

ENGINE STARTING OVERVIEW



OUR COMPANY



Hatraco is worldwide supplier, manufacturer and distributor of customized industrial engine equipment.

Founded in 1984 by Co Hasselaar, Hatraco has since grown from an one-man trading company to a company of 38 employees with a global network of offices, dealers and agents.

Hatraco provides solutions for stationary gas and diesel engines (including gas turbines) for the industry, marine, oil & gas and power generation in all sorts of applications.

With our: In-house engineering
In-house production
In-house service

we guarantee any project to be in the best hands, as we provide the best solutions. Furthermore, with an extensive network of international offices, dealers and agents world-wide, we can ensure fast service in your own language and availability of our high quality products.

Commitment

A testament to our commitment to keep improving is being ISO-9001:2015 certified.



Disclaimer

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Philosophy & Values

Our mission

To improve (industrial) engine performance and contribute to machine reliability in the after-market.

The manner in which we strive to fulfill our mission is by upholding our core values:

- **Be a partner to our customers**
Taking an individual approach towards customers in order to better understand their needs, provide the best solutions and build lasting relationships.
- **Be reliable**
Say what I do and do as I say. This is about honoring commitments on all levels, having transparent communication and always being clear and realistic with all parties involved.
- **Be knowledgeable & skillful**
By continuously nourishing knowledge and skills within the company we are able to keep delivering well-founded solutions.

In summary, Hatraco strives **to be and remain, a reliable and capable partner regarding solutions for (industrial) engines.**

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SPRING STARTING



Mechanical (spring) starting system

Spring starters are spring powered mechanical devices for starting diesel engines, as a replacement or as a redundant starting system allowing an engine to be started easily and safely by hand.

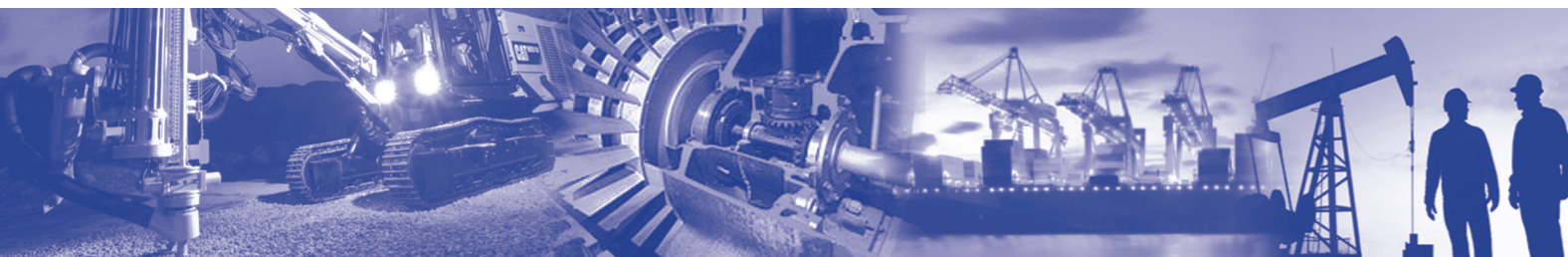
Kineteco spring starters

Kineteco spring starters which are suitable for a large range of diesel engines and can start small 400cc single cylinder- all the way up to 17 litre engines. A spring starter requires no external power systems unlike their electric or air (pneumatic) systems. A spring starter is simple, compact, dependable and often a preferred choice for back-up starting.

Product options

All Kineteco spring starters can be specified as follows:

- **Flameproof finish**, originally Lloyds Register approved, for use in hazardous environments.
- **E-pack dual start protection system.**
For dual starter installations where an electric starter is also used, E-pack prevents simultaneous starter engagement.
- **Pull cord.**



SPRING STARTER TYPES

Kineteco starter ranges by spring type

Two types of springs are used in Kineteco spring loaded starters.

Disc springs

Disc springs (also referred to as 'Belleville Washers') are conically shaped steel washers which are compressed by means of a ball screw.

Disc spring starter benefits are:

- High output torque
- Robust design



Power springs

Power Springs (also referred to as 'clock' springs) are like a coiled flat steel sheet which is wound up. Power spring benefits for spring starting are:

- High number of output revolutions
- Compact design



The user winds a spring in the starter using the supplied cranking handle and converts stored potential energy into rotational kinetic energy used to turn over and start the engine. The user can wind the ratcheted as fast or as slowly as they wish. Once wound, the spring starter can be tripped by pushing a trip lever on the starter when the user is ready and chooses to do so. Using a Kineteco spring starter is safe and easy.

Benefits

- Efficient
- Reliable
- Versatile
- Convenient
- Standard SAE and special mounting flanges available to fit every engine make and model
- Safe
- Simple and compact
- No external power source necessary
- No maintenance required
- Not affected by cold weather

Typical applications

Marine and offshore

- Auxiliary engines
- Emergency gensets
- Propulsion engines (life boats)
- Water pumps
- Compressor installations

Onshore Oil and Gas

- Water pumps
- Emergency generators
- Compressor installations
- Wire/slickline HPU's

Industry and Utilities

- Emergency generators
- Compressor installations
- Water pumps
- Mobile equipment (explosive atmospheres)

Agriculture

- Tractors
- Irrigation pumps
- Generators

Mining

- Transporters
- Drilling equipment
- Pumps

Military

- Emergency generators
- Water pumps
- Mobile equipment

SPRING STARTER RANGES

Spring Starters

SMS/SMR: For engines up to 4 litres



SMS/SMR power spring starters are ideal for smaller engines working in tough conditions. Designed for engines from 0.6 litres to 4 litres displacement, they are perfect for easy and safe hand starting. Using a power spring (rather than a disc spring) makes the body of the SMS/SMR range shorter and lighter. This allows it to be fitted to a wide range of previously incompatible engines.

SZS/SZR: For engines up to 4 litres

SZS/SZR spring starters are ideal where engine clearance or low flywheel inertia (common on modern engines) is a problem. With its flexible Z-drive gearbox, the SZS/SZR series can be configured to give greater engine clearance.



SS/SR: For engines up to 6 litres



The original pre-engaged spring starter with standard duty disc springs. Rugged, reliable with a guaranteed 5,000 start lifecycle. Versatile for all environments. Available with all additional features.

HSS/HSR: For engines up to 9 litres

This spring starter uses a set of powerful disc springs that are compressed as the winding handle is turned. The pinion is pre-engaged with the ring gear, and when the starter is tripped, the shaft is released to transmit the power of the spring into the engine. This spring starter delivers higher torque and long life.



SZHS/SZHR: For engines up to 15 litres



SZHS/SZHR spring starters are designed for engines from 1.25 litres to over 2 litres/cylinder, but are compact and flexible enough to fit smaller, difficult to start engines. With its flexible Z-drive gearbox, the SZHS/SZHR series can be configured to give greater engine clearance.

SZH+: For engines up to 15+ litres

The latest spring starter model: SZH+ have the capability of starting engines from 9 up to 15+litres. They feature all the benefits of the SZH range but with 50% more power, gaining only 70mm extra length on the SZHS/SZHR models. The Z-drive gearbox can be configured to give greater engine clearance.



HYDRAULIC STARTERS

Starter types & ranges

The patented Hydrotor® starter motor has been proven through many years of reliable service under environmental extremes worldwide. Available types and ranges:

- Type A : for engines up to 9 litres
- Type B : for engines up to 18 litres
- Type C : for engines up to 30 litres
- Type D : for engines up to 70 litres
- Type E : for engines up to 100 litres



Typical applications

Marine and offshore

- Auxiliary engines
- Emergency gensets
- Propulsion engines (life boats)
- Cranes
- Fire fight pumps (FIFI)
- Compressor installations

Onshore Oil and Gas

- Fire fight pumps (NFPA-20)
- Emergency generators
- Compressor installations
- Fracturing pumps
- Wire/slickline HPU's

Industry and Utilities

- Black start generators
- Emergency generators
- Compressor installations
- Fire fight pumps
- Mobile equipment (zoned areas)

Agriculture

- Tractors
- Water pumps
- Generators

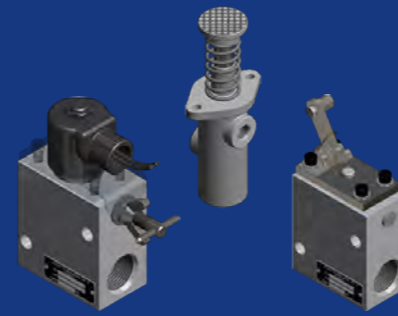
Mining

- Transporters
- Train locomotives
- Haul trucks
- Drilling equipment
- Pumps

HYDRAULIC STARTING COMPONENTS

Valves

There are several options when it comes to control valves. For those who are looking to actuate the hydraulic starting system manually, the two main options include foot pedal actuated and Bowden wire actuated valves. For operators interested in controlling starting system actuation via HMI (panel interface), KTI offers several options of solenoid operated valves that meet industry requirements including explosion proof.



Accumulators

With standard lines of 207 bar (3.000 psi), 345 bar (5.000 psi) and 689 bar (10.000 psi), KTI accumulators effectively cover the commercial range. We also offer a significant range of customized accumulators, which are only limited by the size of our machines. Our accumulators are available with the common classifications and certifications DNV-GL, LR, BV, ABS, CE- PED, ASME.



Pumps

Offered in numerous variations, the KTI recharging pump is driven by some form of prime mover (engine PTO or electric motor) to recharge the hydraulic starting system for starting attempts.

Featuring a built-in unloading valve, the recharging pump unloads when the pre-defined system pressure has been reached. While in this state, the pump is fully lubricated and can run continuously.



The KTI hand pump is a manual pump capable of regenerating system pressure for a starting attempt. Equipped with a 91 cm lever, the manual pump operates on "human" power and can recharge a hydraulic system in a black start condition, thus emphasizing yet another reason why it is relied upon in emergency starting applications.

Filters

High pressure filters, which are typically mounted between the pump and the accumulator and low pressure filters, which are typically mounted to the hand pump suction line are made of high strength, seamless carbon steel tubing and provide 40 micron filtration with minimal flow restriction.



HYDRAULIC STARTING SYSTEMS

Hydraulic starting systems

Hydraulic starting systems are the perfect solution when it comes to engine starting, either in a normal or critical situation. Powered by Kocsis Technologies Inc. products, Hatraco's hydraulic starting systems are extremely reliable under the hardest conditions, nearly unaffected by extreme temperatures and suitable for on- and offshore application. By manual operation and using a hand pump, hydraulic starting systems are capable of overcoming a "black start" condition proven to be critical during emergency situations. Hatraco's hydraulic starting systems are available in standard configuration or fully customized.

Custom hydraulic starting systems

Example 1:

Backup starting system for an Perkins 1106A – engine driven oil field genset.

Technical info

Requirements : 3 consecutive starts
Start duration : 2,5 seconds each attempt
Recharge time : Manual pump, 475 cycles from 0-207bar
Engine firing speed : 230 rpm
Design code / Certification : ASME / non

Example 2:

Backup starting system for Cummins QSK60 driven E-genset for FPSO MV32.

Technical info

Requirements : 3 consecutive starts
Start duration : max 5 seconds each attempt
Recharge time : within 10-15 minutes
Engine firing speed : 150 rpm
Design code / Certification : ABS on accumulators, complying with Brazilian NR13 standards

Suitable for harsh environments

Hatraco offers fully custom hydraulic starting systems for engines up to 100 litres, with start durations up to 90 seconds, for marine, offshore, oil and gas, mining and industry markets.

Example 3:

Backup starting system for Cummins QSK95 driven fire water pump for FPSO Barossa.

Technical info

Requirements : 6 consecutive starts
Start duration : max 15 seconds each attempt
Recharge time : within 45 minutes
Engine firing speed : 120 rpm
Design code / Certification : DNV drawing and skid approval based on DNV supervised assessment

AIR STARTERS

TDI Air Starters

TDI pioneered turbine air starters for reciprocating engines in 1979 by delivering reliable performance in the world's harshest environments. Their reputation and market share has grown ever since, making TDI TurboTwin and TurboStart the most prevalent turbine air starters in the oil and gas industry, on the open waters, at utility power plants, and on mining vehicles around the world. Available TDI starter types:



T30 : for engines up to 20 litres

Max. engine displ. : 20 litres
 Max. power output : 26 Kw
 Torque : 183 Nm
 Drive type : Inertia & pre-engaged



T50: for engines up to 80 litres

Max. engine displ. : 80 litres
 Max. power output : 30 Kw
 Torque : 326 Nm
 Drive type : Inertia & pre-engaged



45M: for engines up to 115 litres

Max. engine displ. : 115 litres
 Max. power output : 43 Kw
 Torque : 440 Nm
 Drive type : Pre-engaged



T6/T7: for engines up to 150 litres

Max. engine displ. : 150 litres
 Max. power output : 39 Kw
 Torque : 461 Nm
 Drive type : Pre-engaged



T100: for engines up to 300 litres

Max. engine displ. : 300 litres
 Max. power output : 50 Kw
 Torque : 476 Nm
 Drive type : Inertia & pre-engaged

Typical applications

Marine and offshore

- Auxiliary engines
- Emergency gensets
- Propulsion engines (life boats)
- Fire fight pumps (FIFI)
- Compressor installations

Onshore Oil and Gas

- Fire fight pumps (NFPA-20)
- Emergency generators
- Compressor installations

Industry and Utilities

- Emergency generators
- Compressor installations
- Fire fight pumps
- Mobile equipment (explosive atmospheres)

Mining

- Transporters
- Train locomotives
- Haul trucks
- Drilling equipment
- Pumps

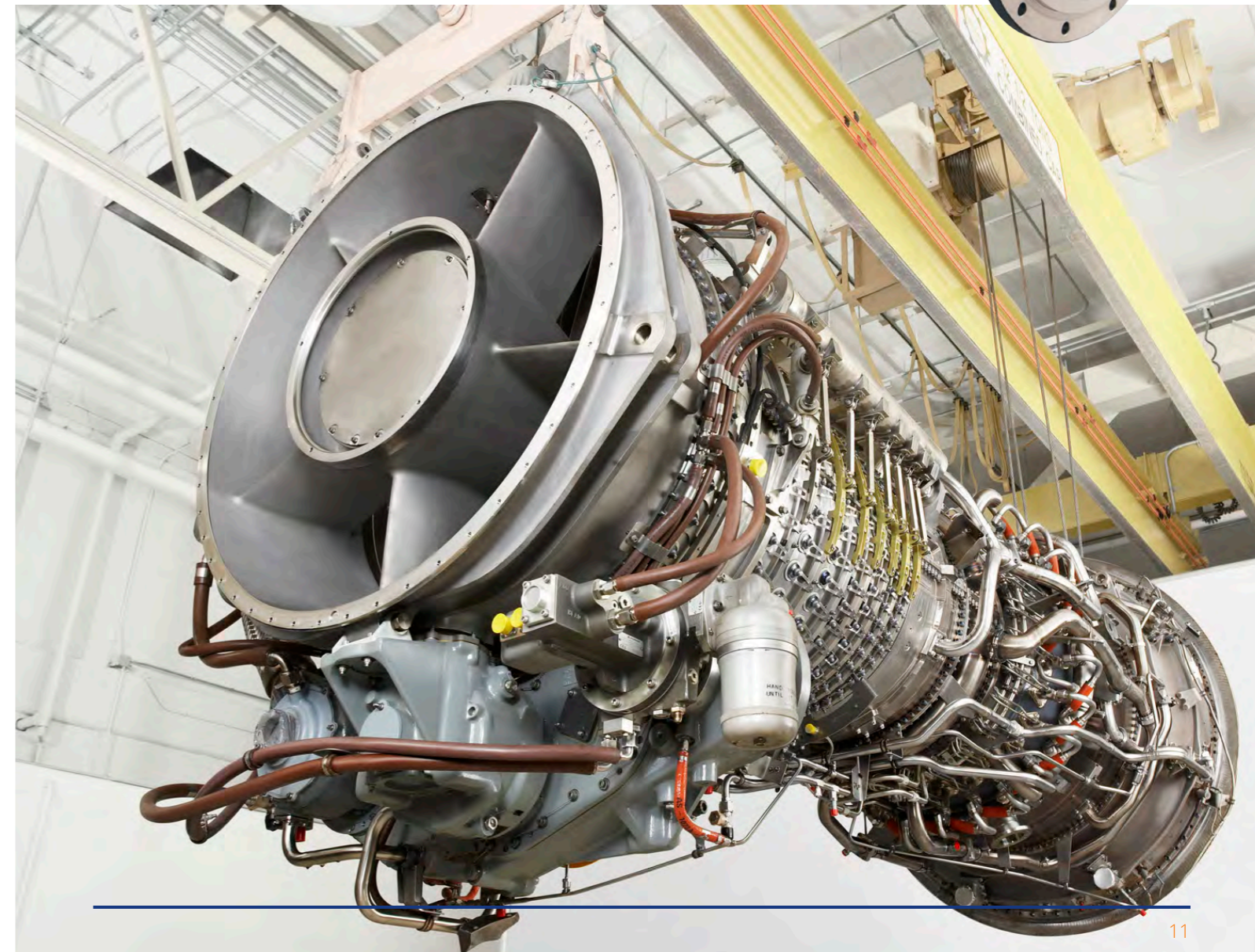
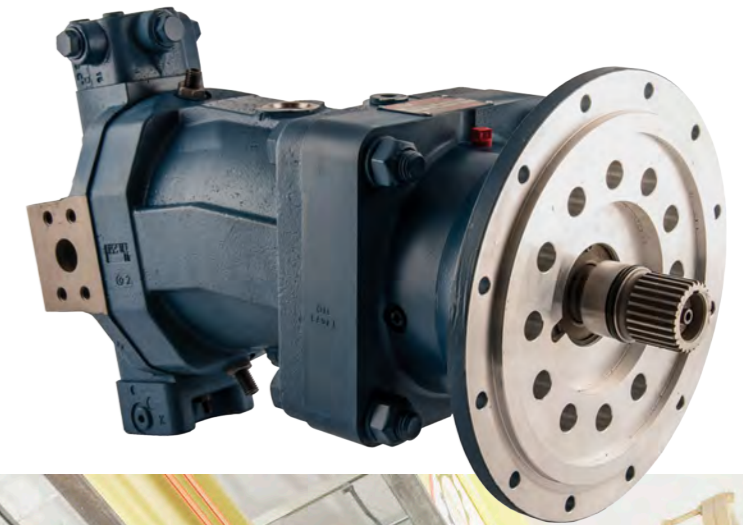
TURBINE STARTING

Gas turbines (gearbox)

Simplicity, easy maintenance, and the ability to handle environmental issues like large particles, dirty field gas, and contaminants are the characteristics of TDI Turbostart air starters for gas turbines. These are qualities that TDI continues to develop to this day. With a Turbostart low pressure type, switching from expensive aero derivative starters to Turbostart air starters for gas turbines, is easier than before. The new low pressure models operate on 3,5 bar (50 psi) max pressure enabling a much easier retrofit into existing aero derivative start systems.

Type 56: for gas turbines

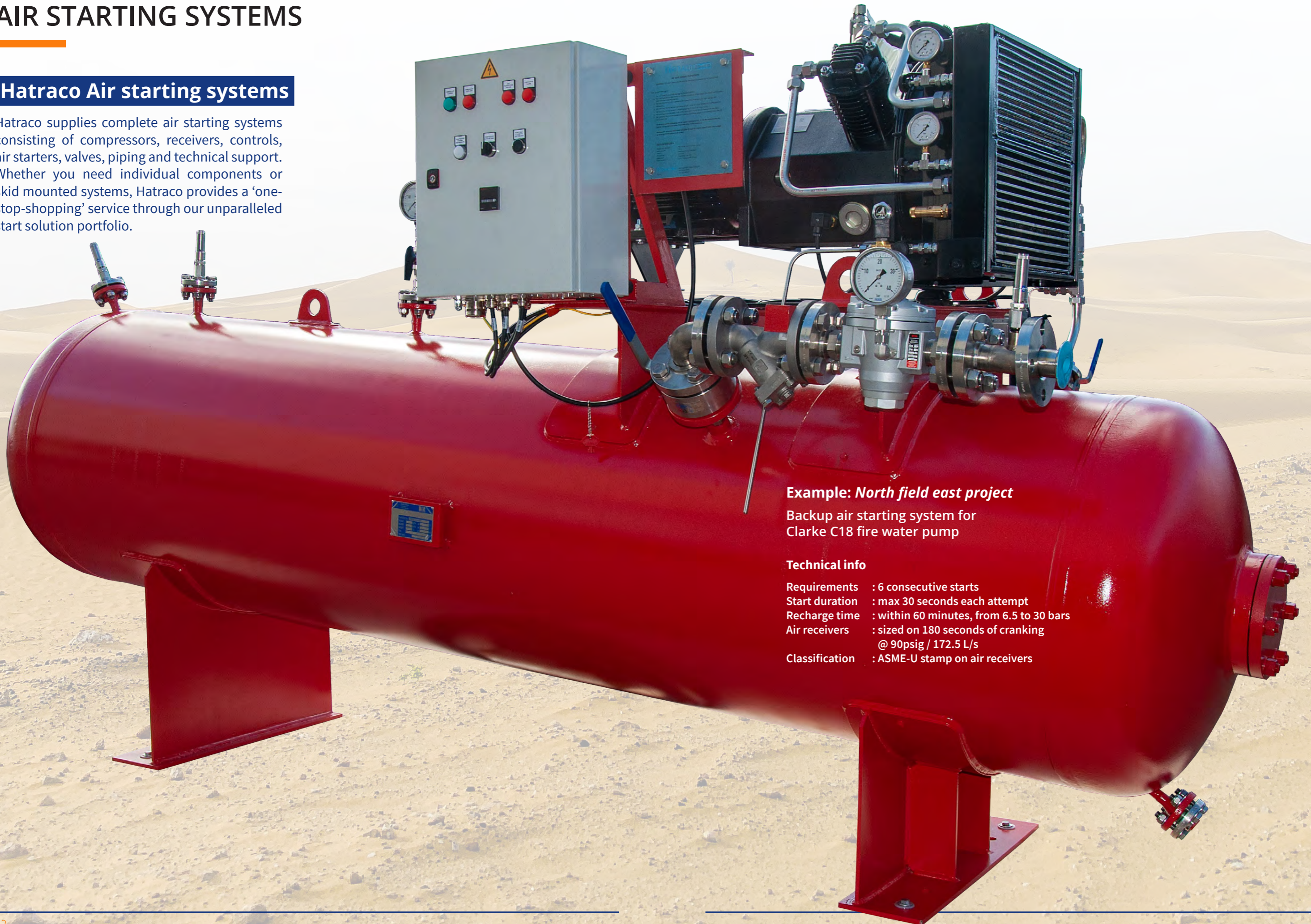
The 56serie is the ideal type to retrofit existing and expensive aero derivative starters used by the major gas turbine OEM's available in standard and low pressure versions. TDI's unique sprag clutch evenly distributes torque across 22 points of contact (compared to three typical systems) which reduces wear by over 400%, extending life, assuring reliability, and eliminating the need for temperamental ramping controls.



AIR STARTING SYSTEMS

Hatraco Air starting systems

Hatraco supplies complete air starting systems consisting of compressors, receivers, controls, air starters, valves, piping and technical support. Whether you need individual components or skid mounted systems, Hatraco provides a 'one-stop-shopping' service through our unparalleled start solution portfolio.



Example: North field east project

Backup air starting system for Clarke C18 fire water pump

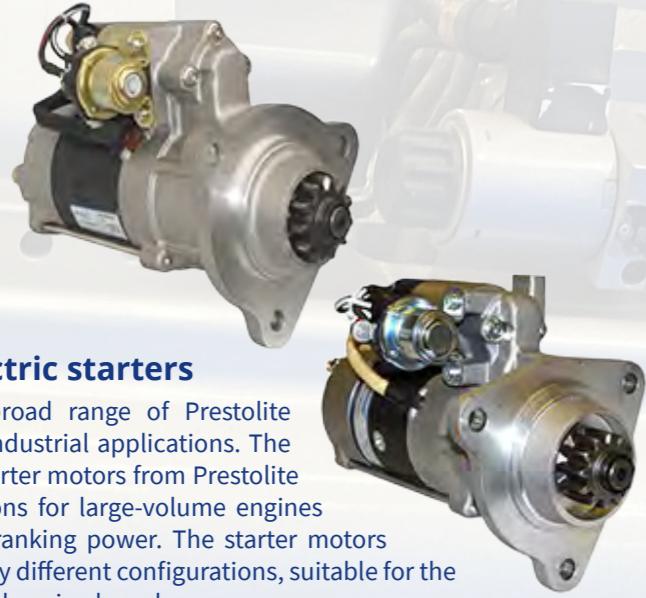
Technical info

Requirements : 6 consecutive starts
Start duration : max 30 seconds each attempt
Recharge time : within 60 minutes, from 6.5 to 30 bars
Air receivers : sized on 180 seconds of cranking
@ 90psig / 172.5 L/s
Classification : ASME-U stamp on air receivers

ELECTRIC STARTING SYSTEMS

Electric starting

The electric starter motor is the most common type used on gasoline engines and small diesel engines. The modern starter motor is either a permanent-magnet or a series parallel wound direct current electric motor with a starter solenoid (similar to a relay) mounted on it.



Prestolite electric starters

Hatraco offers a broad range of Prestolite starter motors for industrial applications. The Heavy Duty (HD)-starter motors from Prestolite are the best solutions for large-volume engines requiring electric cranking power. The starter motors are available in many different configurations, suitable for the majority of industrial engine brands.

Typical applications

Marine and offshore

- Auxiliary engines
- Propulsion engines (*life boats*)
- Fire fight pumps (*FIFI*)

Onshore Oil and Gas

- Fire fight pumps (*NFPA-20*)
- Gas generators (*CHP*)
- Compressor installations

Industry and Utilities

- Gas generators (*CHP*)
- Fire fight pumps (*NFPA-20*)
- Mobile equipment

Agriculture

- Tractors
- Trucks
- Generators

Mining

- Transporters
- Drilling equipment
- Pumps

Military

- Fire fight pumps
- Mobile equipment

QUALITY STANDARDS

Things to know about Hatraco starting systems

Air starting

Air starting can be used at applications where compressed air or other starting gas is present under pressure in a sufficient amount. It is a very reliable and clean method of starting an engine. As mentioned at the beginning of this chapter, typically there are two engine air starting methods: Ring gear starting and starting by means of "air-in-head".

Reciprocating engines & gas turbines

Supported by Tech development inc. Hatraco supplies air and gas starters for reciprocating engines and gas turbines.

Gas turbine starters

OEM, stationary gas turbine engines are often equipped with starter motors designed for flight. TurboStart gas turbine starter motors are specifically designed for (non-flight) stationary gas turbine engines. The manufacturing efficiency for "ground" applications delivers a significantly lower purchase price; that is thousands of dollars less than starters designed for flight. The savings also continues in the field. No need for pre-lubricated drive air and the simplicity of the single planetary gear design makes the unit almost maintenance free. Besides of the air/gas driven starter line there is a hydraulic starter line for gas turbines as well. Hatraco supplies gas turbine starters for: GE, Allison, Dresser Rand, Kongsberg, Kawasaki, Pratt and Whitney, Rolls Royce, Solar and Volvo.

Reciprocating engine starters

TDI pioneered turbine air starters for reciprocating engines in 1979 by delivering reliable performance in the world's harshest environments. Their reputation and market share has grown ever since making TDI TurboTwin and TurboStart the most prevalent turbine air starters in the oil and gas industry, on the open waters, at utility power plants, and on mining vehicles around the world.

Pressure and volume

A benefit of using higher system pressures is that the storage volume can be kept relatively small. Although these pressures are not always obvious in every environment or difficult to maintain. Diesel and gas engines can already be started with pressures as low as 2-4 bar by using the low pressure turbine technology of TDI air starters.

Product supply

We have the expertise to help you with any type of air starting equipment. We supply your equipment skid mounted, containerized or as stand-alone components according to the project requirements.

Standards

ATEX and CSA

For applications used in explosive atmospheres our air starting systems are available in ATEX and CSA versions according to ATEX MARKING: CE EX II 3 G c T4 (Ta= -34 to 79C) and Class 1, Div 2, Groups C and D.

Bureau Veritas, DNV-GL, ABS

All TDI air starters are certified and in compliance with the regulations of the above mentioned parties.



For a customized advice, please contact us through our global network of offices, dealers or agents.

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