



Twin-input propulsion gearboxes for green systems



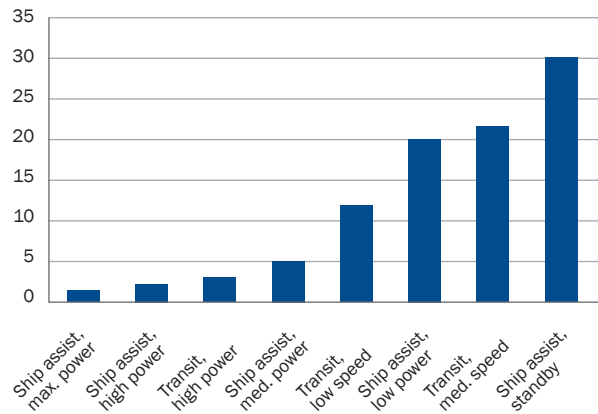
Green Marine drives – A mechanical alternative

The propulsion lines on tugs and AHT's are traditionally optimized for maximum power during bollard pull. This is not compatible with high fuel efficiency in other modes, e.g. transit, towing and DP-operations. The table on the right illustrates typical working modes for a tug, i.e. showing that tugs mostly **do not** operate at full power.

The Kumera 2E4D6C-2500 is an advanced gearbox for a diesel-mechanical alternative to Green drive & Hybrid systems. The Kumera gearbox facilitates optimized efficiency of propulsors and engines in all working modes.

The ASD tug "BB Power" is operating with two Kumera 2E4D6C-2500 gearboxes installed, each driven by two diesel engines, in a father-and-son set-up.

TUGS - OPERATING PROFILE
% of time in operating condition



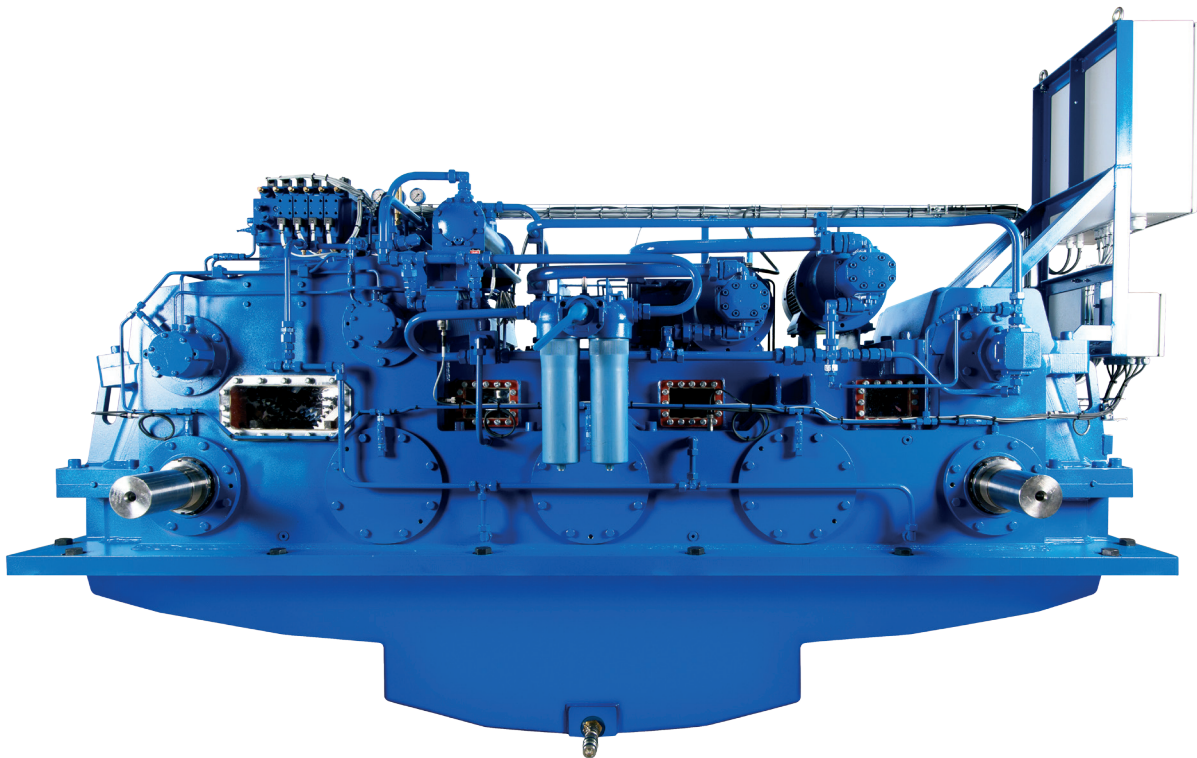
” Due to the innovative propulsion system including the 4 ABC main engines and the two-step Kumera gears, we have achieved above **20% lower fuel consumption** compared to our more traditional ASD tugs.

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Kumera 2E4D6C-2500 gearbox features

- Twin-input gearbox, each driven by two diesel engines, in a father-and-son set-up
- The gearbox can be powered by either one of the engines separately, or by both engines at the same time
- Split function allows the two engines on each gearbox to run independently when in DP-mode, i.e. different rpm on the father and son engines
- Each gearbox has six built-in hydraulic clutches
- Two-speed gearing for the propulsion, i.e. two different transmission ratios
- Total transmitted power for each gearbox: 3350 kW
- Each gearbox is driving:
 - main propulsion (azimuth)
 - PTO for Fi-Fi pump
 - PTO for winch pump
 - PTO for shaft generator (used to power the bow thrusters)

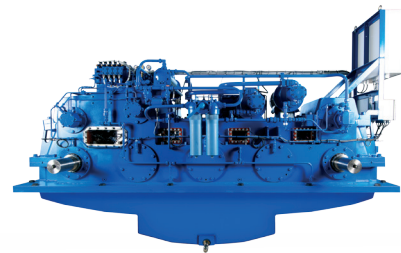


Advantages with a 4-engine system and Kumera twin-input gearboxes

Compared to a 2-engine system, a 4-engine system combined with two Kumera twin-input gearboxes will provide the following benefits:

- Approximately 40% reduction in running hours of the main engines
- Low-load running of the engines will be more or less avoided
- Reduced noise and vibrations
- Resulting from the above points, there is naturally:
 - Reduced fuel consumption
 - Reduced soot and particle emissions
 - Higher exhaust temperatures, which improves the efficiency of any SCR
 - Prolonged engine lifetime

The below table indicates the favorable efficiency losses for this twin-input, two-step diesel-mechanical system compared to two other typical drive systems.



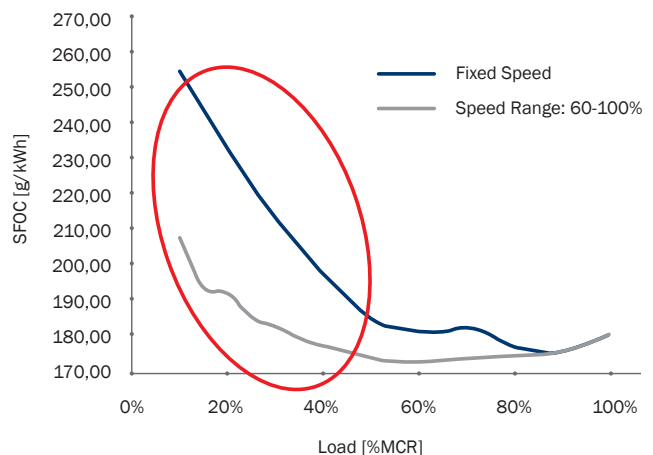
OPERATING PROFILE	DIESEL-ELECTRIC	DIESEL-MECHANICAL	2-STEP GB DIESEL-MECHANICAL
Bollard Pull	12%	2%	3%
Economic Transfer (20-30% power)	20-25%	8-10%	3-5%
Towage	15-20%	5-8%	3-5%
DP	20-30%	30-40%	10-20%

DURING DYNAMIC POSITIONING OPERATIONS

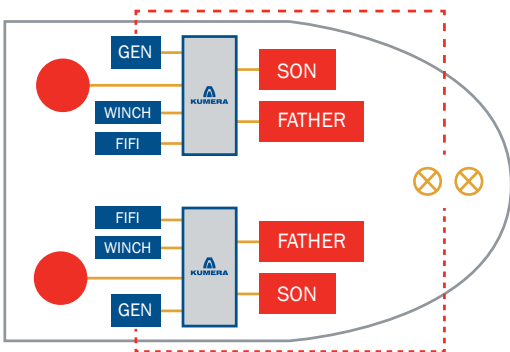
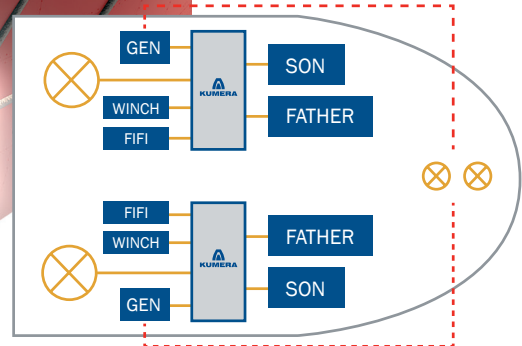
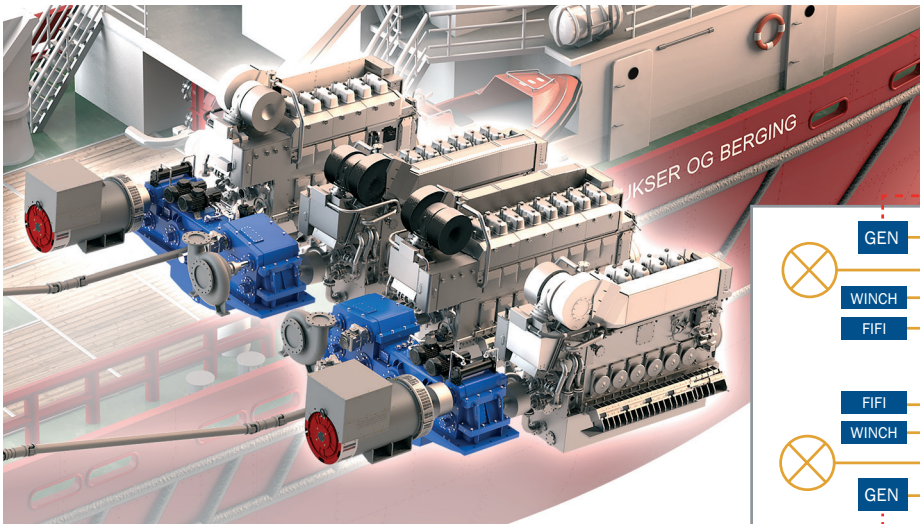
The smaller diesel engines will drive the bow thrusters, and at the same time the larger diesel engines will power the azimuth thrusters – the Kumera gearboxes are then in split-mode.

Both the father and son engines run with **variable rpm**, optimizing the efficiency of the propellers and the specific fuel consumption of the engines, resulting in reduced emissions – this effect is further enhanced by the two-speed gearing of the Kumera gearbox.

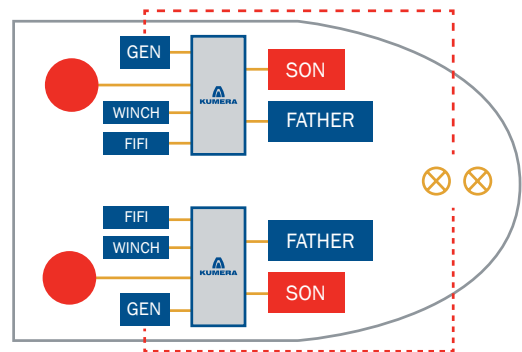
COMPARISON OF FIXED AND VARIABLE RPM SYSTEMS BY LEVEL OF EMISSIONS



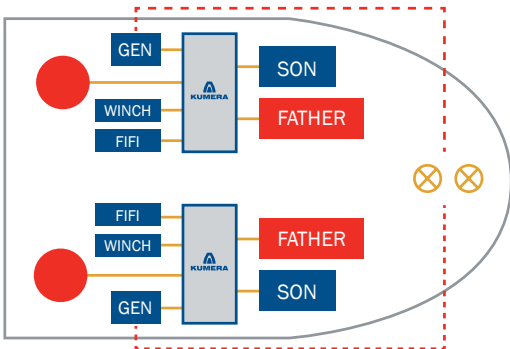
“BB Power” propulsion line and main working modes



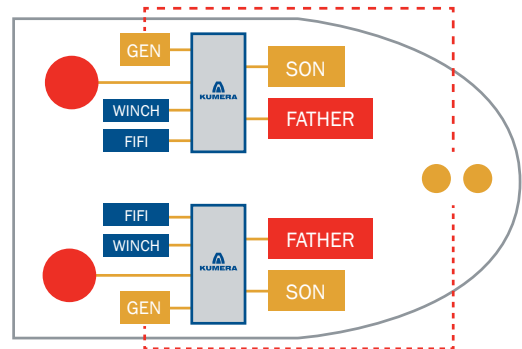
Max bollard pull – Gear step 1



Transit and lighter loads – Gear step 2



Towing and normal ops – Gear step 2



Dynamic positioning ops – Gear step 2

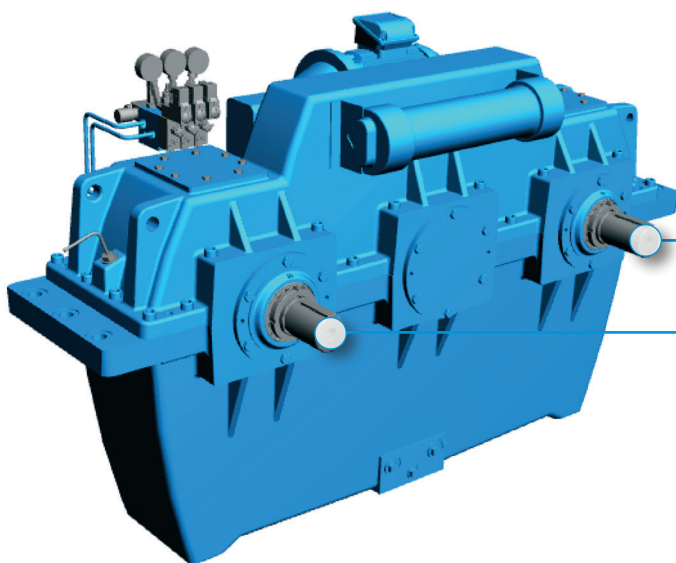
Tailor made propulsion lines and gearbox designs

Kumera can readily tailor make multiple-input gearboxes to:

- Specified power
- Different power sources
- Multiple transmission ratios
- Specified number of PTOs
- Multiple built-in hydraulic clutches

Concept development and new solutions for alternative propulsion systems are driven by the increased focus and requirements for more environmentally friendly ships. Particularly the new IMO regulations for Environmental Controlled Areas (ECA), will force the development of green drives.

Kumera is in the forefront of this process, by developing and offering power transmissions suitable for your requested green drive systems

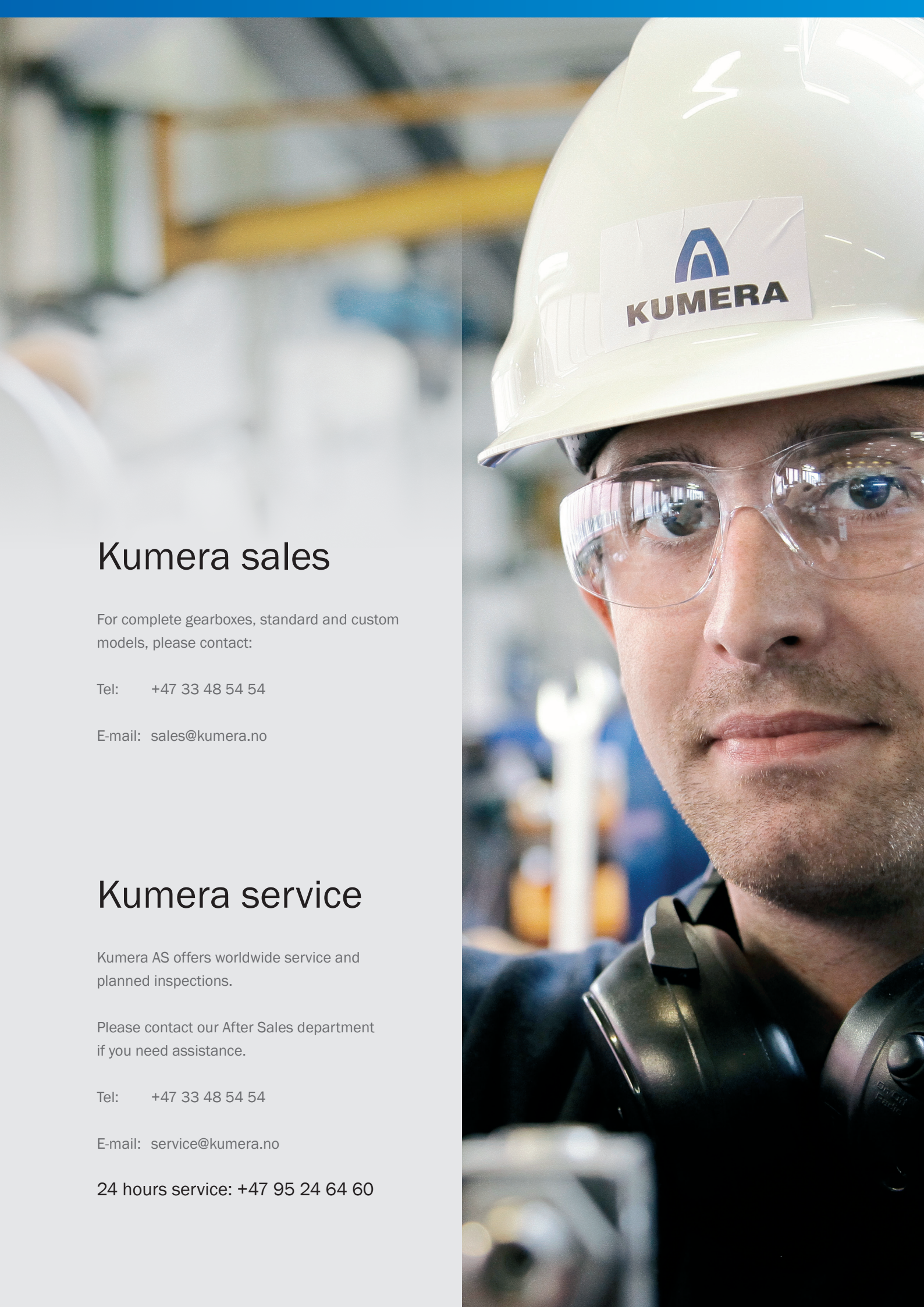


Motor/Generator

To azimuth unit

COMBINING ENGINE AND MOTOR

A variant of the two diesel engine system described above for the BB Power, is a system combining one diesel engine with one electric motor/generator. One basic design for this set-up is illustrated below. The diesel engine input is on the opposite side.



Kumera sales

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Kumera service

Kumera AS offers worldwide service and planned inspections.

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Global Sales and Service

For decades, Kumera has been known as a global leader in industrial and marine gear solutions, with more than a hundred thousand Kumera gear units installed at customer locations around the world. Our global network of service providers offer local support for your gear unit through consultation, installation, training, replacements, spare parts, condition monitoring and overhauls. Contact a Kumera sales or service representative to learn more.



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