standard sealing solutions.

Valve diameter mm (")	Pressure rating					
	PN 20 ASME 150	PN 50 ASME 300	PN 100 ASME 600	PN 150 ASME 900	PN 250 ASME 1500	PN 420 ASME 2500
≤ 400 (16")						
≤ 600 (24")						
≤ 1200 (48")						

Larger sizes and higher pressure ratings (incl. API) upon request. The complete table with sizes and ratings can be downloaded from [www.mokveld.com](http://www.mokveld.com)

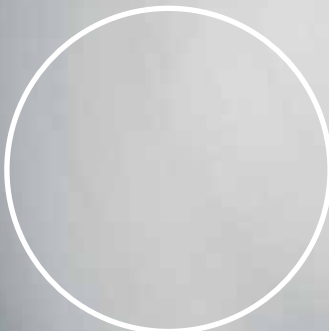
## Extensive material selection

Mokveld valve products are tailored towards the changing needs of the gas and oil market. We take into account that the medium will frequently contain free water, chlorides, CO<sub>2</sub>, H<sub>2</sub>S, and other corrosive compounds. Therefore valves are available in a wide range of body materials, varying from plain carbon steel to nickel based materials and even titanium. For the valve internals matching material selections are available, sometimes engineered to order. To avoid problems related to explosive decompression the standard seal selection is non-elastomeric HP lipseals.

## Quality and Health, Safety and Environment

At Mokveld we consider quality and health, safety and environment prime objectives for the successful completion of any project. An integrated QHSE management system focuses on continuous improvement. We aim to build customer trust and confidence through a quality of products and service that meets customers' requirements and expectations. In-house valve test facilities are available for hydrostatic and gas body and seat tests under ambient or cryogenic temperatures. All our products are designed and built in accordance with the required international standards and certified by recognized authorities such as Lloyd's and the American Petroleum Institute (API). Our valve designs comply with the standards that are most frequently used in the gas and oil industries, i.e. PED, API 6A-ISO 10423, API 6D-ISO 14313 and ASME B16.34. Next to these we are also familiar with Deutsches Institut für Normung (DIN), NORSOK, Russian GOST and a variety of standards specific to certain countries, users and projects. Mokveld quality and environment management systems have been certified according to NEN-EN-ISO 9001:2008 and 14001:2004 and OHSAS 18001:2007. We also hold various customer and country specific certificates and we are qualified for qualification systems like Achilles JQS and FPAL. A copy of our QHSE-manual can be submitted on request.

# at top quality



# global network - supported locally



## Mokveld Offices

- 1 Mokveld Valves BV
- 2 Mokveld USA Inc
- 3 Mokveld UK Ltd
- 4 Mokveld Norge AS
- 5 Mokveld Central Europe GmbH
- 6 Mokveld Marketing JV
- 7 Mokveld Valves BV, Middle East
- 8 Mokveld Valves BV, Saudi Arabia
- 9 Mokveld Valves BV, Asia Pacific
- 10 Mokveld Valves BV, China
- 11 Mokveld Valves BV, Algeria
- 12 Mokveld Valves BV, Brazil

## Addresses

**Gouda, The Netherlands**  
Houston (Tx), United States of America  
Cirencester, United Kingdom  
Stavanger, Norway  
Oberhausen, Germany  
Sumy, Ukraine  
Dubai, United Arab Emirates  
Al Khobar, Saudi Arabia  
Kuala Lumpur, Malaysia  
Beijing, the People's Republic of China  
Alger, Algeria  
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