

THRUSTER RANGE



Thruster Systems
for any kind
of ship



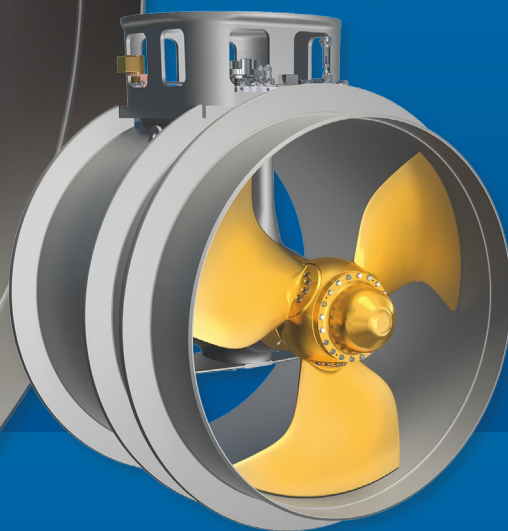
BRUNN

Thrusters for manoeuvring,



The Largest – 3,500 kW

The Smallest – 100 kW

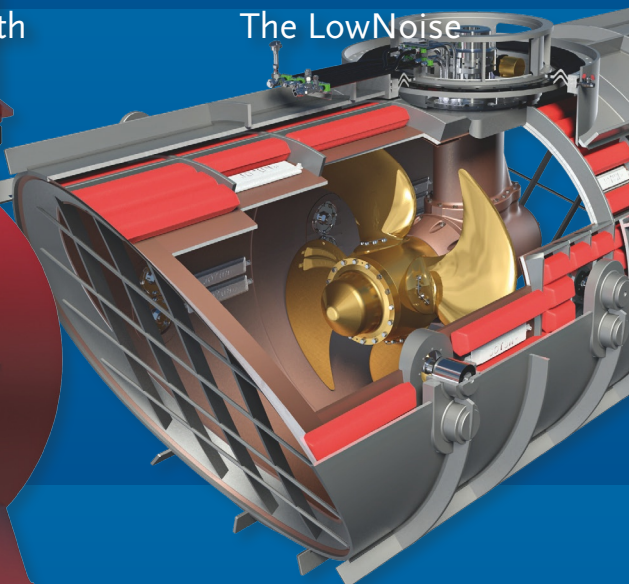


The Rim Driven RDT

positioning and propulsion



The Retractable Azimuth



The LowNoise



The Propulsion Unit

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SYSTEM

Quality components seamlessly

Brunvoll Control Panels



Brunvoll Electronic Cabinet



To other systems – integration with DP, ship management or VDR

Gravity Tank



Electric Motor Starter



Brunvoll's Compact Hydraulic Power Unit



HPU Starter



Electric Motor



Thruster Unit



EMMS

integrated – from a single source

Thruster Systems are our only business – our extensive experience and expertise is available to our customers.

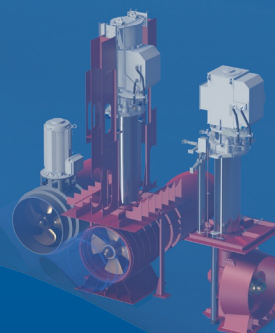
Brunvoll is a single-source supplier and takes full responsibility for the whole thruster system.

Brunvoll provides fully integrated thruster solutions complete with drive motors, hydraulic power units, control, alarm and monitoring system.

Each system can be optimized to meet the needs of the individual vessel and operation.

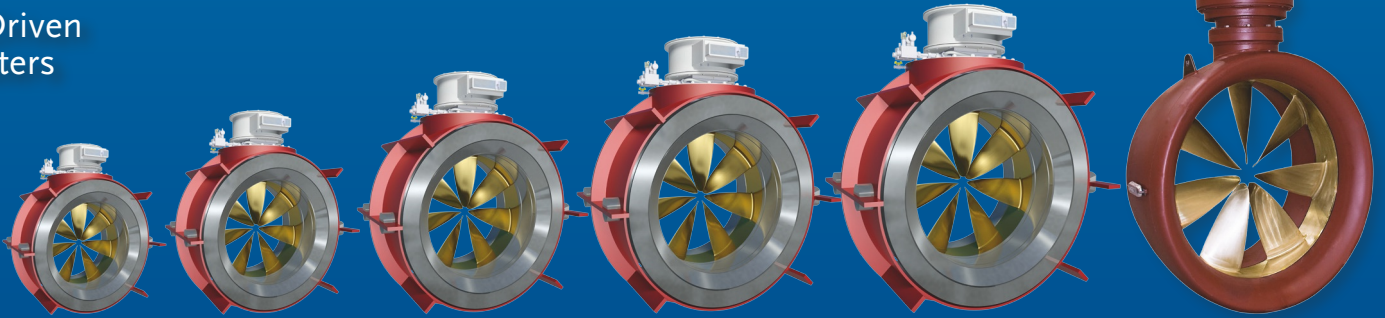
We offer electric and diesel drive systems.

We provide service and support for the lifetime of the Thruster System.



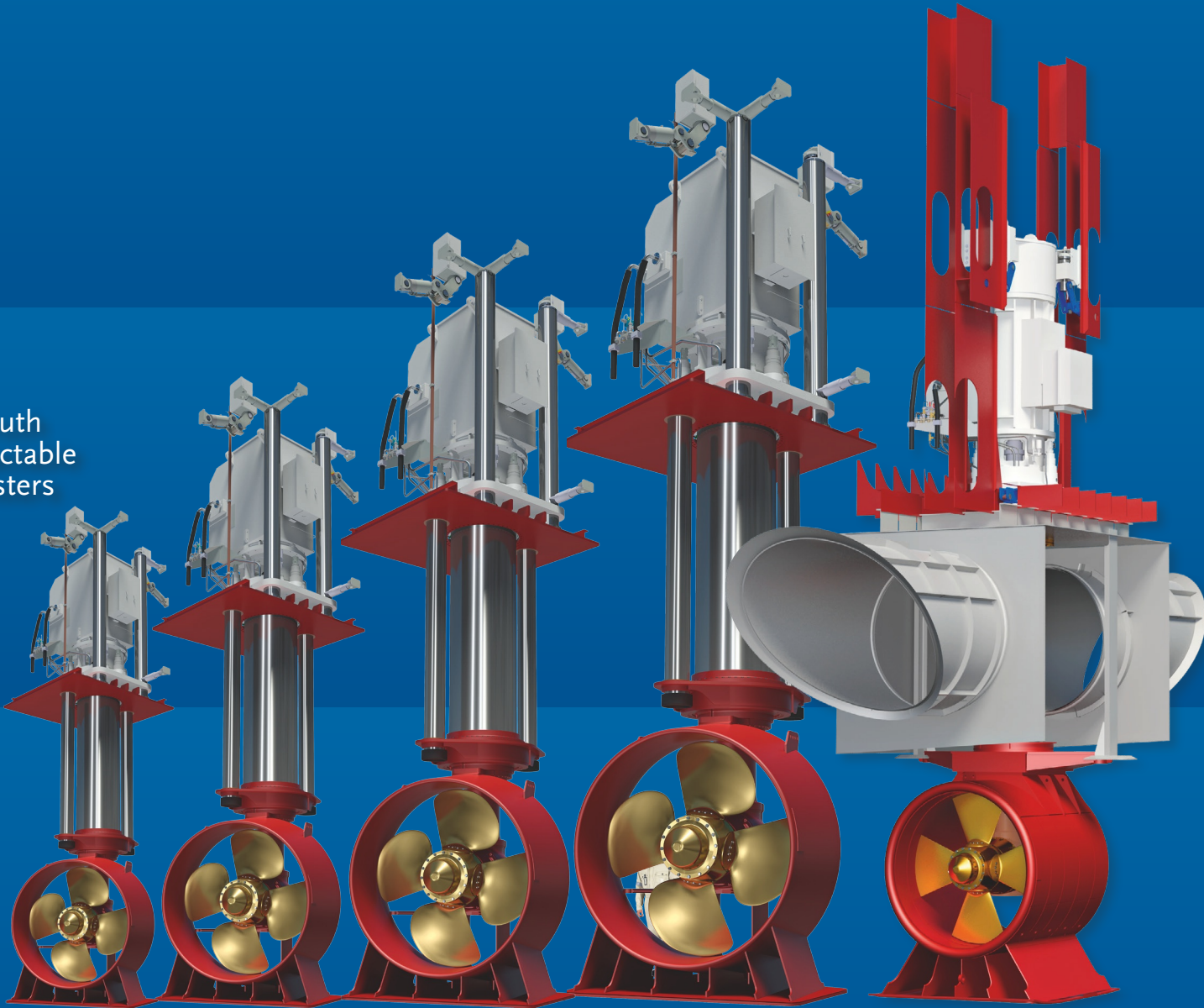
Brunvoll's Compre

Rim Driven Thrusters RDT



Type	RDT800	RDT1000	RDT1250	RDT1500	RDT1750	AU RDT1500
Diameter	800	1000	1250	1500	1750	1500
Power kW	200	300	450	600	900	600

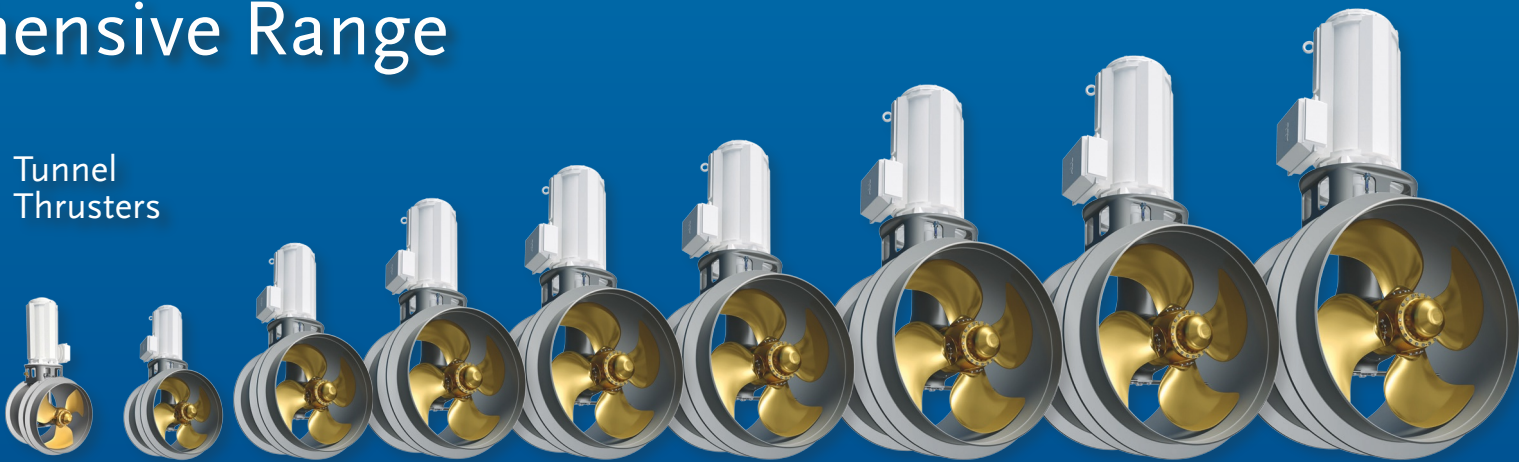
Azimuth Retractable Thrusters



Type	AR63	AR80	AR100	AR115	AR Combi
Diameter	1650	2100	2600	2900	
Power kW	500-880	1000-1500	1500-2500	2300-3000	

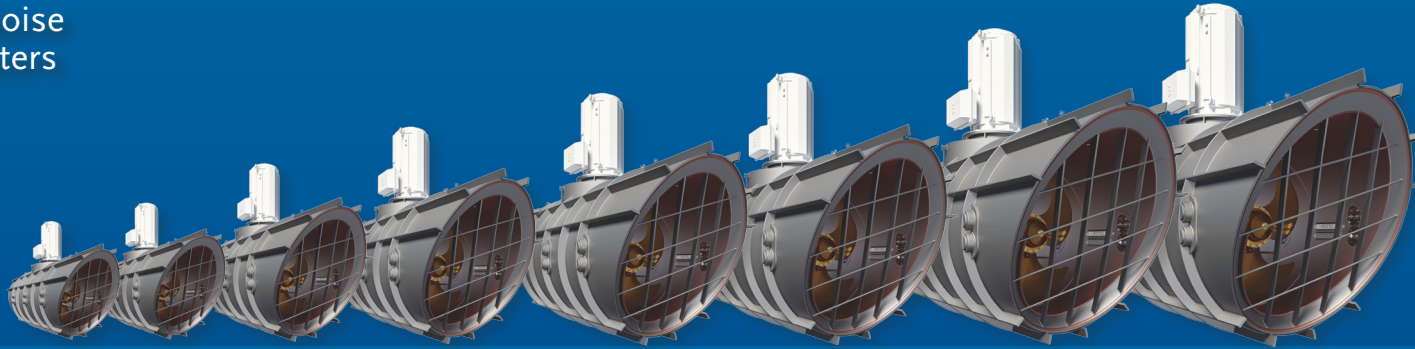
Extensive Range

Tunnel Thrusters



FU37	FU45	FU63	FU74	FU80	FU93	FU100	FU115	FU120
1000	1225/1375	1550/1750	2000	2000/2250	2500	2450/2750	3000	3500
75-250	250-450	400-900	800-1400	1000-1500	1400-2200	1800-2500	2000-3500	3000-4000

LowNoise Thrusters

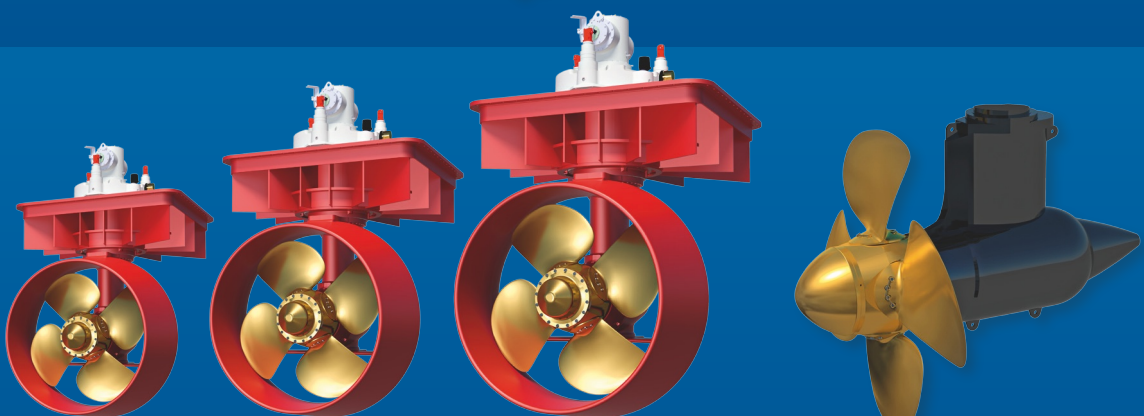


Type	FU37	FU45	FU63	FU74	FU80	FU93	FU100	FU115
Diameter	1000	1375	1750	2000	2250	2500	2750	3000

BruCon Control, Alarm and Monitoring Units



Azimuth Propulsion Thrusters



AU/AW63	AU/AW80	AU/AW100	PU3000
1650	2100	2600	
400-800	1000-1400	1600-2000	

PROPE

Brunvoll Propeller

Developing the optimal propeller for each application – from icebreakers to cruise ships – demands the skills of a specialist.

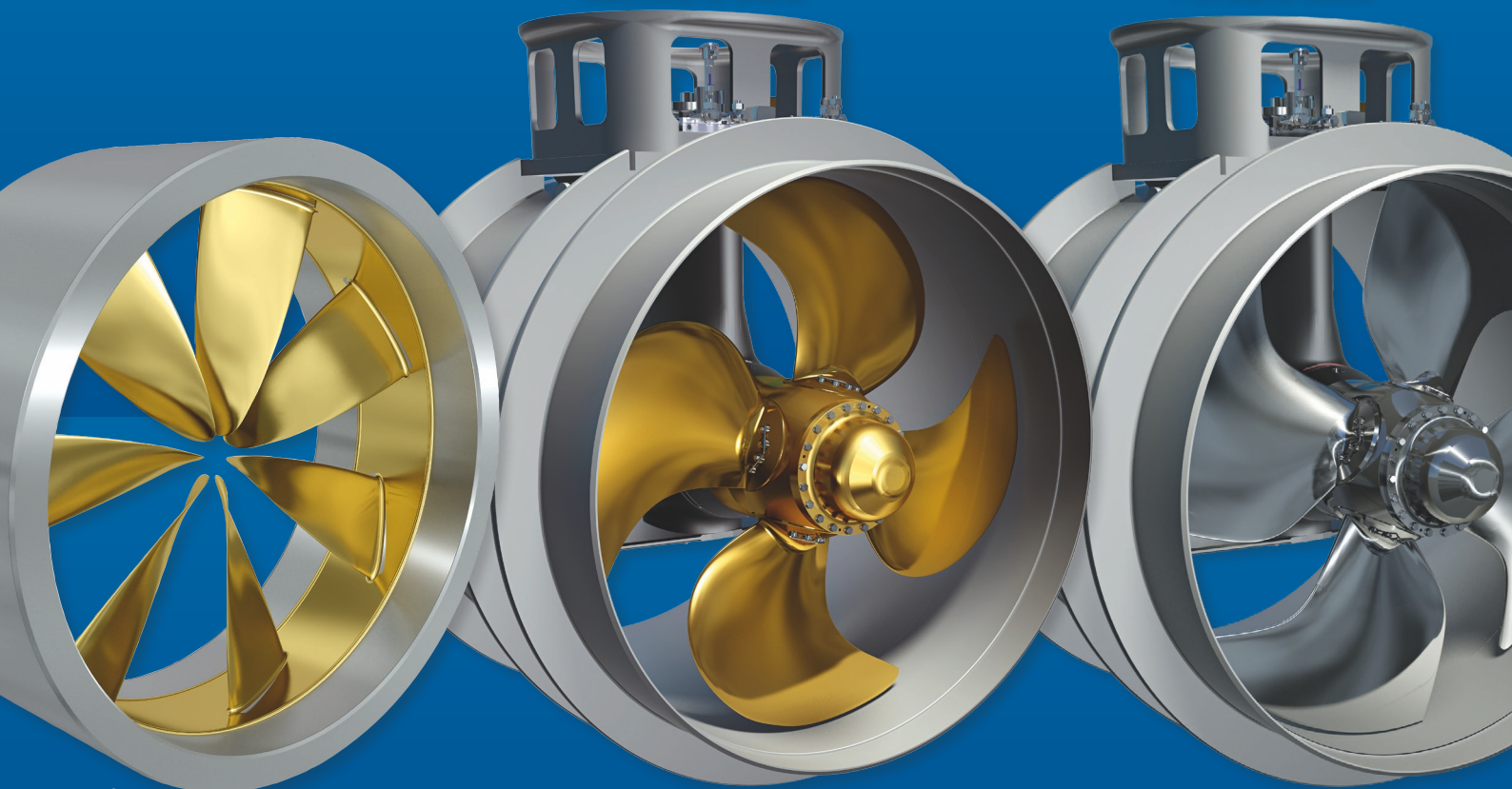
The design process involves simulation and calculations using advanced computer modelling systems.

The flows around the thruster gear housing and propeller as well as the interaction between the thruster and the hull are highly complex.

RDT

Backward skew

Forward skew



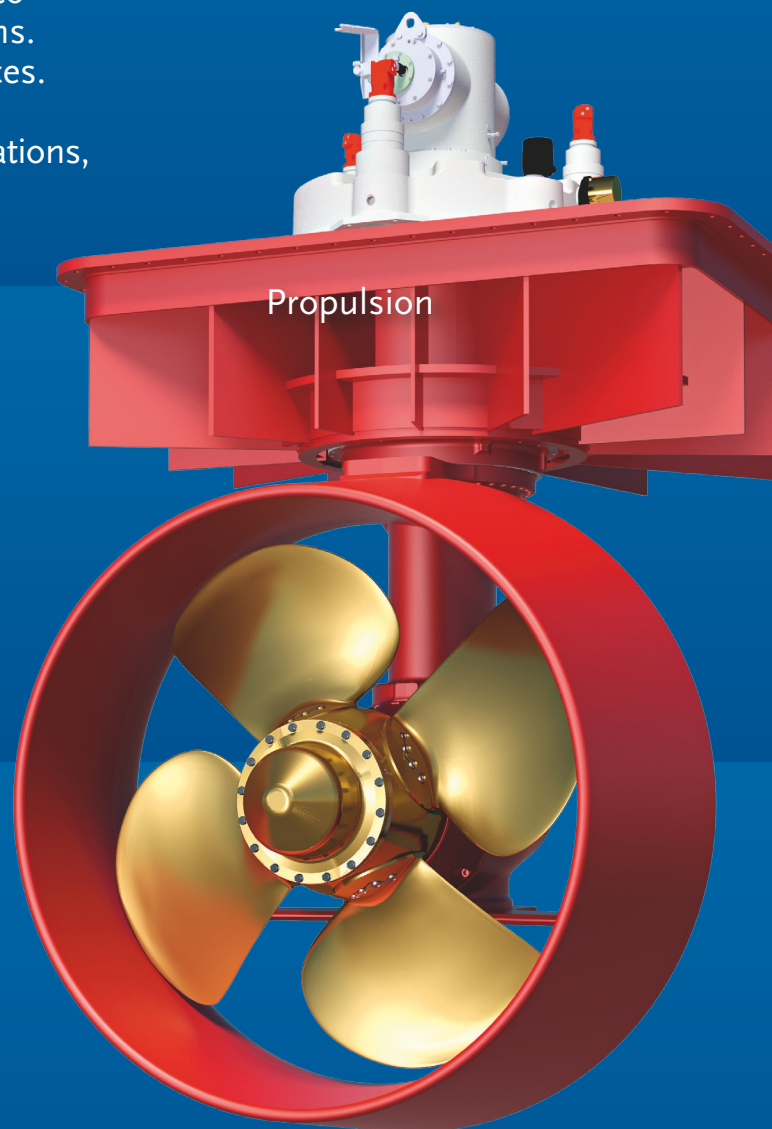
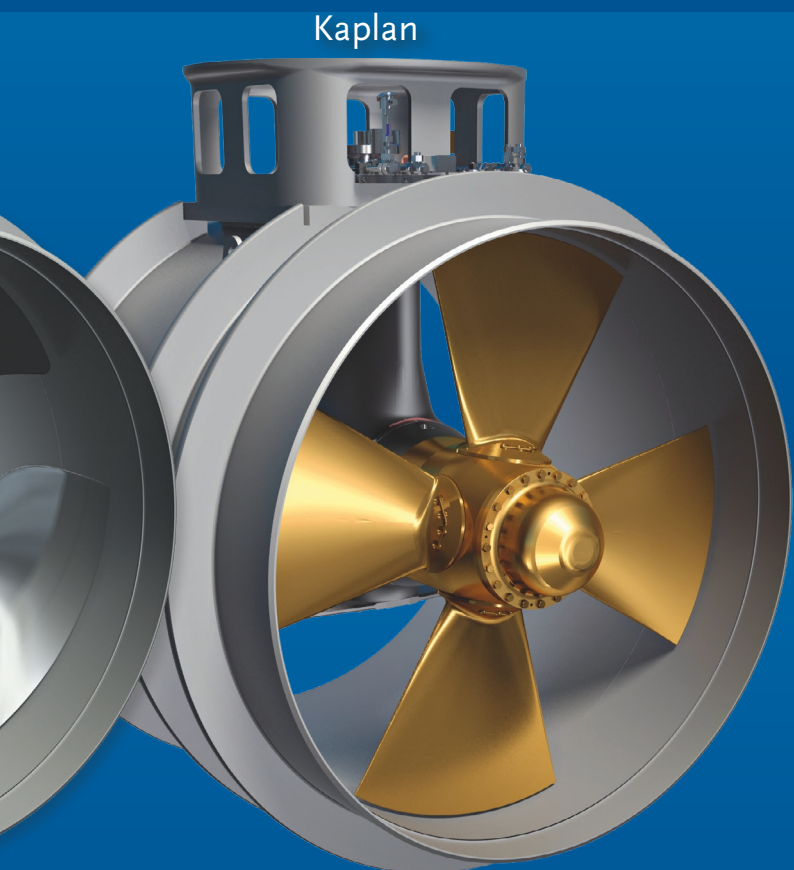
ILLERS

Design for performance

Full-scale experience and model testing are needed to validate the calculations.

The design process involves expertise in mechanical engineering and metallurgy as well as insight into the operation of electro-hydraulic control systems. Each customer has specific needs and preferences.

We listen. For complicated and challenging applications, Brunvoll's thruster expertise is unmatched.



TUNNEL THRU

Small or large – a compre

Refined continuously through 4 thruster generations

Since 1965, we have delivered thousands of tunnel thrusters for fishing, cruise, naval, merchant and offshore vessels – a success story for generations.

We focus on developing ever more reliable, optimized and cost-effective systems

- Enhanced gearbox for optimal hydrodynamic performance.
- Robust gear maintains optimum tooth contact in various operating conditions.
- More compact propeller hub.
- Balanced backward skew blades minimize servo and excitation forces.
- Replaceable blade bearing liners.
- Options for non-pollution seals and lip seal systems that can be replaced without removal of the propeller hub.
- Underwater unit can be removed with propeller blades in place.
- Pipe connections are easy to access.
- Pitch feedback unit includes a visible display.
- Shaft coupling enables easy installation and removal of drive motor.
- Reduced weight of the gearbox, propeller hub and tunnel – structural improvements ensure that the thruster is just as rugged despite the lower weight.
- The tunnel is being optimized and strengthened to reduce vibration.
- Nodular cast iron in the motor frame improves stability, reducing vibration and noise.



METAL STEERS

extensive range of Tunnel Thrusters

Supreme technical solutions

Brunvoll introduced propeller shaft sealing systems with a safety chamber and multiple seals as early as 1965

Medium pressure servo systems hydraulics reduce noise levels
Cost efficient, easier installation and maintenance, higher reliability and extended lifetime. Quieter than a high-pressure system.

Precise Manoeuvring
A variable displacement pump delivers the exact amount of oil needed for the propeller pitch movements. The valve mechanism automatically adjusts the oil flow to enable smooth and highly precise manoeuvring via a direct hub linkage mechanism.

One oil type for lube and servo system

- Gear
- Pitch mechanism
- Multiple propeller shaft sealing system

No forced cooling for lubrication oil
The HPU uses natural cooling, as the oil reservoir is located in the thruster gearbox.

Protection of the marine environment
– is a growing concern throughout the shipping industry. Oil leakage from thrusters can harm even the best of reputations. Brunvoll designs systems focused on preventing such pollution.

Easy checking of oil condition
Valves accessible from the top of the thruster are connected both to the seal safety chamber and gearbox bottom. This makes it easy to drain oil and detect any traces of water or particles in the oil – an early warning.

Overhaul without removal of gearbox
While the gearbox is still in the tunnel, one can:

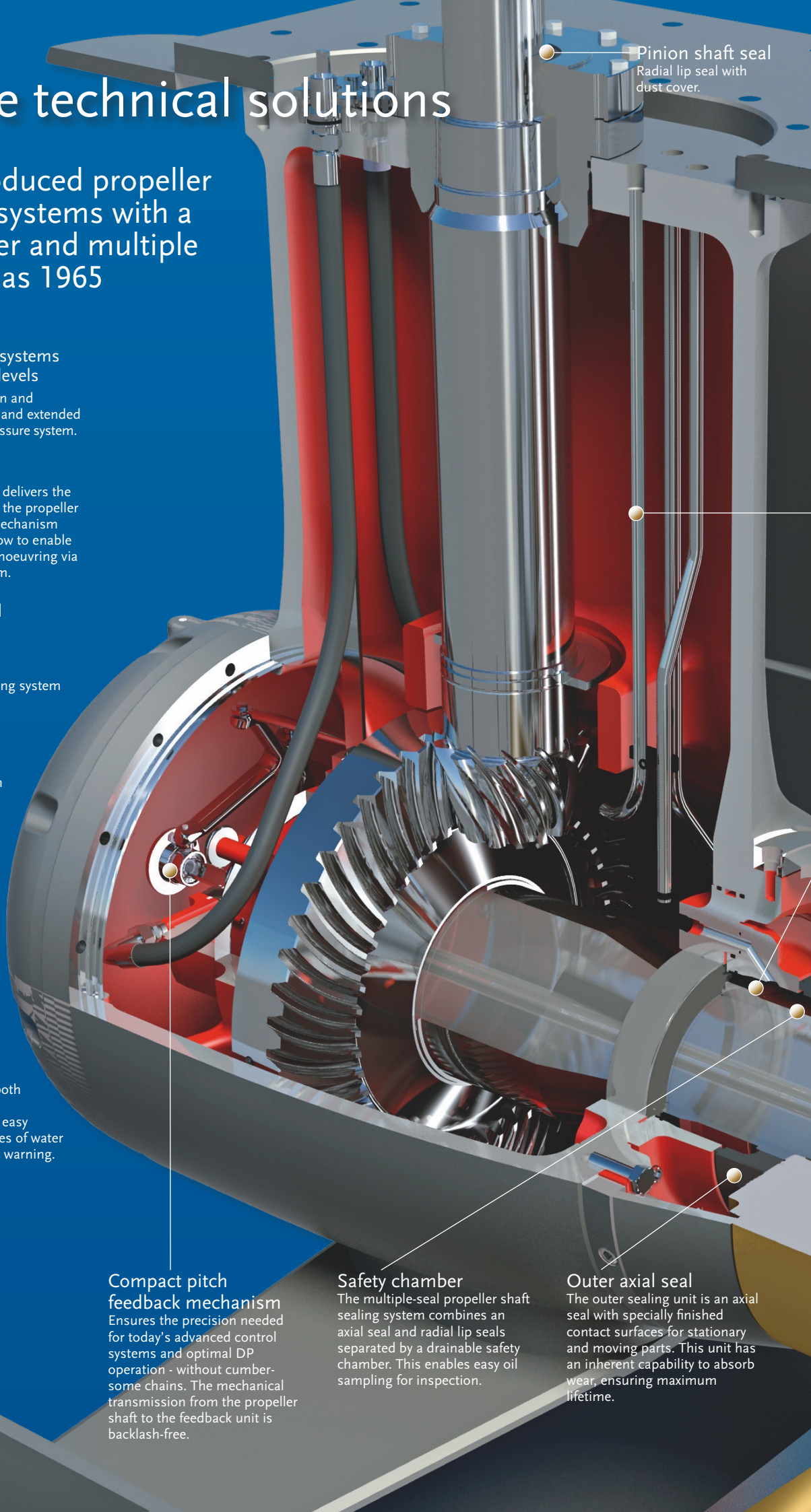
- Change individual propeller blades or blade seals.
- Remove the propeller hub to change shaft seals.
- Take out the whole propeller shaft assembly.

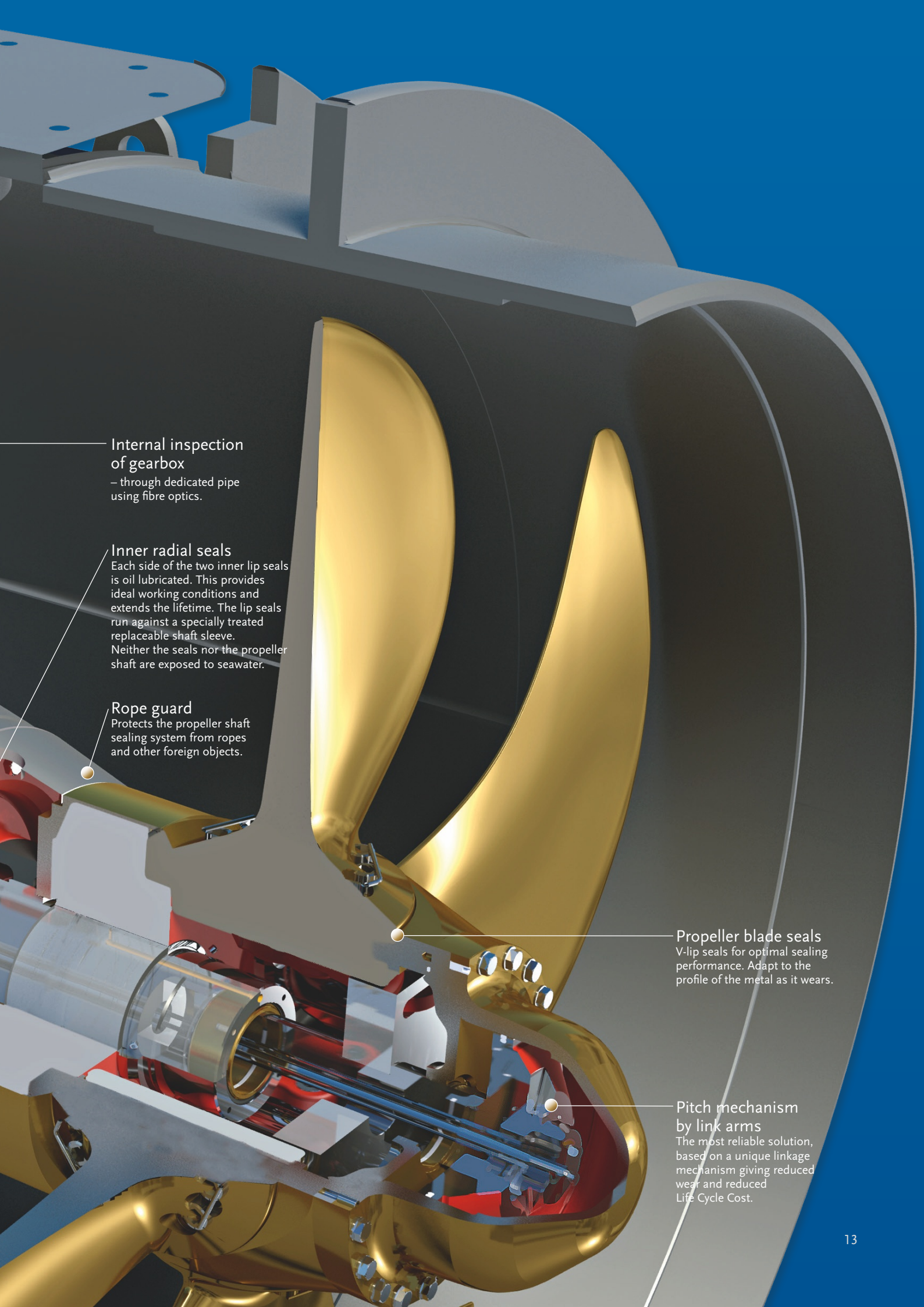
Compact pitch feedback mechanism
Ensures the precision needed for today's advanced control systems and optimal DP operation - without cumbersome chains. The mechanical transmission from the propeller shaft to the feedback unit is backlash-free.

Safety chamber
The multiple-seal propeller shaft sealing system combines an axial seal and radial lip seals separated by a drainable safety chamber. This enables easy oil sampling for inspection.

Outer axial seal
The outer sealing unit is an axial seal with specially finished contact surfaces for stationary and moving parts. This unit has an inherent capability to absorb wear, ensuring maximum lifetime.

Pinion shaft seal
Radial lip seal with dust cover.





**Internal inspection
of gearbox**

– through dedicated pipe
using fibre optics.

Inner radial seals

Each side of the two inner lip seals
is oil lubricated. This provides
ideal working conditions and
extends the lifetime. The lip seals
run against a specially treated
replaceable shaft sleeve.
Neither the seals nor the propeller
shaft are exposed to seawater.

Rope guard

Protects the propeller shaft
sealing system from ropes
and other foreign objects.

Propeller blade seals

V-lip seals for optimal sealing
performance. Adapt to the
profile of the metal as it wears.

**Pitch mechanism
by link arms**

The most reliable solution,
based on a unique linkage
mechanism giving reduced
wear and reduced
Life Cycle Cost.

NO

No short cuts which cause trouble

Inadequate sealing systems

– may allow seawater to enter the thruster – the most frequent cause of thruster failure.

Seawater in the oil can destroy gears, bearings and other vital components inside the unit.

Stripping essential features

– such as the rope guard – exposes the propeller shaft sealing system to damage from debris.

Without a rope guard, shipowners must consider other means of protection.

Overpowering

– for example by stretching the length of the gear teeth – causes overloading of the gear.

This shortens the lifetime and increases maintenance costs. If a tooth actually breaks, costly repairs will be needed.

Overspeeding

– results in excessive propeller cavitation, thrust loss and heavy erosion of the propeller blades and the walls of the tunnel.

This may in turn increase wear and tear as well as life cycle costs.

Reducing the structural rigidity

– normally means a less robust design that cuts safety margins.

Inadequate structural rigidity results in vibration that can cause serious damage both to the thruster and to other equipment in the thruster room.

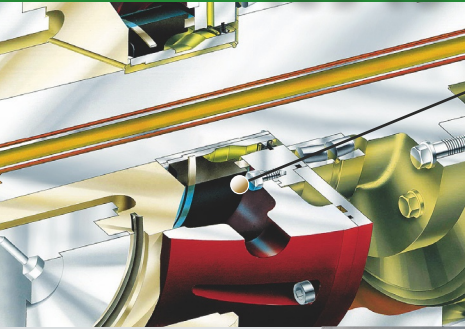
Excessive propeller tip clearance

Some thrusters have a large clearance between the blade and the tunnel to allow for imprecision and distortion during installation – downgrading the performance.



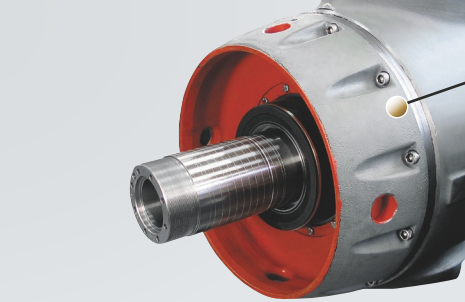
YES

Yes to Brunvoll quality solutions



Brunvoll's multiple sealing system with an outer seal, inner seal and safety chamber keeps seawater out of the thruster, increasing the lifetime of the seal.

The intermediate safety chamber makes it easy to monitor the seal condition.

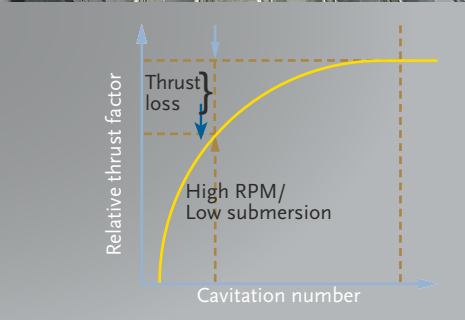


Brunvoll thrusters are fitted with rope guards as a standard feature to protect the propeller shaft sealing system from ropes and other foreign objects.



At Brunvoll, we design the gear and mesh to generous specifications that ensure high endurance and maximum component life.

Optimum contact patterns ensure robust performance.



Brunvoll complies with recognized guidelines for tip speed and cavitation behaviour.

This enhances thruster performance with increased thrust, less noise and vibration, and lower life cycle costs.



Brunvoll designs thrusters both for easy installation and with generous dimensions for lifetime dependability. We supply the tunnel complete with stiffener rings as standard.

At Brunvoll we give priority to reliable performance with engineering that shrugs off punishing real-life conditions.



Brunvoll's design, high-precision manufacturing and robust stiffening make it possible to minimize the propeller tip clearance, resulting in improved overall thruster performance.

Standard or Customized

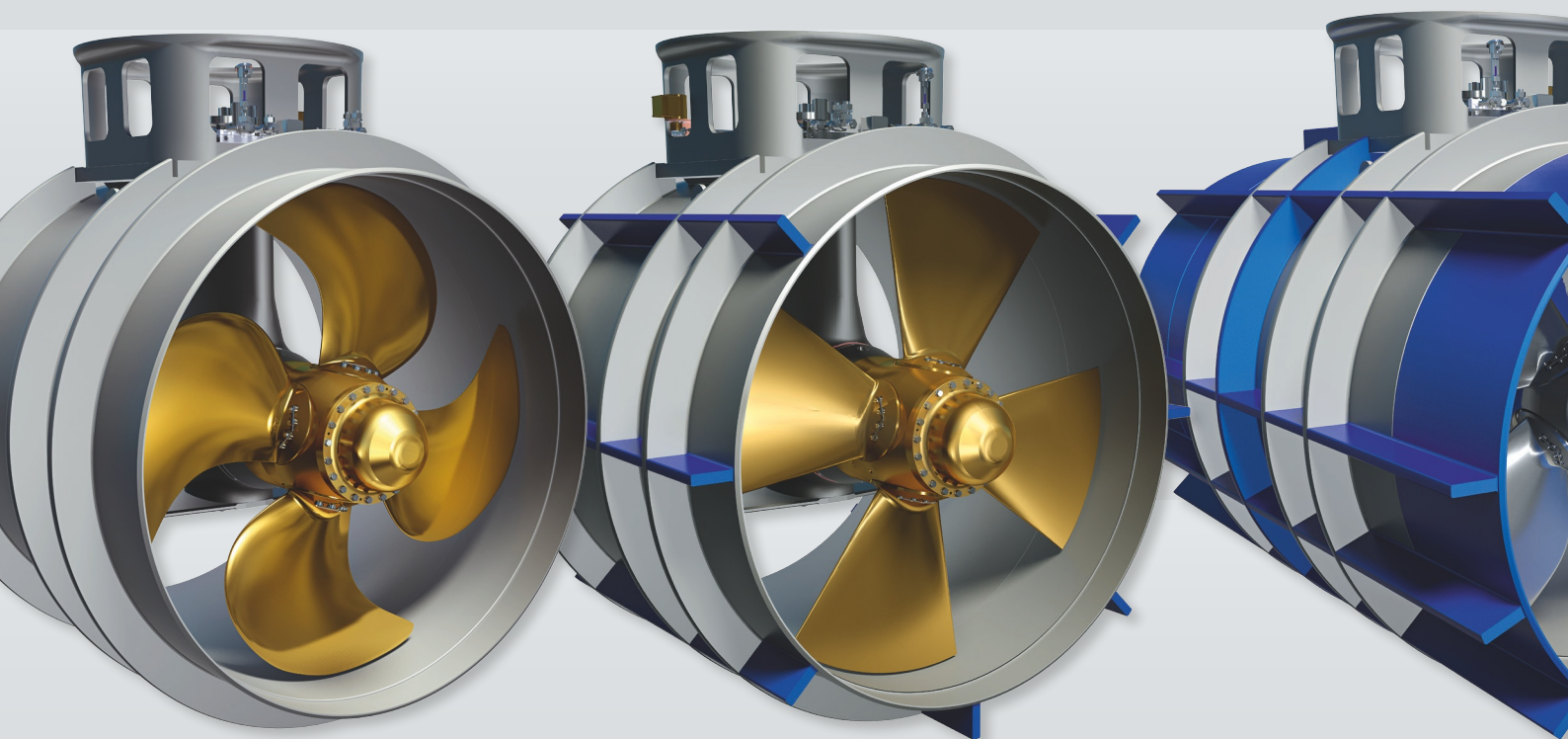
Brunvoll offers extended scope of supply with a variety of extensions to suit your needs. Our portfolio of in-house expertise enables us to develop effective solutions for challenging projects. Our design engineers work together with the yard's hull design team to achieve cost-effective thruster installation.

The standard Brunvoll tunnel thruster unit

- Rigid tunnel construction
- Ring stiffeners
- Modularized motor foundation

With landing bars to avoid direct welding on the tunnel wall

- Rigid tunnel construction
- Ring stiffeners
- Modularized motor foundation
- Landing bars adapted to tank top and hull frames

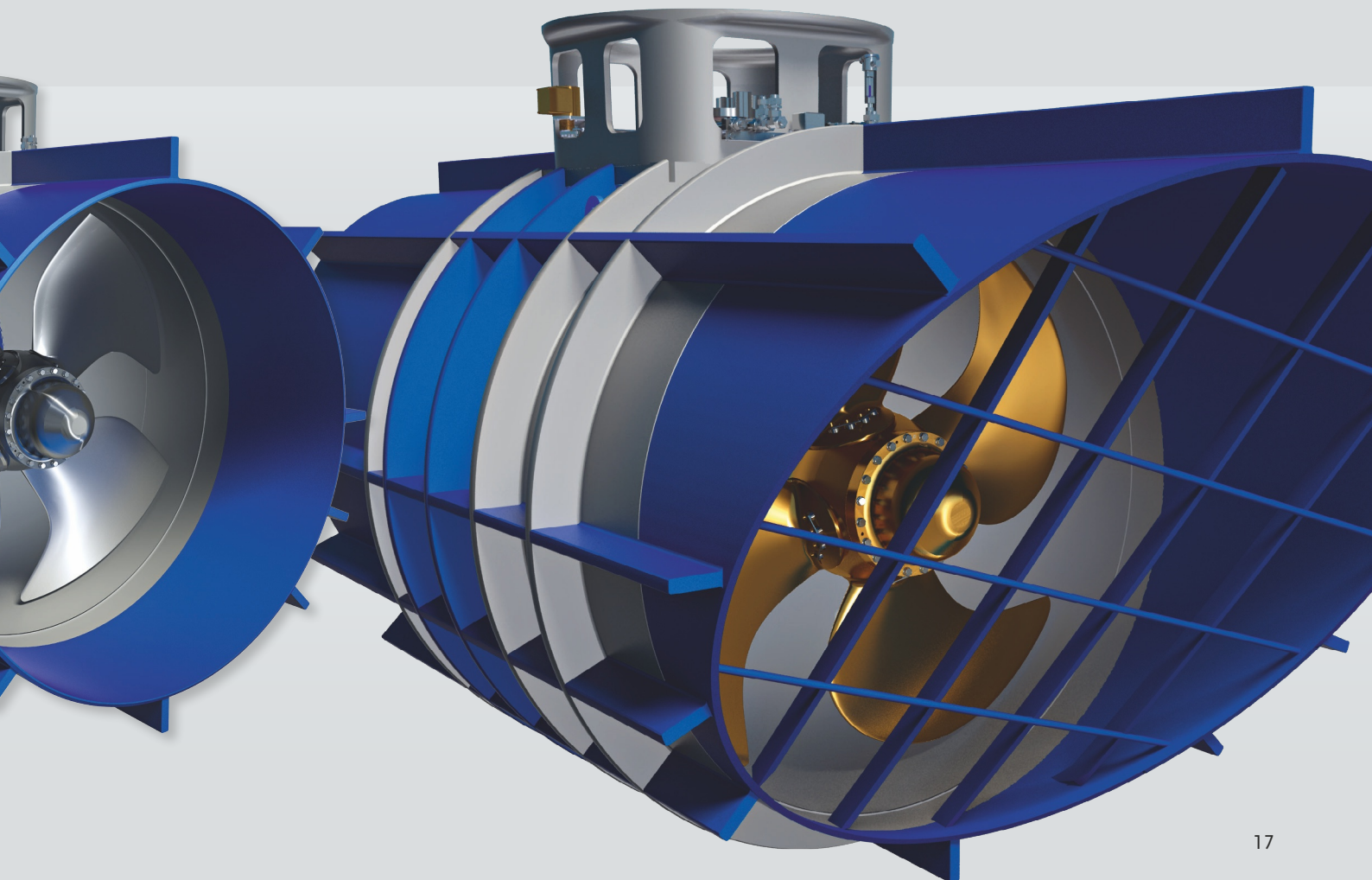


With straight-cut tunnel extensions

- Rigid tunnel construction
- Ring stiffeners
- Modularized motor foundation
- Landing bars adapted to tank top and hull frames
- Straight cut tunnel extensions for trimming at the yard
- Extra rigid stiffeners adapted to centre girder
- Propeller blade design on request

With tunnel extensions cut to suit hull lines and protection grids

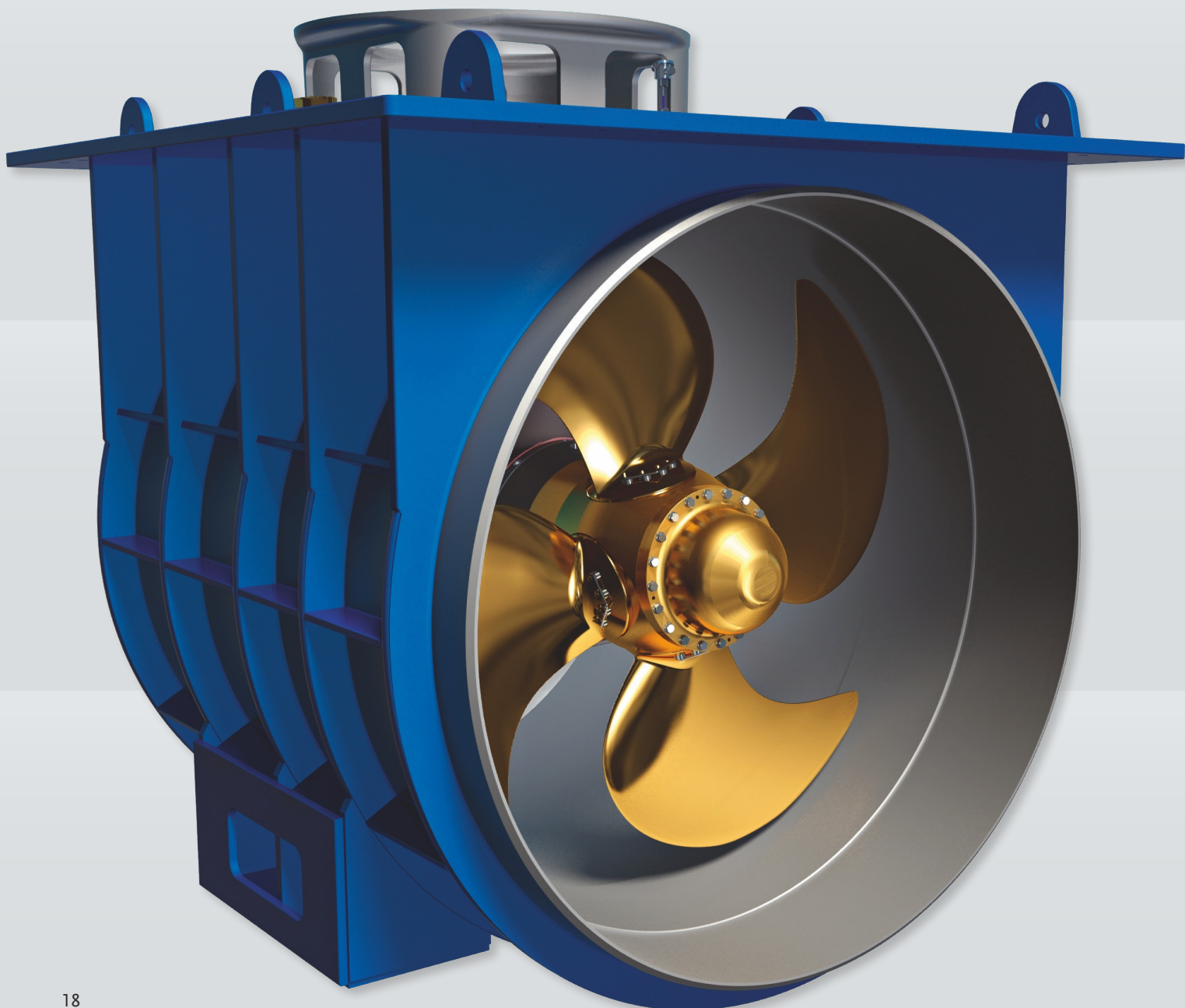
- Rigid tunnel construction
- Ring stiffeners
- Modularized motor foundation
- Landing bars adapted to tank top and hull frames
- Tunnel extensions customized to suit to the hull lines
- Protection grids in the tunnel entrances
- Propeller blade design on request

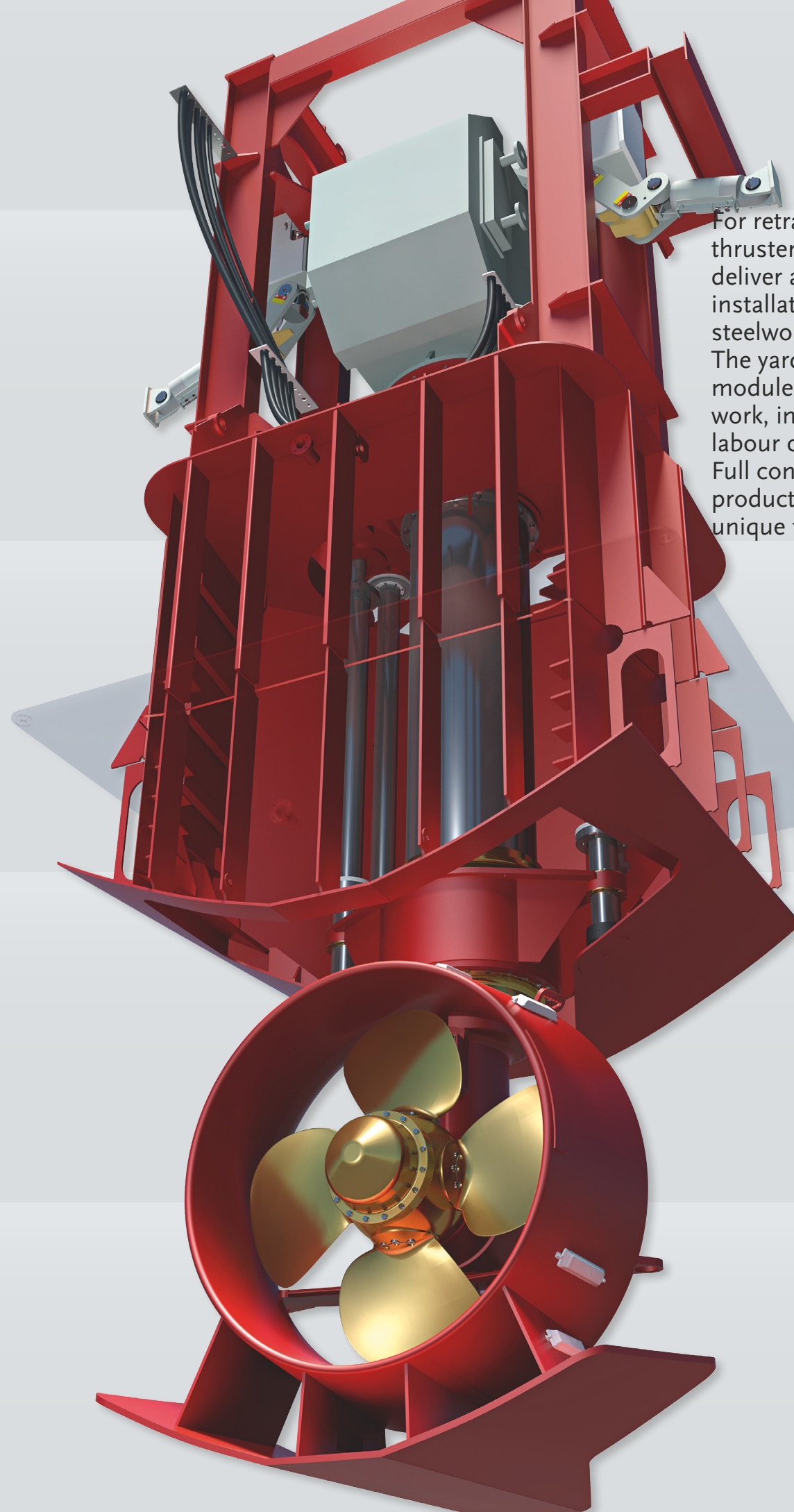


Customized solutions – easy hull integration

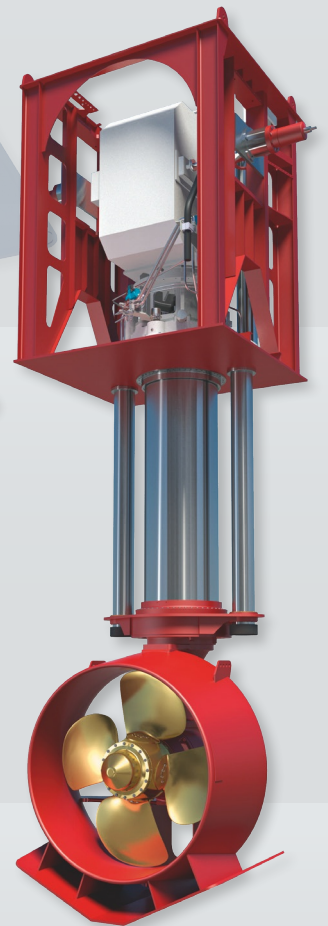
Brunvoll can supply thruster units fitted in a steel section based on the hull section drawings for the specific vessel.

Our modular tunnel thruster unit reduces the yard's installation work and responsibility. Brunvoll trunk-mounted tunnel thruster units enable easy serviceability and repair without dry-docking the vessel.



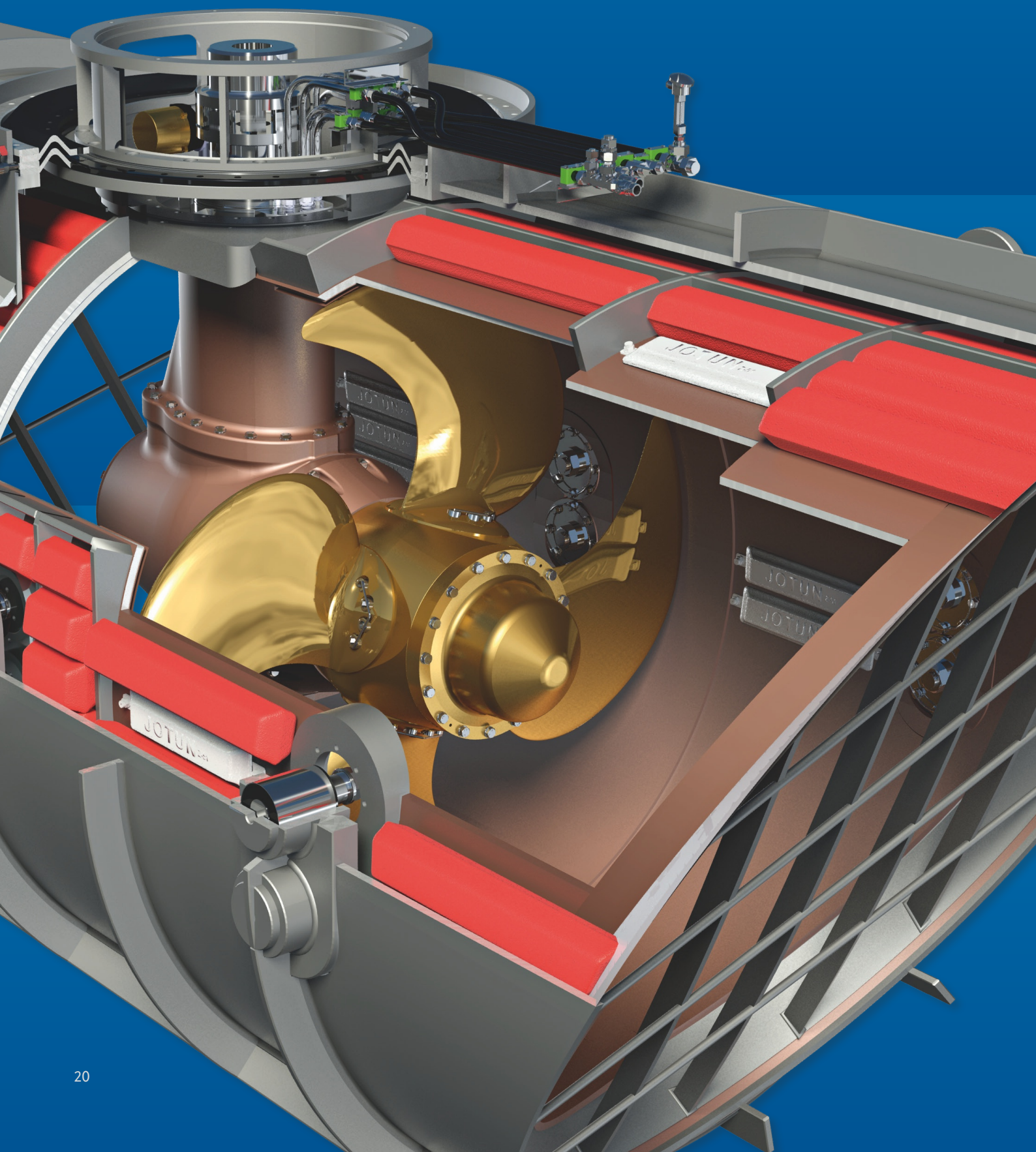


For retractable azimuth thrusters, Brunvoll can deliver a complete thruster installation with all necessary steelwork surrounding it. The yard simply plugs in the module, reducing fabrication work, installation time and labour costs. Full control of our production enables unique flexibility.



LOW

No. 1 in Low



NOISE

Noise thrusters

The trend is towards LowNoise thrusters and Brunvoll has shown the way.

Thruster noise is a major problem for crews.

The stress and discomfort it causes may threaten both performance and safety on board.

Quieter manoeuvring means better sleep, improving the alertness and efficiency of the crew. Passengers enjoy a new degree of comfort.

Brunvoll introduced the LowNoise thruster in 1977. Through four technological generations we have refined our patented solutions into a proven concept.

Noise levels of 75-88 dB(A) are typical in cabins next to and above conventional tunnel thrusters. Brunvoll's advanced technology can cut this by up to 15 dB(A). Combined with other measures, noise reductions of up to 20-25 dB(A) have been verified.

Brunvoll pioneered the LowNoise thruster in 1977.

Since then, we have continuously refined our solutions into a proven concept.

Today, Brunvoll is recognized worldwide as the major supplier of effective LowNoise solutions.

Thruster noise control

Alternative source treatment
Noise reduction in full load range

Brunvoll resilient mounting	11-15 db(A)
Double tunnel resilient mounting, acoustic short circuit at tunnel ends	5-9 db(A)
Resilient mounting of mid-section	4-6 db(A)
Oversized thruster	2-3 db(A)
Tunnel design	1-3 db(A)
Air injection system	1-3 db(A)
Propeller blade design	1-2 db(A)
Variable speed drive	1-2 db(A)

Masters of LowNoise Thrusters – Brunvoll offers unique expertise

Multidisciplinary in-house capabilities

One of Brunvoll's most valuable assets is the unmatched knowledge base that we have developed in-house.

Our specialized skills have been developed over decades, in the punishing test laboratory of the North Sea.

We have developed a vast storehouse of expertise in hydraulics, hydrodynamics, mechanical and electrical engineering, and production – a complete technological environment dedicated to thruster systems.

30 years' experience – numerous projects

From DP applications in harsh offshore environments to low-noise thrust for cruise liners manoeuvring in and out of challenging harbours, Brunvoll has a wealth of experience in both standard and special thruster systems.

“Pacific” with a new
Brunvoll solution
combining
LowNoise Thruster and
Rim Driven Thruster



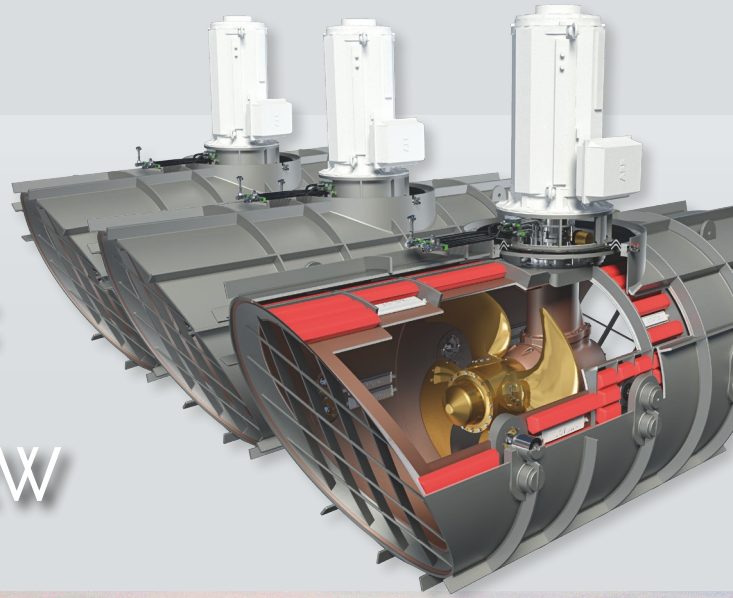
Modularization and customization

Brunvoll LowNoise systems can be tailored to specific requirements for easy installation combined with optimal performance and efficiency.

Flexibility for special solutions

Multipurpose applications that enable new operational flexibility are increasingly relevant for advanced and innovative vessels. Brunvoll is in a unique position to provide reliable LowNoise systems for complex applications.

Celebrity Cruises' Millennium ships with the world's largest LowNoise Thrusters Brunvoll FU100 2,350 kW



...Brunvoll now introduces an even larger LowNoise version – the FU115 at 3,000 kW

Decades of Brunvoll expertise in LowNoise have now been applied to Brunvoll's largest thruster – the FU115. This innovation is attracting growing interest in the market, especially the offshore and cruise sectors.

Effects of noise exposure

Challenges for the crew

On large, powerful ships ranging from cruise liners to sophisticated offshore vessels, today's operating personnel must perform more complex tasks than the seafarers of old could ever have imagined.

They must control a variety of advanced technology and respond quickly to input from an array of interfaces.

They must be able to make vital decisions in split seconds if necessary.

They must fulfil stringent requirements for the efficiency and quality of their work.

45-50
dB(A)

Noise limits set by regulatory bodies

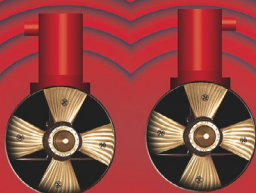


Without noise suppression, noise levels in accommodation areas above and near thrusters operating at full power may be 75-88 dB(A).

Basis for noise criteria

Crew cabins on mobile offshore units, passenger cabins on board cruise ships.

This quiet environment allows recovery from exposure to high noise levels, and gives high-quality rest and personal comfort for passengers and crew.



The growing focus on working conditions and comfort for the crew has resulted in stricter requirements for shipboard noise and vibration levels.

Head-pounding vibration is no longer acceptable on board.

Tasks at sea demand precise performance, and it is essential that crews are alert and focused on their work.

Innovative solutions are needed to make ships an attractive workplace.

Outstanding shipping companies that set the trend in the market insist on low-noise vessels.

This lowers risk and promotes safety, boosting the quality and efficiency of the entire operation.

55-65
dB(A)

65-75
dB(A)

75-85
dB(A)

Crew cabins and offices on merchant ships.

Specific work areas on board, e.g. wheelhouse, control rooms.

General work areas.

Partly based on noise statistics and physiological data. Effects in the form of annoyance and stress (subjective effect on sleep quality).

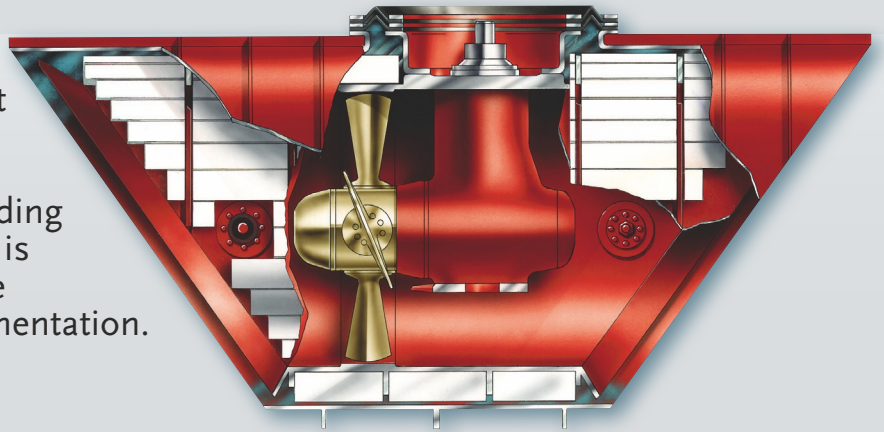
Speech becomes less intelligible at higher levels: 70 dB(A) requires a raised voice. Annoyance and stress start to affect the performance of demanding tasks.

Levels above 75 dB(A) give clear indications of reduced performance for demanding tasks. Above 85 dB(A): High probability of reduced performance.

Brunvoll's three generations of LowNoise evolution

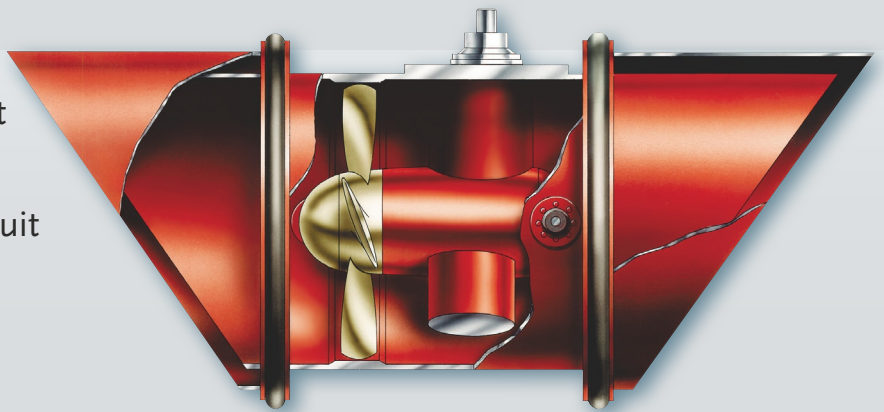
3rd

- Double tunnel.
- Full length resilient mounting of inner tunnel.
- Brunvoll's outstanding noise suppression is confirmed by noise assessment documentation.



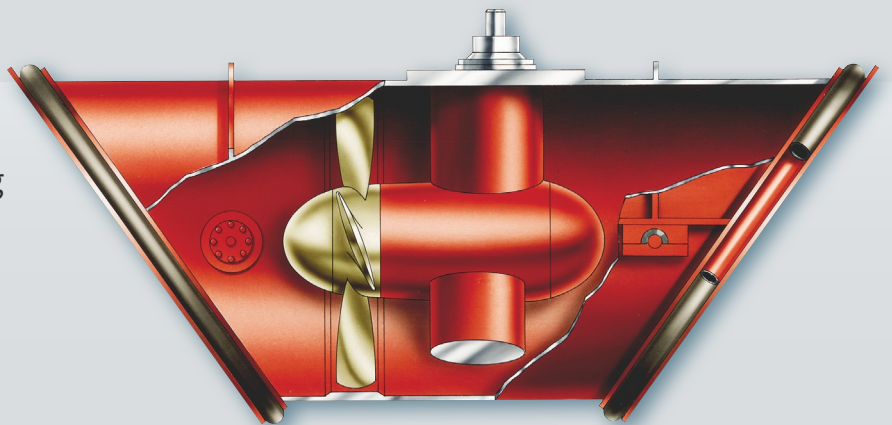
2nd

- Double tunnel.
- Full length resilient mounting of inner tunnel.
- Acoustic short circuit at tunnel ends.



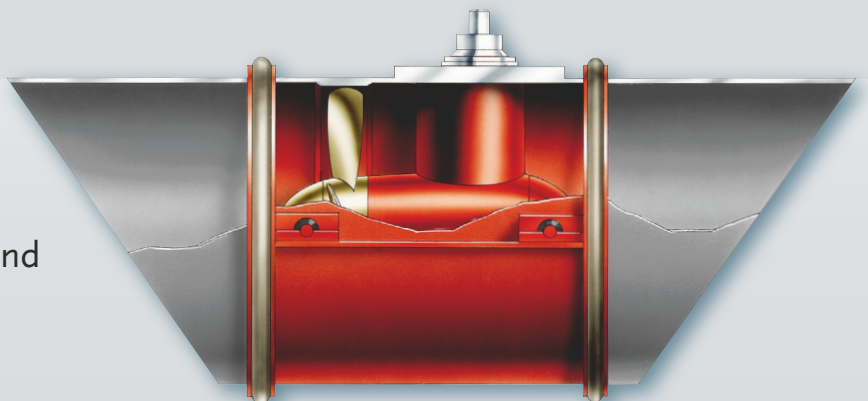
1st

- Single tunnel.
- Full length resilient mounting of tunnel.



Others: Single tunnel

- Single tunnel.
- Partial length resilient mounting of tunnel.
- Integrated sealing and resilient mounting elements.



Noise reduction:

Safety aspects and serviceability:

Structural integration and installation:

11–15 dB(A)

Complete isolation obtained without the drawbacks of Brunvoll 1st generation.

Brunvoll's superior technology is recognized by leading regulatory bodies.

Good

Seals and mounts are well protected with good serviceability.

Unmatched ease of inspection.

Good

Tailored to hull structure and hull lines.

Complete delivery with no assembling at yard.

5–9 dB(A)

Acoustic short circuiting via water outside seals.

Less good

Outer seals less well protected.

Poor serviceability.

Less good

Tailored to hull lines.

Structural integration less good.

Assembling at yard.

11–15 dB(A)

Complete isolation obtained.

Poor/Less good

Outer seals exposed / vulnerable to damage.

Poor

Requires a plane hull surface at tunnel ends.

Structural integration less good.

Assembling at yard.

5–6 dB(A)

The source is not completely isolated.

Noise emission from non-isolated part of tunnel is decisive.

Less good

Outer seals less well protected.

Poor/Less good

May be tailored to hull lines, but structural integration and ease of installation is poor.

Assembling at yard.

Patented LowNoise thrusters from Brunvoll

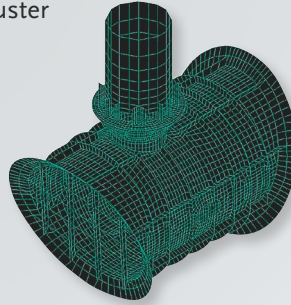
Structural design

For easy hull integration, complete full-length double tunnel suits hull lines and complete outer tunnel has stiffeners. Rigid inner and outer tunnel provides:

- Maximum attenuation
- Rigid support for mounts
- Rigid support for flange-mounted underwater thruster gearbox

Engineering services

- Selection of thruster type, size and location
- Structural thruster-hull integration
- Noise assessments



Unique full-length double-tunnel construction features an air-water mix between the outer and inner tunnel

Hydrodynamic design

Refined propeller blades and conical tunnel inlets provide:

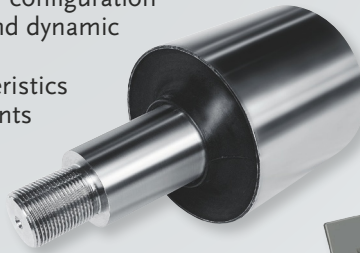
- Minimum excitation
- Maximum thrust



Resilient mounts

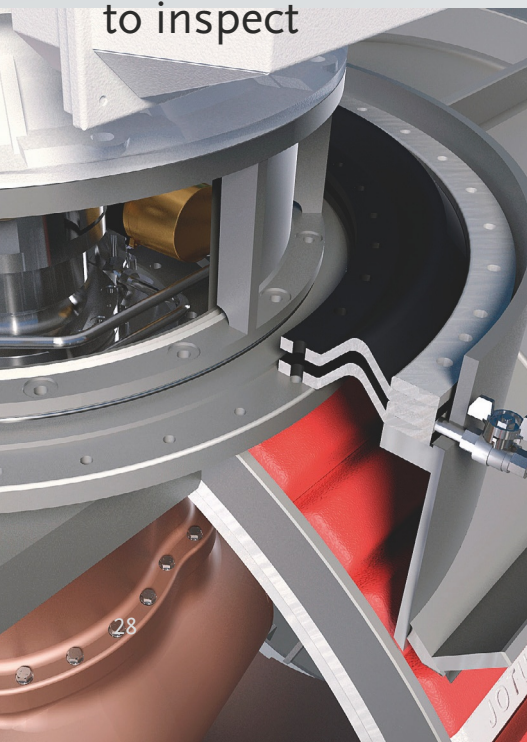
Size, number and location based on data for:

- Thruster configuration
- Static and dynamic stiffness characteristics for mounts



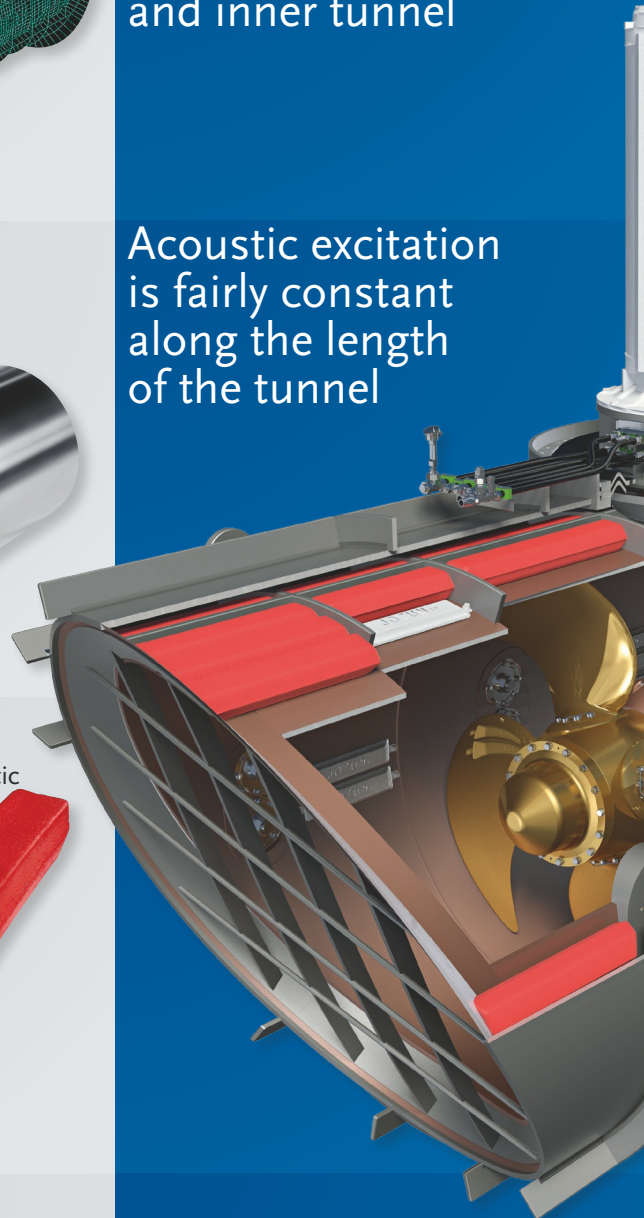
Acoustic excitation is fairly constant along the length of the tunnel

Double seals between inner and outer tunnel – in a protected position, but easy to inspect

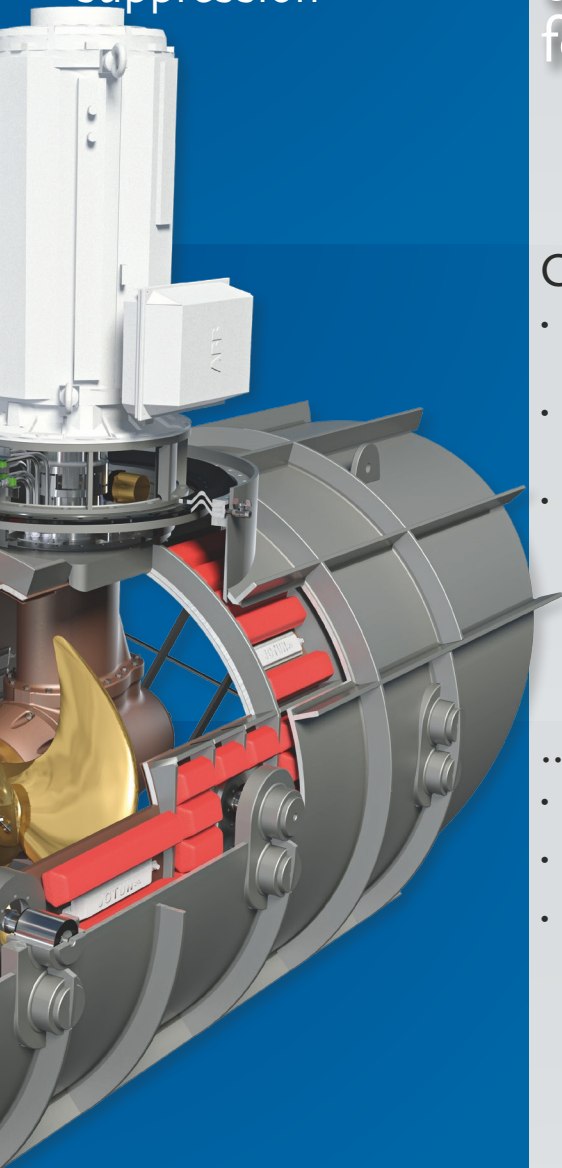


Acoustic elements

- Specially designed air-filled acoustic elements between inner and outer tunnel.
- These elements ensure that no seals are required to avoid acoustic short-circuiting between inner and outer tunnel.



Full-length resilient mounting is paramount for maximum noise suppression



Built as a complete module for easy installation for yards:

Easy inspection and maintenance:

Complete delivery

- Complete from factory with no assembly at the yard, suitable for L-drive with flange-mounted motor.
- Tunnel length and shape tailored to the hull shape. No additional welding of tunnel extensions at yard.
- Outer tunnel complete with ring and axial stiffeners located to meet hull frames, tank top and longitudinal hull structure.

Tunnel seals

- Double seals located in a protected position. May be inspected visually and have additional drain valve for checking cavity between seals.
- The design implies that there is no requirement for a water-tight thruster compartment.
- Anticipated lifetime more than 25 years.

... featuring ...

- Inner tunnel delivered complete with conical inlets.
- Grids delivered pre-installed on request.
- Delivered with cathodic protection and paint treatment, including anti-fouling except for the outer surface of the outer tunnel.

Resilient mounts/ isolators

- Located with no exposure to oil, sunlight or high temperatures.
- May be withdrawn for inspection from inside the tunnel even with the ship afloat – without affecting the hull integrity.
- Anticipated lifetime more than 25 years.

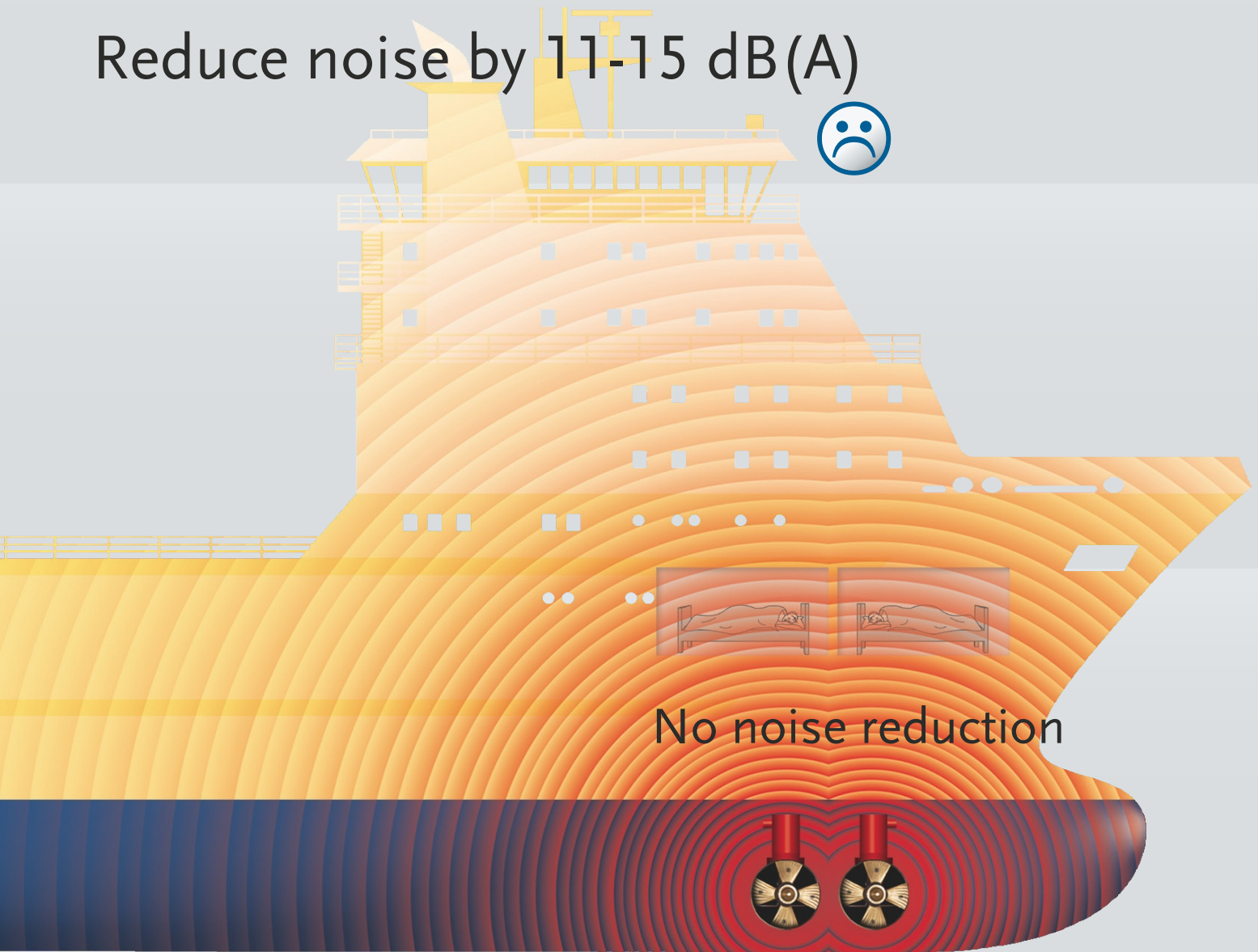
Engineering support

- Brunvoll offers expert assistance in noise assessment.
- Engineering support for hull integration.

Acoustic elements between tunnels

- Designed to ensure that properties are maintained under variable environmental conditions.
- Can be accessed via cover plates in inner tunnel conical inlets.

Reduce noise by 11-15 dB(A)



Where thrusters run continuously for long periods, thruster operation is increasingly considered as a normal seagoing condition. This requires compliance with the IMO Resolution A.468 – Code on Noise Levels on Board Ships.

High and variable noise levels have become an intolerable problem on a ship where thrusters may run for as many as 7,000 hours per year, and where extreme precision is vital to quality, performance and safety. This demand implies a new class of offshore service vessels.

Subsea 7's "Seven Pelican" is a unique high-performance diving support vessel which has clocked up nearly 130,000 hours (2011) of operation in demanding conditions all over the globe. Designed for intensive inspection, repair and maintenance (IRM) programmes, the "Seven Pelican" accommodates a crew of 108, including air-diving teams and saturation divers.

Its three resiliently mounted bow thrusters and stern thruster have run smoothly since they were delivered by Brunvoll when the vessel was built in 1985.

Bow: 3 x LowNoise Tunnel Thruster SPA-VP 1,100kW
Stern: 1 x Tunnel Thruster SPA-VP 920 kW





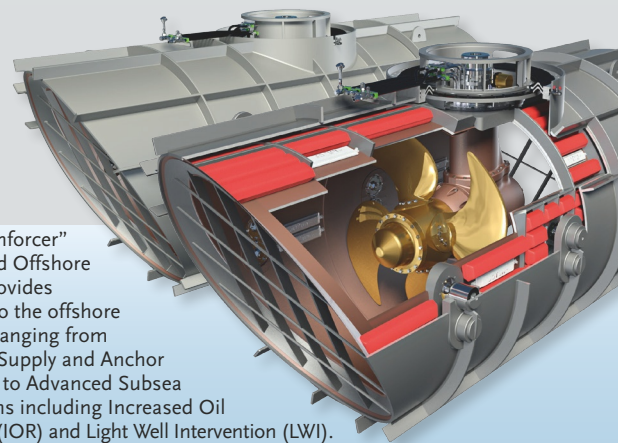
LowNoise Brunvoll thrusters reduce noise by 11-15 dB(A) and cause less vibration



Brunvoll's LowNoise thrusters are a proven solution to this challenge and the single most effective means of noise reduction.

A growing number of charterers and shipowners require new noise solutions because lower noise reduces risk and promotes safety, boosting the quality and efficiency of the entire operation.

Yards will be responsible for implementing new and stricter noise requirements.



"Island Enforcer"
The Island Offshore Group provides services to the offshore industry ranging from Platform Supply and Anchor Handling to Advanced Subsea Operations including Increased Oil Recovery (IOR) and Light Well Intervention (LWI). "Island Enforcer" was designed to meet the growing demand for vessels equipped to handle highly complex operations in subsea maintenance and construction.

Bow: 1 x LowNoise Tunnel Thruster FU100 LRC 2750 2,000 kW
 1 x LowNoise Tunnel Thruster FU100 LRC 2750 2,000 kW
 1 x Retractable Azimuth Thruster AR100 LNC 2600 2,200 kW
 Stern: 1 x Tunnel Thruster FU100 LTC 2750 2,000 kW



Preferred by cruise and yacht leaders

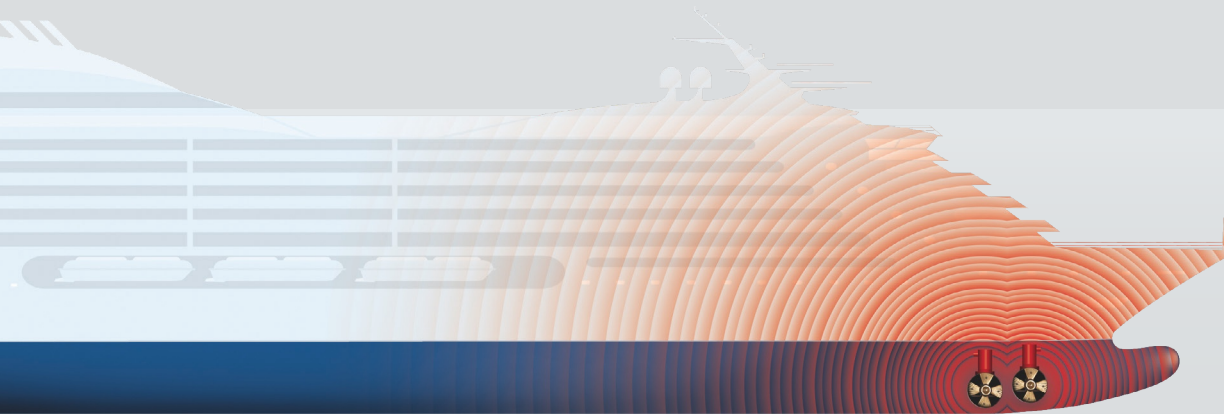
The ultimate in quiet manoeuvring adds a new dimension of comfort and pleasure to the voyage – much appreciated by discerning travellers. Noisy thrusters would create a harsh, disturbing contrast. That's why major cruise ship owners insist on LowNoise thrusters – and Brunvoll's noise suppression leads the field.



Level 3



Level 2



Level 1



Brunvoll LowNoise thrusters provide a 7,050kW thrust on each of the four Millennium-class cruise ships: Celebrity Cruise's ultra-modern "GTS Millennium", "GTS Infinity", "GTS Summit" and "GTS Constellation". LowNoise thrusters are a natural complement to the clean, quiet turbine technology, which minimizes environmental impact. These advanced vessels entered service in 2001 and 2002.

"Al Said". Bow: 2 x LowNoise Tunnel Thrusters FU63 LRC 1750 550 kW
Stern: 2 x LowNoise Tunnel Thrusters FU37 LRC 1000 200 kW



The figures show typical noise levels, in a cabin 3-4 decks above the thruster room:

Brunvoll's noise reduction

55
dB(A)

Ordinary noise reduction

67
dB(A)

No noise reduction

72
dB(A)

"Eclipse" – Bow: 2 x LowNoise Tunnel Thrusters
FU63 LRC 1750 500 kW



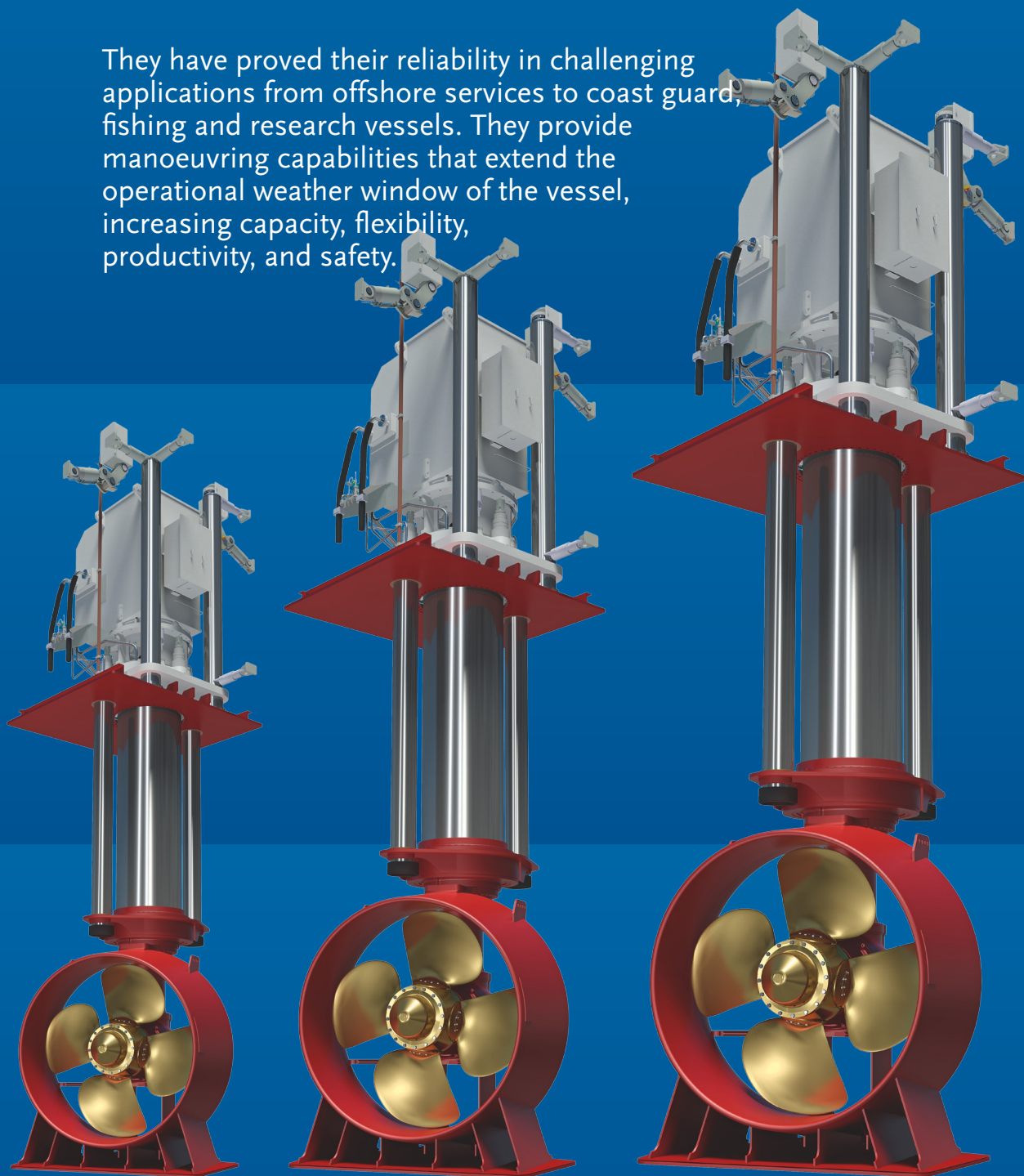
For outstanding manoeuvrability, "Europa 2" will have LowNoise bow thrusters from Brunvoll – 2 x FU80 LRC 2250 1,500 kW.



RECTRA AZZIM

Demand is growing for Brunvoll's

They have proved their reliability in challenging applications from offshore services to coast guard, fishing and research vessels. They provide manoeuvring capabilities that extend the operational weather window of the vessel, increasing capacity, flexibility, productivity, and safety.



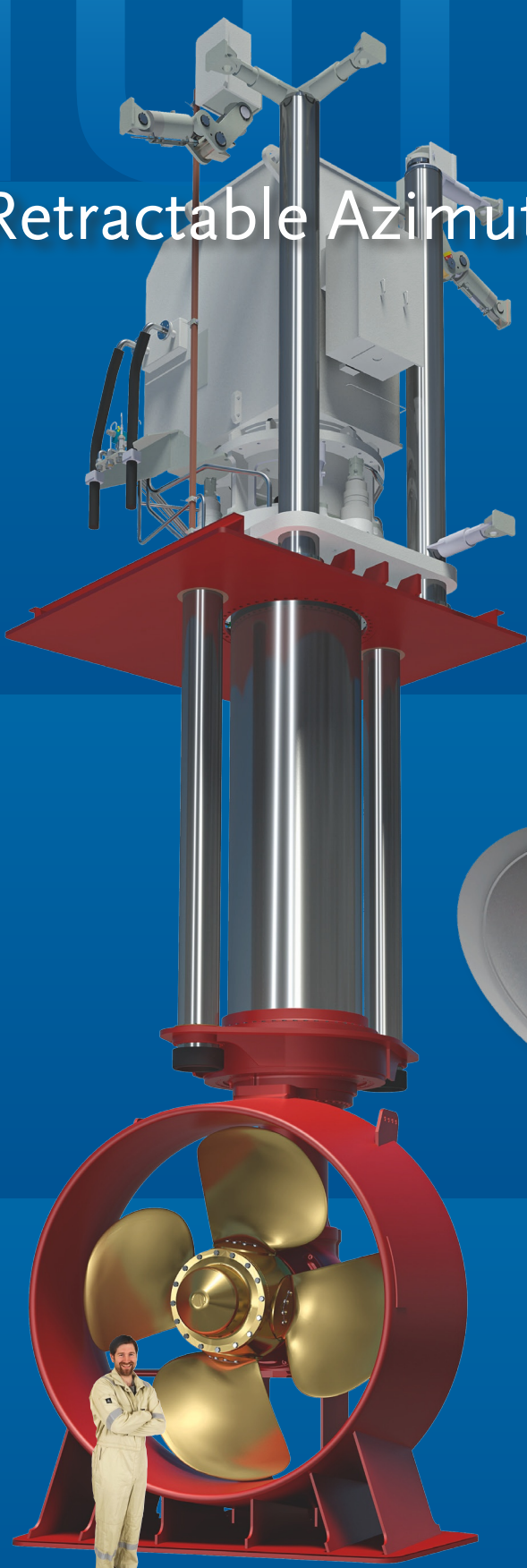
AR63

AR80

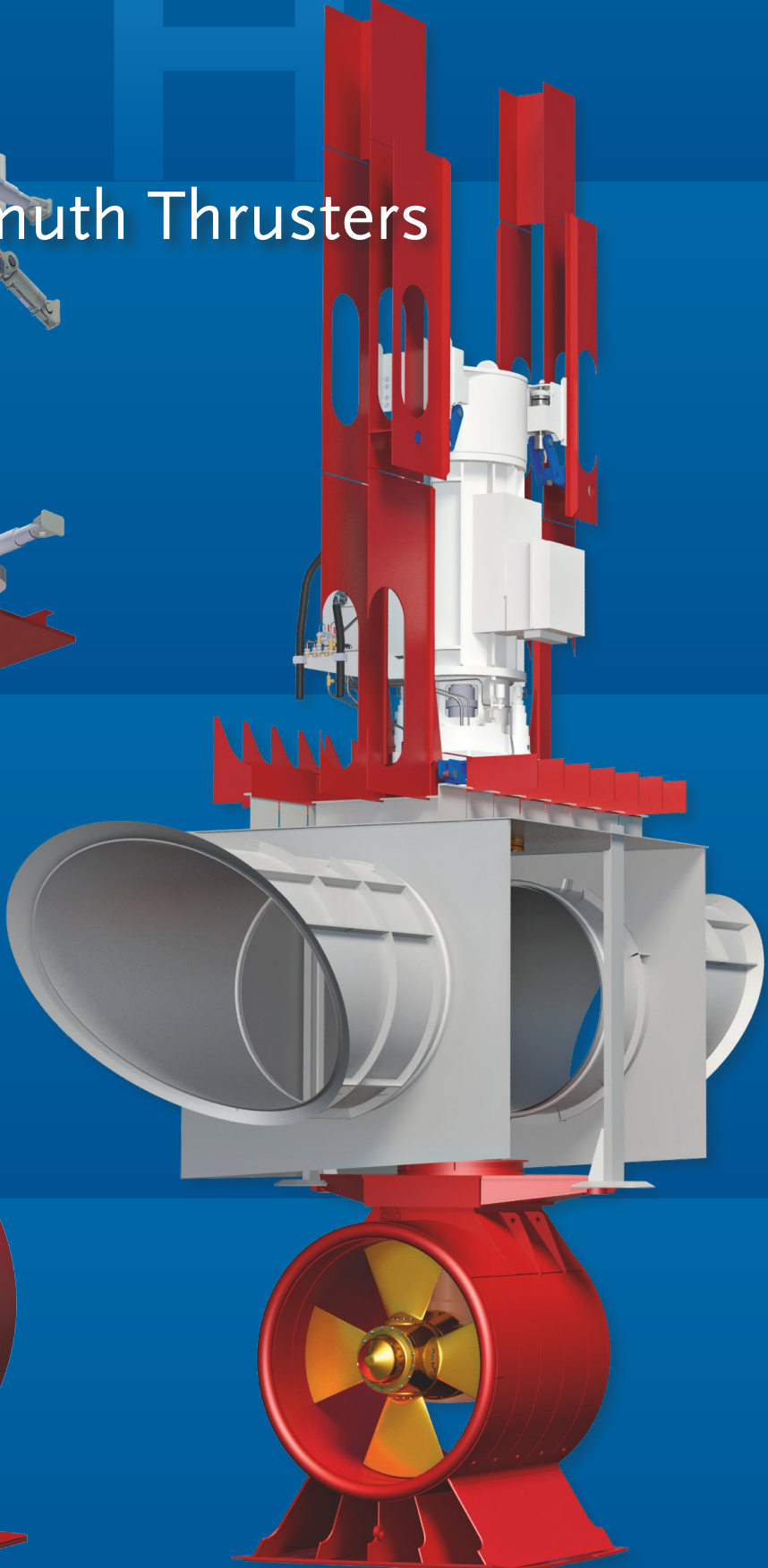
AR100

CTABILE MULTI

Retractable Azimuth Thrusters



AR115



AR Combi

Brunvoll's Retractable Thrusters – reliable and proven technology

A Brunvoll success

- Almost an industry standard for shuttle tankers.
- Shock-qualified thrusters available for naval vessels.
- A popular choice for product tankers, reefers, chemical tankers and container ships in the merchant navy.
- Can serve as take-home propulsion.

Robust technology

- Hull cover securely closes the bottom opening, reducing drag.
- First-class inspection possibilities
- Renowned for reliability.
- Robust column.
- Top-quality locking devices.

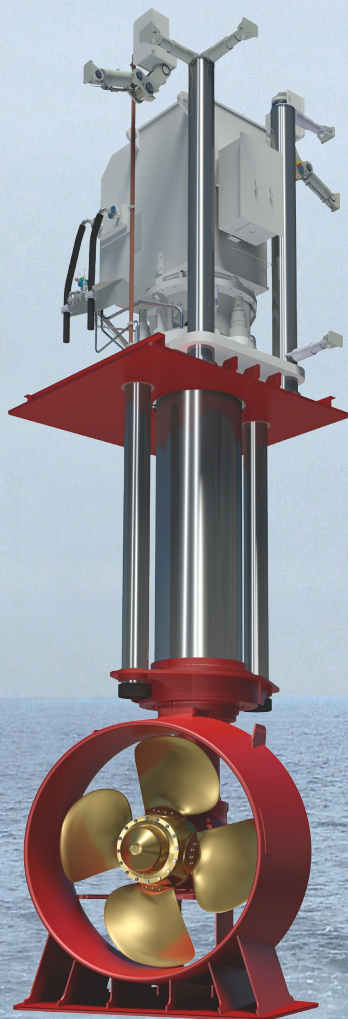
The first Azimuth Retractable

Back in the 1970s, the Norwegian Coast Guard saw the need for an azimuth thruster that could be lowered into position quickly – exactly when extra manoeuvrability was needed – and kept out of the way for the rest of the time.

Brunvoll already had a reputation for delivery of reliable tunnel thrusters to the Coast Guard.

“For a small firm with a pioneering spirit and a passion for thrusters, the challenge was irresistible”, recalls Terje Dyrseth, who was Brunvoll's Sales Manager at the time.

“The Coast Guard vessels operate in Arctic seas with ice, where fierce storms may blow up suddenly. They must expect the unexpected. They need superb manoeuvrability for patrol and rescue operations. We shared ideas in-house and had an ongoing dialogue with the Coast Guard to develop a thruster that met their demands.”



Easy installation

- Easily arranged and installed
- Minimal footprint.
- Option for complete plug-in installation.

The first retractable azimuth thruster was installed on KV “Nordkapp”, delivered in 1980. KV “Nordkapp” was followed by KV “Senja” and KV “Andenes”, each with a Brunvoll Retractable Azimuth Thruster system.

The success of this innovation attracted attention in the offshore market. It solved a problem faced by shuttle tankers in ballast condition. In heavy seas, rolling motions can cause conventional tunnel thrusters to draw air if they break the surface, which may prevent the tanker from loading. A retractable azimuth thruster can be lowered in a minute, so that the vessel can carry on working.

Today, we are seeing a trend toward increased use of these versatile thrusters. Modern shuttle tankers and offshore construction vessels can be designed with several retractable azimuth thrusters combined with several tunnel thrusters.

Creative owners of advanced fishing vessels have implemented retractable thrusters to make their catch process more effective. And retractable azimuth thrusters add to the flexibility of high-investment ships, enabling year-round operation as multi-purpose vessels.



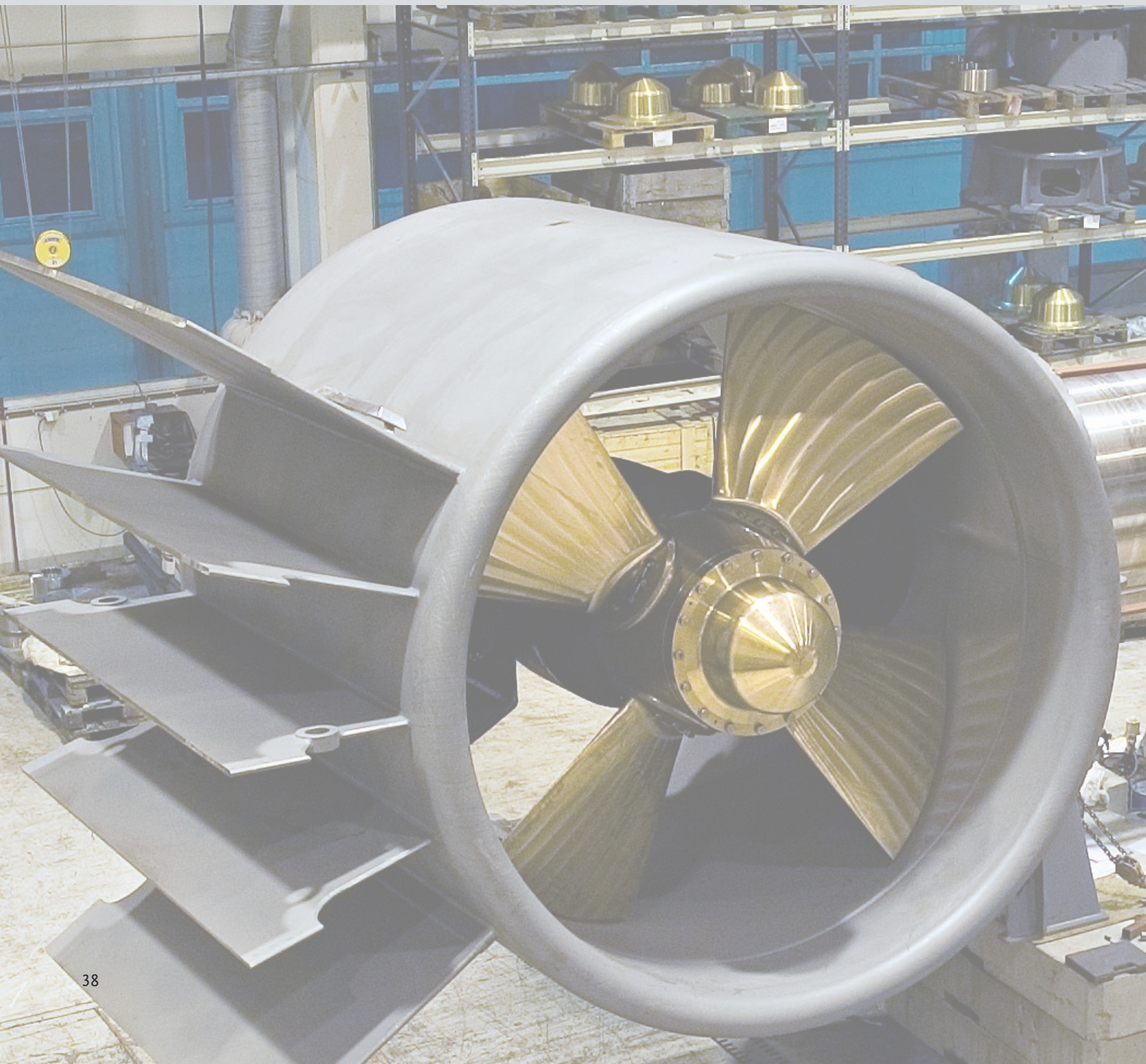
Introducing the largest Retractable ever

Ever larger ships.
Highly advanced technology.
More challenging applications.
Increasing demand for manoeuvrability.
The demand for larger thruster units is growing steadily.

Sophisticated vessels are being developed for functions such as well intervention, offshore construction, subsea maintenance and wind turbine installation.

Larger and larger ships are being equipped with dynamic positioning systems.

Brunvoll's response is the largest retractable azimuth thruster so far: the AR115.



With many AR100 thrusters in operation on the seven seas, we are investing decades of valuable experience in our new thruster.

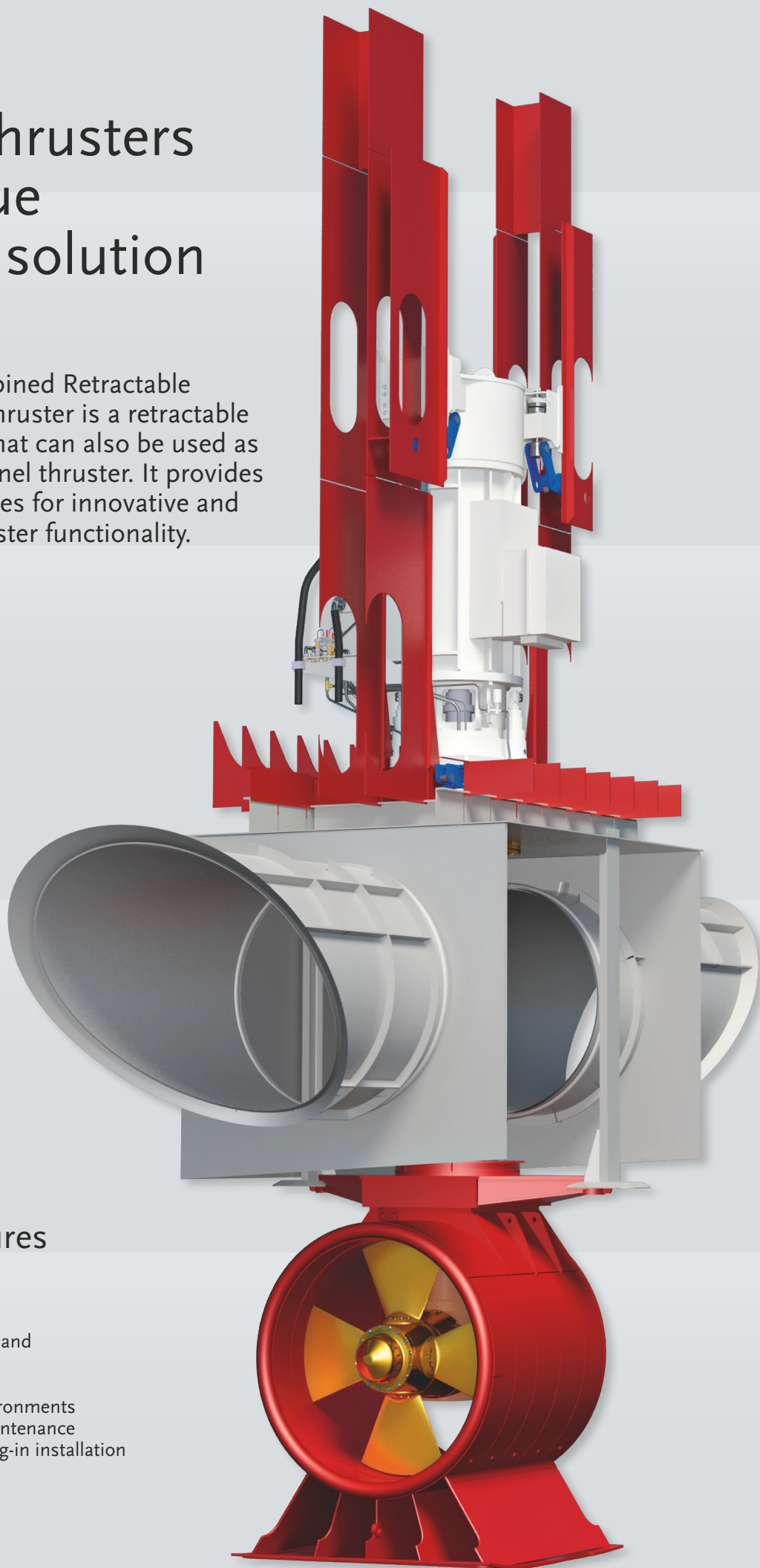
The generous dimensions and robust solutions are designed to withstand heavy seas and harsh environments.

Brunvoll's largest retractable azimuth is attracting growing interest for naval, merchant and offshore vessels.



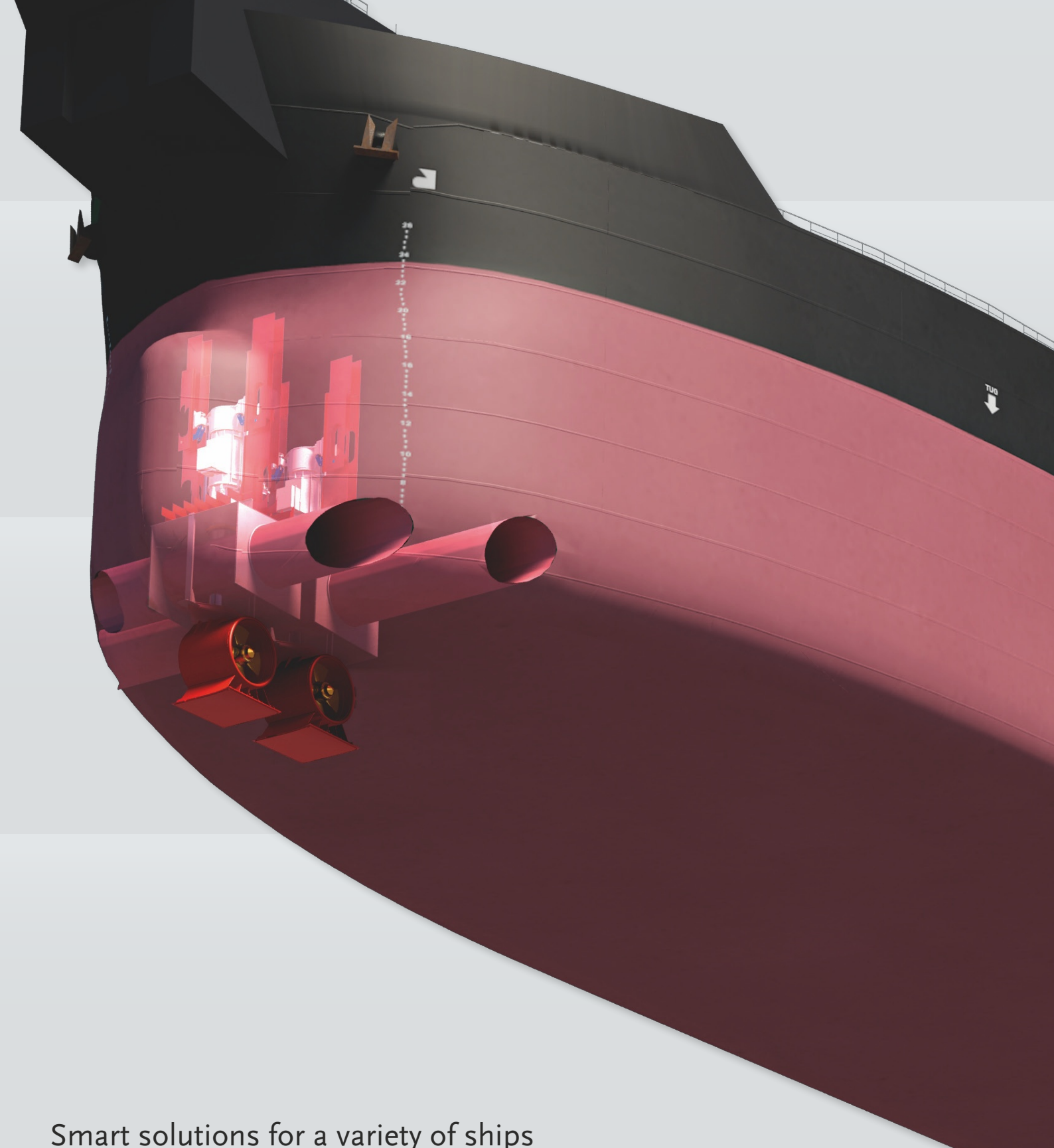
Azimuth Combi Thrusters – a unique Brunvoll solution

The Brunvoll Combined Retractable Azimuth/Tunnel Thruster is a retractable azimuth thruster that can also be used as a conventional tunnel thruster. It provides unique opportunities for innovative and flexible use of thruster functionality.



Technical features

- Locking device
- Electric motor
- Only one gear
- Hull cover reduces drag and protects the thruster
- Minimal footprint
- Designed for harsh environments
- Easy inspection and maintenance
- Option for complete plug-in installation



Smart solutions for a variety of ships

The Brunvoll Combined Retractable Azimuth/Tunnel Thruster is of special interest for advanced fishing vessels (To the right: "Gitte Henning" with one unit in the bow), product tankers, seismic vessels, shuttle tankers operating in heavy seas and emergency "take-home" propulsion.

Brunvoll Combined Retractable Azimuth/Tunnel Thrusters were chosen for 2 Knutsen NYK newbuildings (illustration above) for delivery in 2014 – with two in the bow and two in the stern.



RDT

The new Brunvoll RDT Concept



RDT800

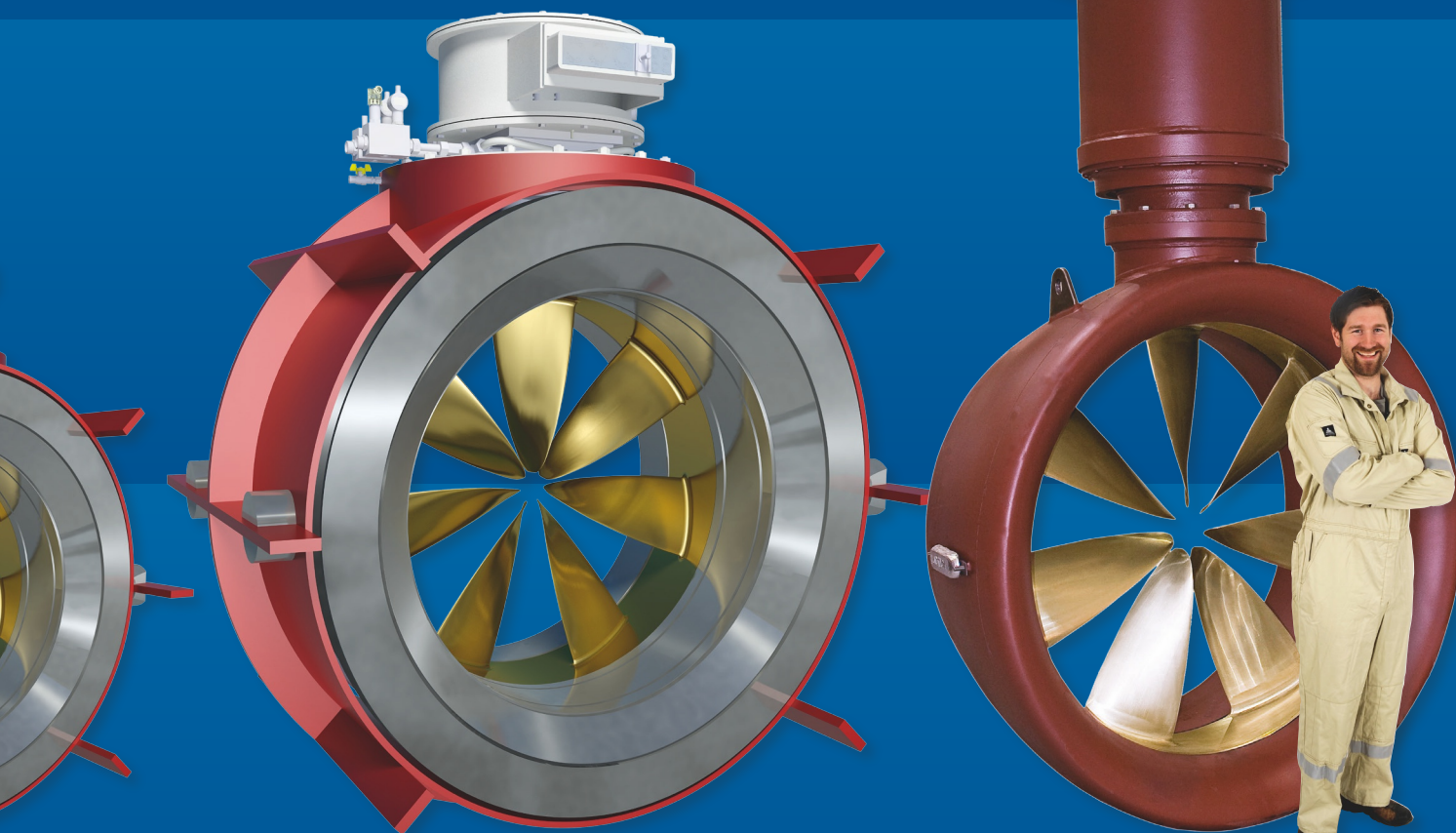
RDT1000

RDT1250

RDT1500

with major potential in different areas

The Brunvoll Rim-Driven Thruster saves space and energy, offering higher propeller efficiency and lower environmental impact with exceptionally low noise. The RDT concept creates exciting potential for both manoeuvring and main propulsion.



RDT1750

AU RDT1500

Advantages of the Brunvoll RDT

Brunvoll's commitment to innovation – RDT development, testing and pilots

The thruster, propeller and motor are in one compact unit – there is no need for an external motor, shafts or couplings.

With no gap between the propeller tips and the duct or tunnel, propeller efficiency is higher, while noise and vibration levels are exceptionally low.

The compact design increases arrangement flexibility and makes more space available on board.

The RDT can be fitted in places where there is little room for conventional thrusters.

2002

Brunvoll started development of the Rim Driven Thruster in cooperation with Norpropeller AS.

2003

Finalization of the prototype for a 100 kW RDT azimuth thruster.

Start of full-scale testing.

2005

After successful testing, Brunvoll presents the RDT concept to the market.

2007

810 kW DT1750 installed in the Platform Supply Vessel "Edda Fram" owned by Østensjø Rederi AS.

2008

Two RDTs delivered for fishery inspection vessel under construction in Spain for Danish fishing authorities.

2009

RDT delivered to megayacht under construction at Fr. Lürssen Werft.

RDT installed on "Edda Frende", sister vessel to "Edda Fram".

2010

Two azimuth RDTs installed for main propulsion of the 40-year old ferry "Eiksund".

Inspection of RDT installed in "Edda Fram" showed positive results.

RDT delivered for fishery inspection vessel under construction in Spain for the University of Dubai.

Successful commissioning of RDT for megayacht.

Continued testing and refinement of the RDT in a variety of real-life conditions.

2013

Development of new versions and larger RDTs.

Water-lubricated bearings eliminate the need for lube oil – and the risk of oil pollution.

With no central shaft and no dynamic seals, there is less risk of damage due to line and rope entering the thruster.

Permanent magnets provide greater flexibility in selection of motor speed (number of motor poles) and a motor with high efficiency running at a lower temperature.

The propeller blade thickness can be reduced to make

the propeller even more efficient, reducing fuel consumption and operating costs.

Greater efficiency means reduced emissions – a greener solution.

Simpler installation saves time and costs.

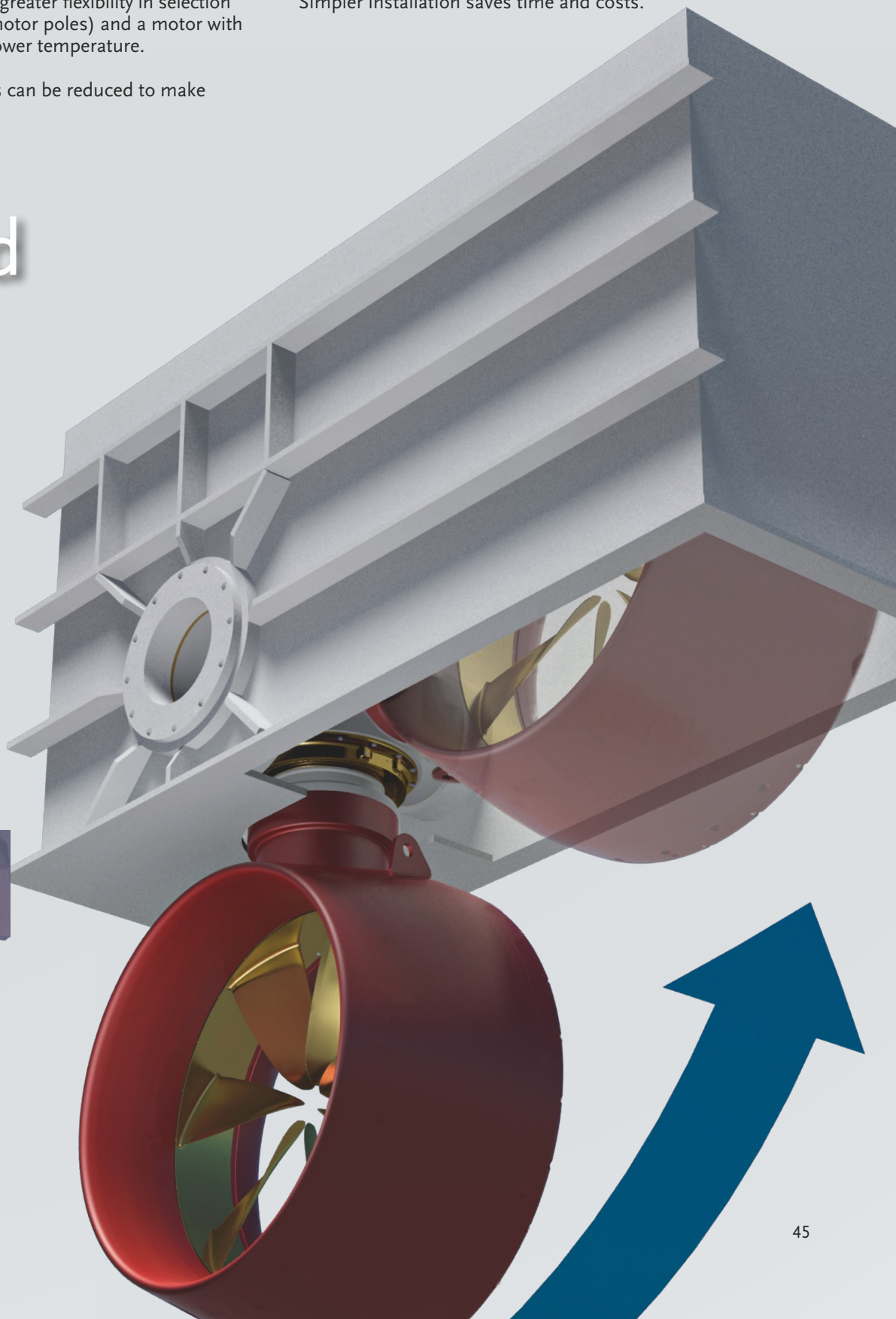
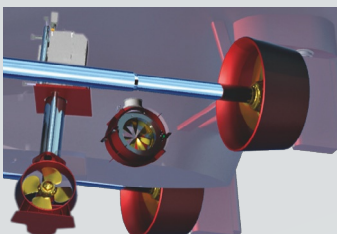
Planned

Further development of the RDT concept:

AR RDT Retractable Azimuth

- Flexibility – Efficient manoeuvring
- Highly compact – small footprint
- Minimal height
- Minimal space needed
- Can be placed in narrow skeg
- Low noise and vibration

SwingUp RDT version



Thousands of hours demanding North Sea operation – no problem!

Design innovations demand equipment innovations
We produced the first large Rim Driven Thruster in early 2007.
This innovative RDT was developed, engineered and produced by Brunvoll.
It was installed with resilient mounting to supplement the two existing LowNoise tunnel thrusters.
The combination of resilient mounting and RDT technology represent the ultimate in noise reduction measures.

The 810 kW RDT was installed in “Edda Fram” in 2007

On schedule we delivered the RDT1750 to the Platform Supply Vessel “Edda Fram” owned by Østensjø Rederi As.

This pioneering ship has diesel-electric propulsion with advanced cycloidal propellers, reducing fuel consumption and emissions.

The RDT has been designed for easy installation, and this was achieved in only 3 days. The installation has worked without problems.

Smooth operation

The resiliently mounted RDT and the 2 LowNoise thrusters all functioned smoothly. The RDT was used the most! The crew seemed to prefer it. Noise level measurements are expected to indicate levels about 20 dB(A) quieter than for conventional tunnel thrusters.



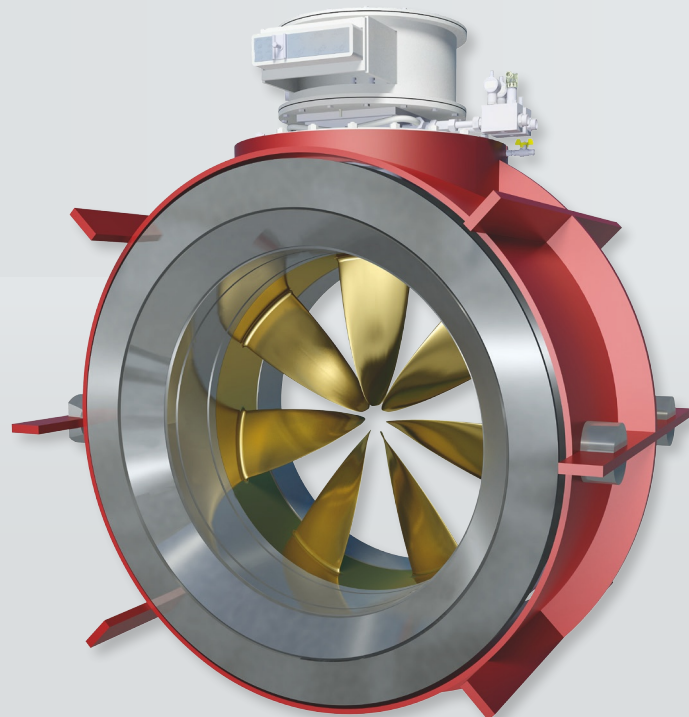
“Edda Fram” “Edda Frende”



Østensjø Rederi AS

- The shipowner is recognized as a leader in the offshore and towage sectors. It has a reputation for producing innovative ideas that improve safety, capacity and costs.
- Crew comfort is a high priority for Østensjø Rederi. Both “Edda Fram” and “Edda Frende” meet DNV’s Comfort class criteria.
- The “Edda Fram” won the Offshore Support Journal award for the Ship of the Year in 2007.





3,000 running hours, inspection in June 2010

During scheduled docking, we removed the test RDT for inspection and replaced it with a new RDT – and this is what we found... Our engineers were pleased with the results and noted possibilities for further refinements related to bearings and corrosion protection - refinements implemented in new units.

Second RDT installed before the test period was over

After the Brunvoll RDT had run for some 1,500 hours on “Edda Fram”, Østensjø Rederi installed a second RDT from Brunvoll on her sister vessel “Edda Frende” in 2009. The installation has now accumulated more years of problem-free service.

Third vessel to same shipowner

Experience from Brunvoll RDTs i “Edda Fram” and “Edda Frende” made Østensjø order another RDT installation for the third ship in a series.



“Edda Ferd”



A rewarding partnership

Østensjø Rederi and Brunvoll shared the costs and benefits of this partnership. Brunvoll covered the costs of the RDT as well as follow-up of the thruster. Østensjø contributed with the frequency converter and installation expenses. This is a typical example of how the Norwegian maritime cluster shares resources, expertise and experience to the advantage of all parties.

RDT development, testing and pilots

Case Ferry 2010

In a spectacular ferry crossing...

The project “Eiksund” – a ferry built 40 years ago – is the first ship in commercial operation to have Brunvoll Azimuth Rim Driven Thrusters (RDTs) installed for main propulsion.

After running for more than 160,000 hours, the ferry’s old diesel engine and propulsion system needed replacement. Brunvoll engineers saw an opportunity to test its RDT technology on the fjord “next door” to its facilities.

Ferry operator Fjord1 was keen to try out new propulsion technology to reduce operating costs and emissions.

Major challenges of this project:

- Continuous operation
- High load
- Side forces during steering in transit
- Design of Rim Driven propeller blades for main propulsion

The partners in a unique industrial R&D collaboration

Fjord1 – the operator of the “Eiksund” – is one of Norway’s largest transport companies. Fjord1 operates many of the ferries on the coastline of western Norway. Its fleet consists of more than 60 ferries and some 17 other vessels.

This forward-looking enterprise is concerned with green technology and has attracted attention for its use of natural gas ferries, which dramatically reduce NOx emissions.



Brunvoll

After developing and refining RDT technology for nearly a decade, Brunvoll developed two azimuth RDTs to be used for the ferry's main propulsion.

Innovation Norway

This State-owned organization, which promotes industrial development in Norway, contributed some of the project funding.

Other contributors

Specialized firms in Norway worked together with Brunvoll in developing this concept with diesel-electric drive based on Permanent Magnet generators and motors connected via a true electric shaft.



PROPU

Brunvoll Propu

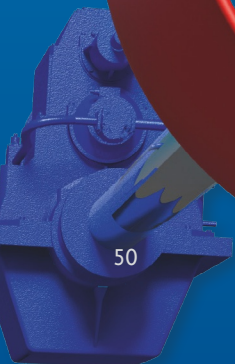
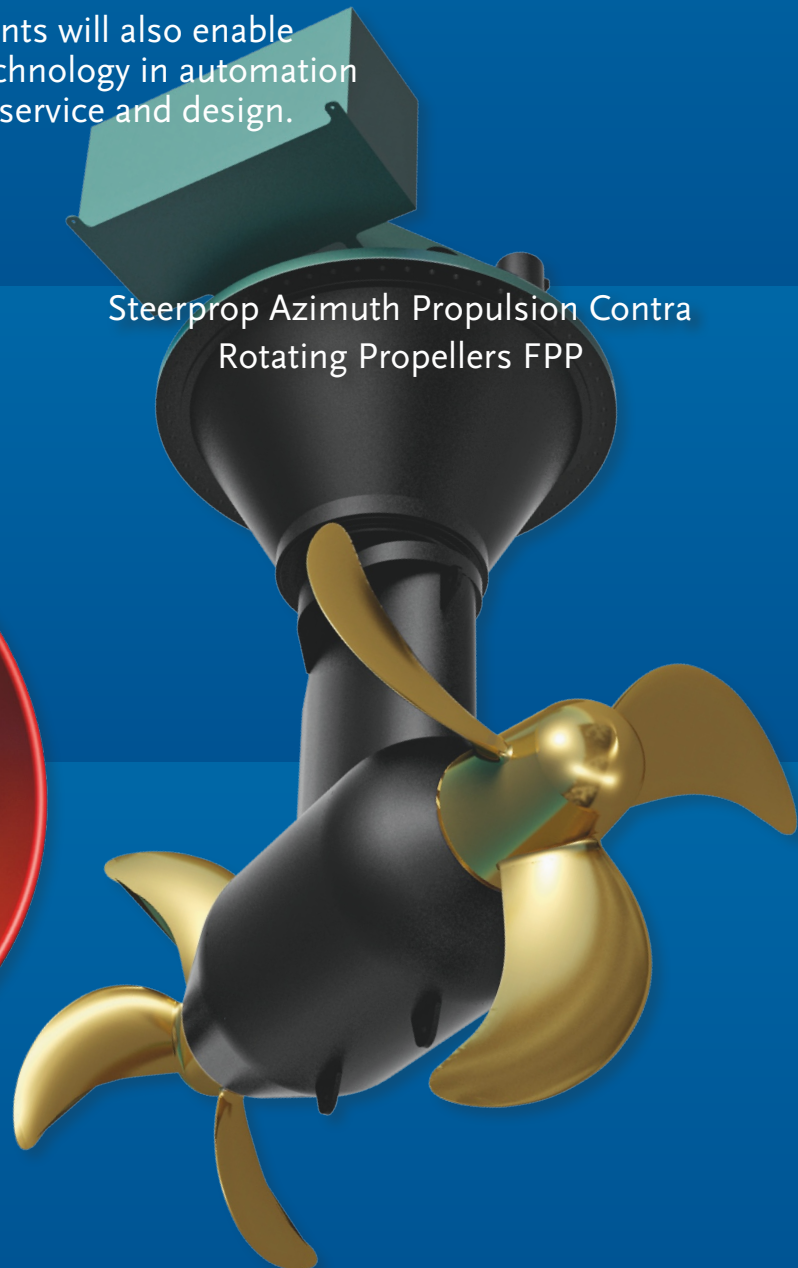
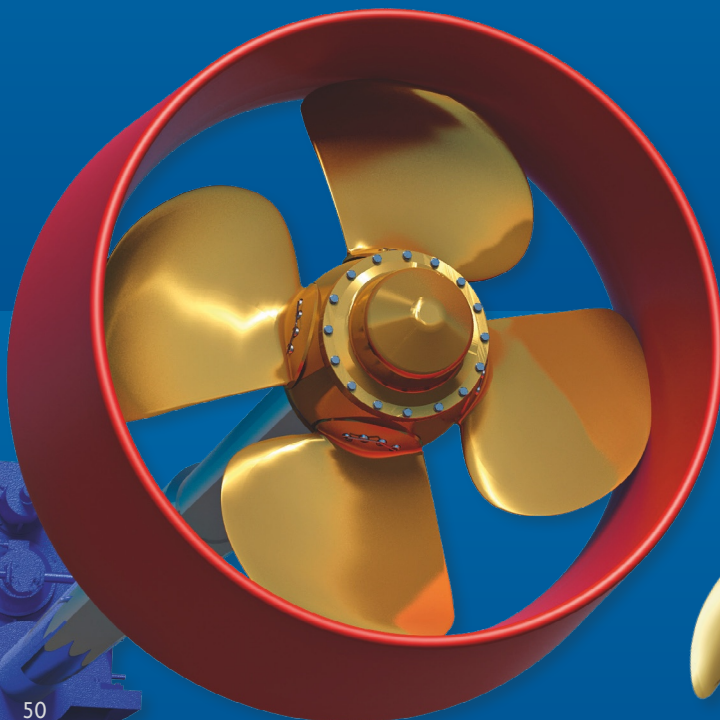
Brunvoll is committed to developing a PU 3000 propulsion unit with CPP technology.

To complement our range with azimuth and FPP propulsion, we are working together with Steerprop Ltd, in Finland. For conventional CPP propulsion, we have a collaboration with Finnøy Gear & Propeller to enable complete delivery of thruster units combined with main propulsion equipment including gears, shaft line, and propeller.

Cooperation agreements will also enable future exchange of technology in automation and control systems, service and design.

Finnøy Propulsion CPP

Steerprop Azimuth Propulsion Contra Rotating Propellers FPP



LSION

Ision Solutions



Propulsion Unit 3000 CPP



Azimuth Rim Driven Thruster

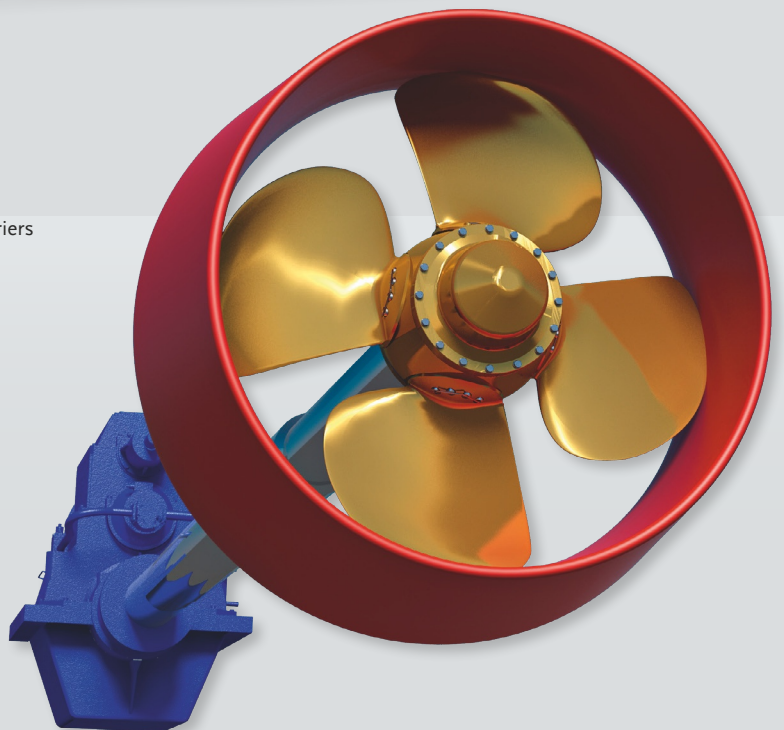


Propulsion Azimuth Thrusters CPP

Complete Manoeuvring and Propulsion from Finnøy and Brunvoll in cooperation



"Ro Fjell" – one of the world's largest and most advanced live fish carriers – has Finnøy main propulsion and Brunvoll thrusters complete with control, monitoring and alarm systems.





Brunvoll has extensive collaboration with Finnøy Gear & Propeller to enable a complete delivery of thruster units combined with main propulsion equipment including gears, shaft line and propeller

This teamwork makes it possible for us to offer coordinated systems for automation of propulsion and manoeuvring. Together with Finnøy, we can offer service and support related to our joint deliveries.

With attractive solutions for fishing vessels, smaller tankers and chemical tankers, offshore platform supply vessels (PSVs) and smaller anchor handling tug supply (AHTS) vessels, this cooperation offers new opportunities.

Complete Manoeuvring and Propulsion from Steerprop and Brunvoll in cooperation



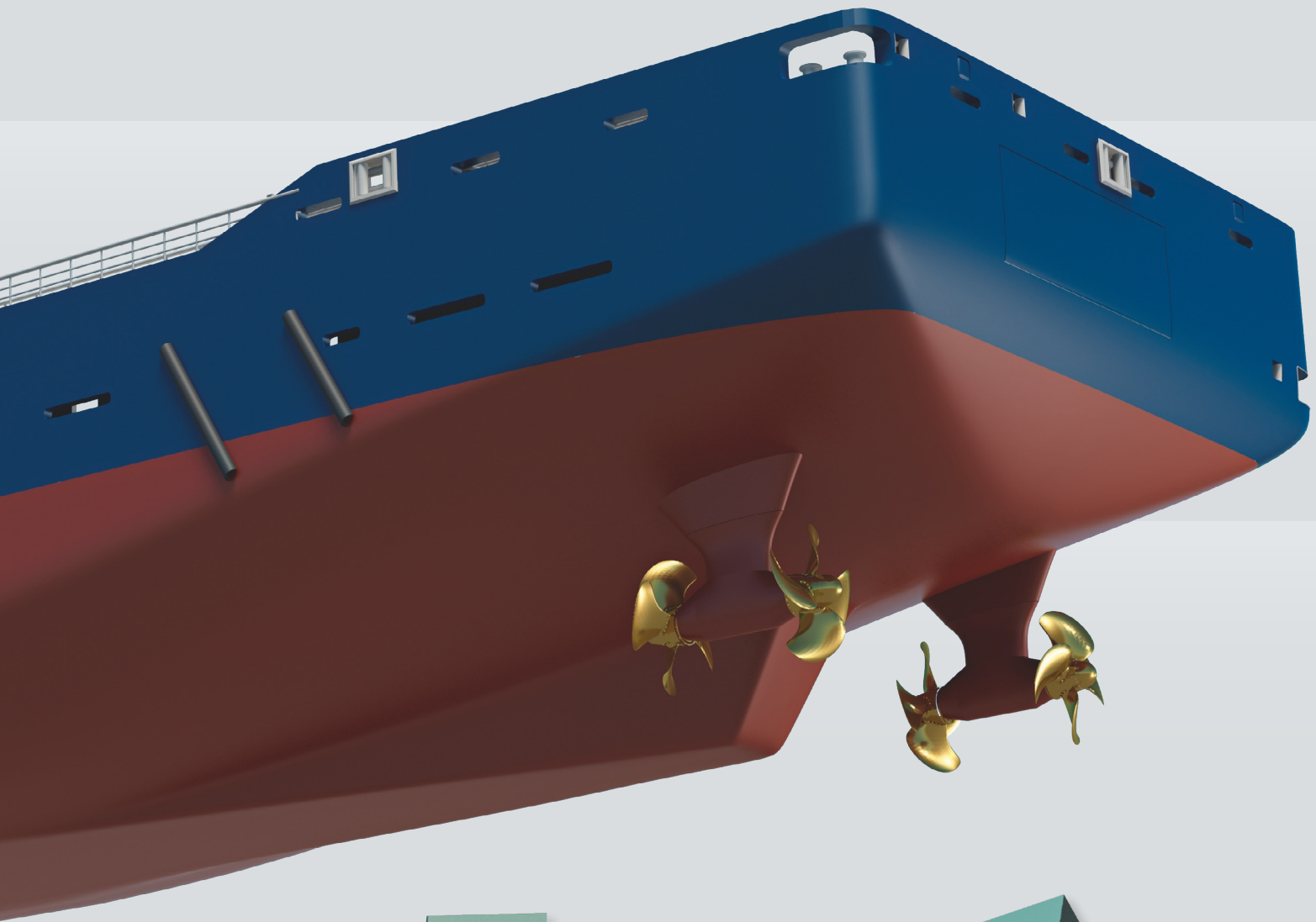
“Stril Orion” is an example of a vessel with azimuth propulsion equipment from Steerprop and thruster systems from Brunvoll.

Brunvoll is collaborating with Steerprop in Finland, to offer azimuth propulsion combined with manoeuvring equipment.

This teamwork provides new options for shipyards, owners and designers.

Steerprop will deliver its azimuth propulsion equipment and Brunvoll will deliver thrusters for manoeuvring.

In addition to mechanical equipment, the cooperation includes delivery of control and automation systems as well as after-sales services.



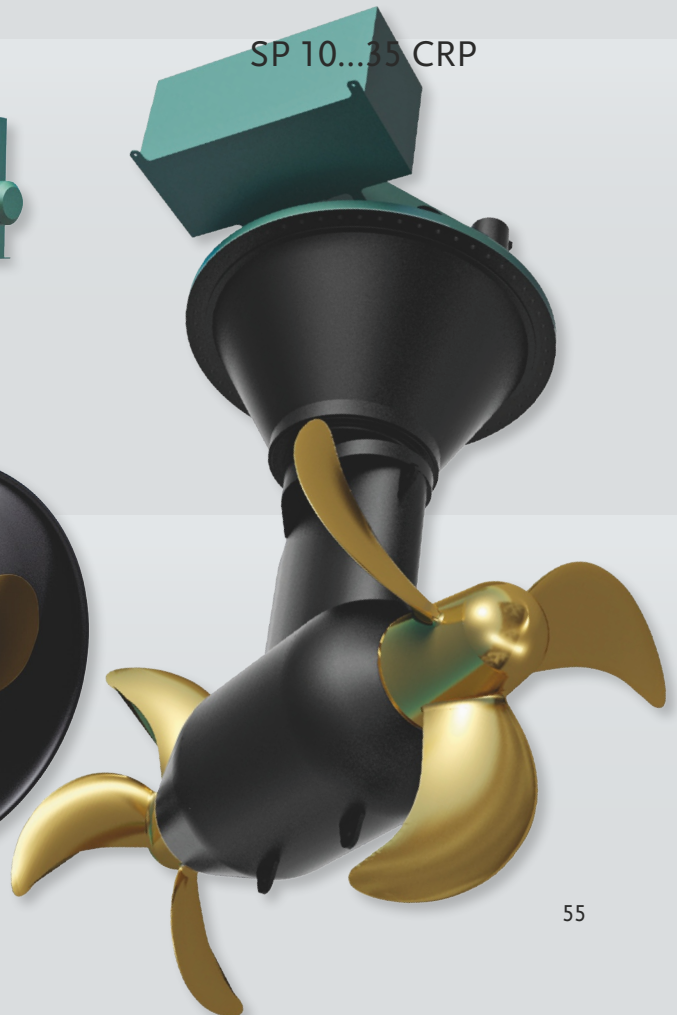
SP 10...45



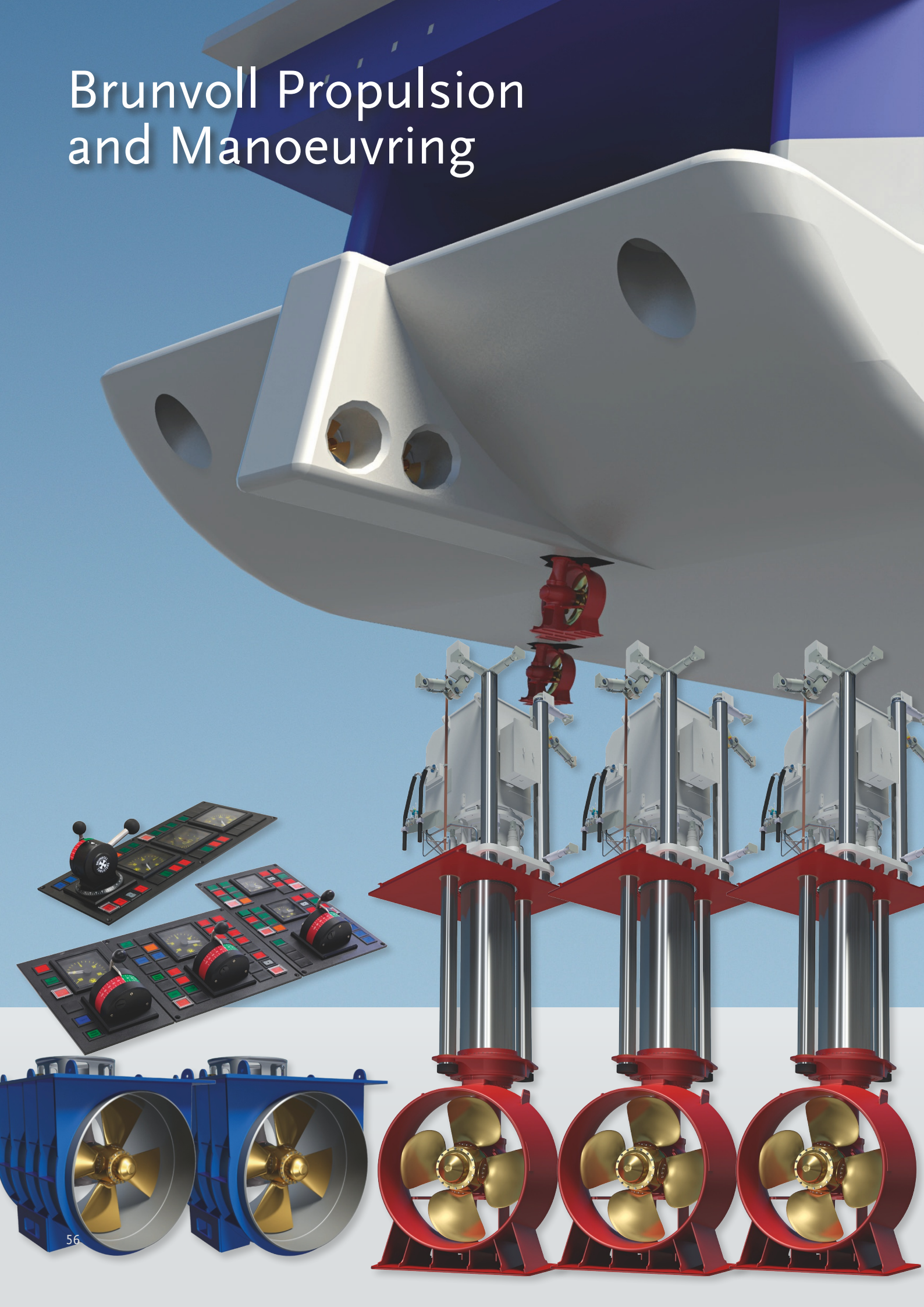
SP 50...80



SP 10...35 CRP



Brunvoll Propulsion and Manoeuvring



New synergies

For special applications, Brunvoll's thruster expertise is unmatched.

The complex interaction between the modules in this positioning and propulsion thruster system with a complete automation solution was masterfully engineered by Brunvoll.



Pioneering propulsion with Rim Driven Thrusters

A patented drive solution using a permanent magnet generator

– enables variable speed control, using a true electric shaft where the thruster speed is controlled by varying the speed of the diesel engine.

The azimuth RDT and direct speed control offer several advantages

- System simplicity reduces costs.
- The RDT frees up valuable space.
- Propulsion efficiency is improved.
- Power generation for shipboard needs is improved.
- Noise and vibration are reduced.
- A high degree of manoeuvrability is possible.



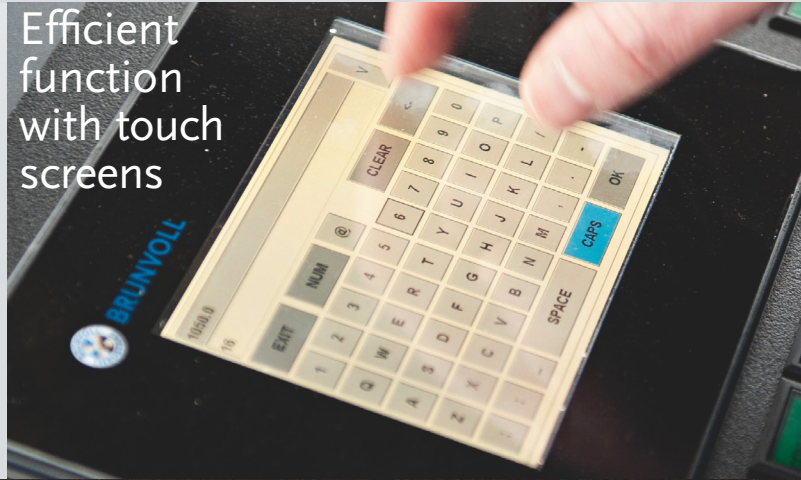
Environmental benefits

The RDTs have no gears and bearings that need oil lubrication. Replacing outdated diesel engines with more efficient RDT propulsion systems will reduce emissions and the associated NOx levy.

Greater efficiency and lower costs

- Lower fuel consumption thanks to optimal loading of the diesel engines.
- Lower power transmission losses than mechanically driven units or diesel-electric systems with variable speed drive.

Efficient function with touch screens



This double-ended ferry has been upgraded with an eagerly awaited innovation:

Two 380 kW azimuth RDT1500s delivered by Brunvoll

Brunvoll information resources are available in the publications shown here.

Please contact us if you would like to receive any of our brochures.

You are also welcome to read or download them as PDF files at www.brunvoll.no

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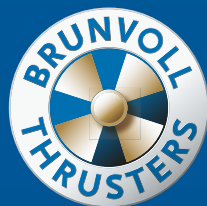
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