HYDRAULICA system

– Hydraulically supported Fuel Valves

Introduction

- engineering experts focusing on the maritime and stationary energy transition
- the **HYDRAULICA** system is a proven design
- providing emission compliance for existing Diesel engines
- robust and reliable fuel and emission saving solution
- verified functionality, performance and durability
- AES provides also an **E.G.R.** system for reducing NO_x and can be installed on any possible marine or stationary application
- both **HYDRAULICA** and the **E.G.R.** system from AES can be combined together

Description of the HYDRAULICA system

- when the engine is running and the HYDRAULICA system is installed, a defined hydraulic oil pressure is being applied to the fuel valve in order to avoid the spring bouncing and fuel dropping into the combustion chamber after the fuel pump is closed
- the fuel valve will be modified with hydraulic oil supply on top or into the spring chamber (depending on fuel valve design) and the fuel oil leakage opening will be closed; recommended to be done before a scheduled maintenance of the fuel valve
- with the improved function of the fuel valve through the HYDRAULICA system a better combustion is achieved especially outside the optimized MCR range
- the improved combustion is leading to a lower fuel oil consumption, less emissions as well an extended Time Between Overhaul (TBO) and an extended service life on engine parts
- works on 2-stroke and 4-stroke Diesel engines

HYDRAULICA – WORKING PRINCIPLE & TECHNICAL SETUP

Hydraulic Pump Unit (HPU)

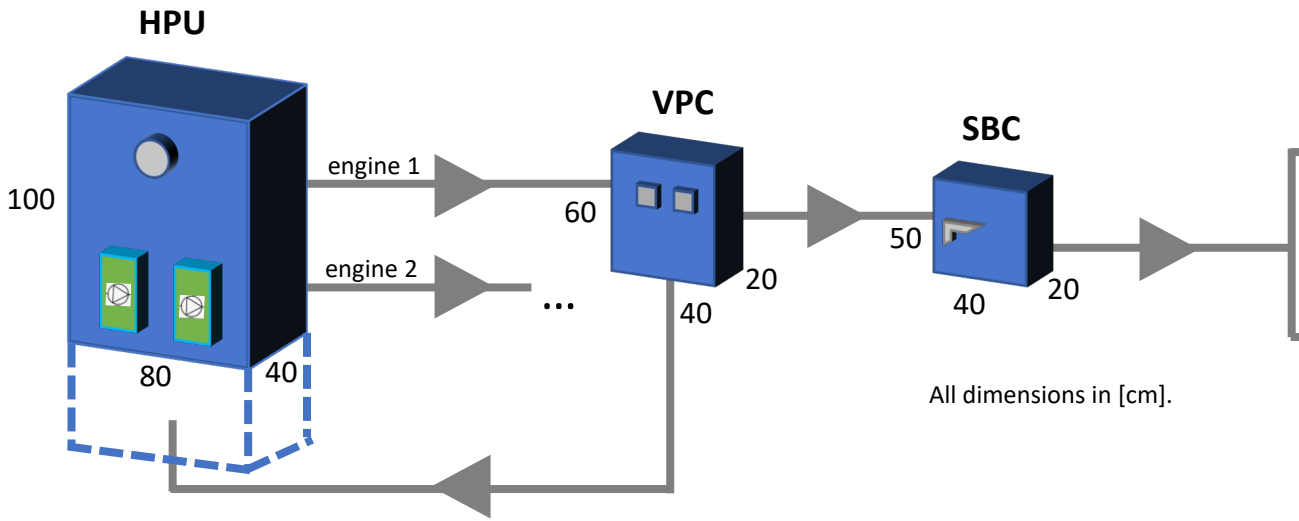
- including oil tank underneath, operating and standby pump for redundancy, all electrical equipment; oil is the same as engine lubrication oil
- pump capacity can be chosen for multiple engine application if required

Variable Pressure Controller (VPC)

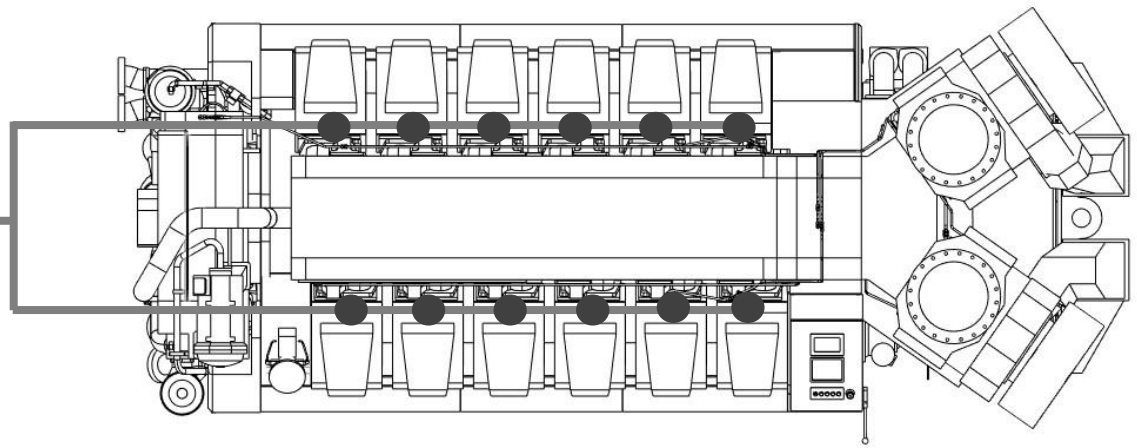
- this pressure control unit consists of a distribution block, proportionality valve and a current calculator
- calculation give the signal for the right pressure

Separation Block Cabinet (SBC)

- this cabinet needs to be installed as close as possible to the engine
- main task is to act as a shut-off device and a monitoring unit for the pressures



typical V-type Diesel engine (top view) as example



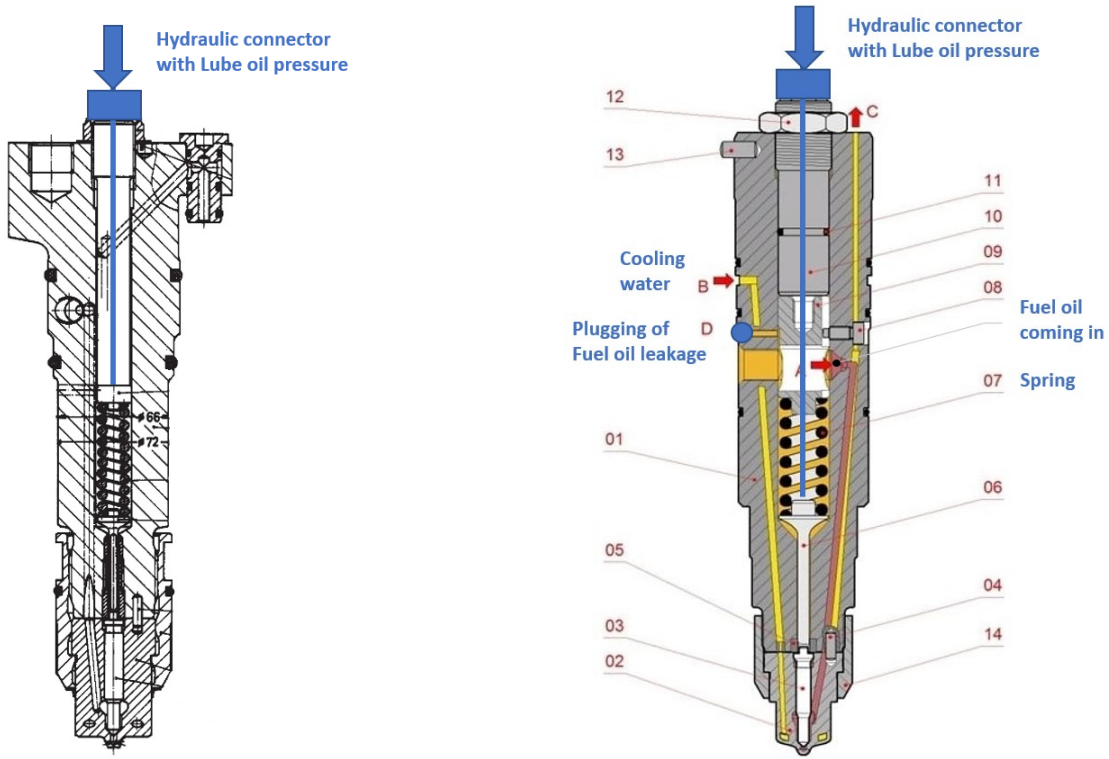
high pressure distribution pipes
(single-walled or double-walled available)

modified fuel valve (details are not shown)

HYDRAULICA – WORKING PRINCIPLE & TECHNICAL SETUP

Modified fuel valves

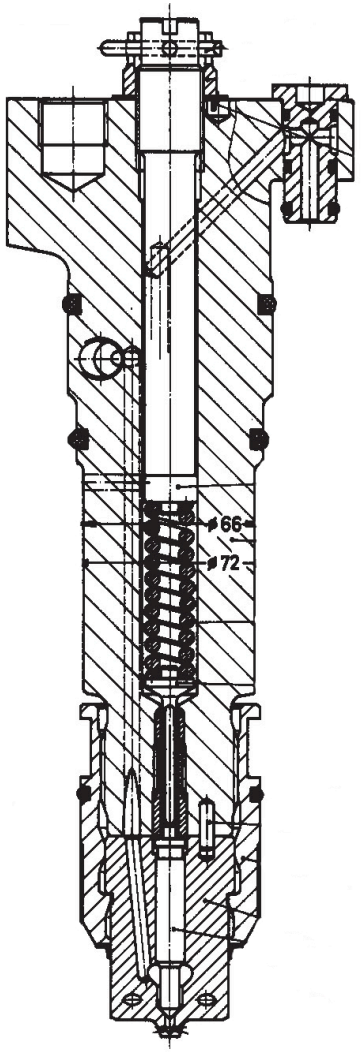
- the fuel valves will be modified in a way, that lube oil will keep the opening pressure on top or inside of the spring chamber
- in most solutions the HYDRAULICA parts are being exchanged 1:1, **no modification** on the injector is needed
- lube oil will need access with a hydraulic connector to the fuel valve



examples of typical 4-stroke medium-speed fuel valves with applied hydraulic oil

HYDRAULICA – EXAMPLE (1/3)

PIELSTICK PC2.6B injector with exchangeable HYDRAULICA parts

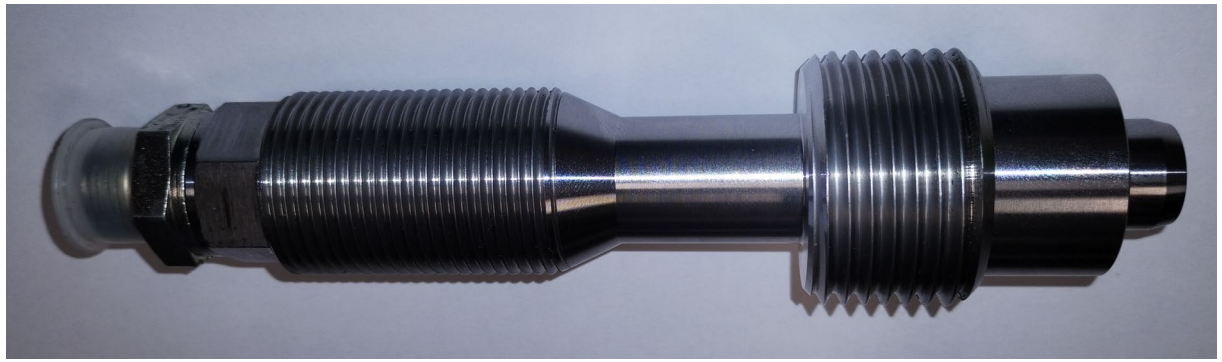


HYDRAULICA parts

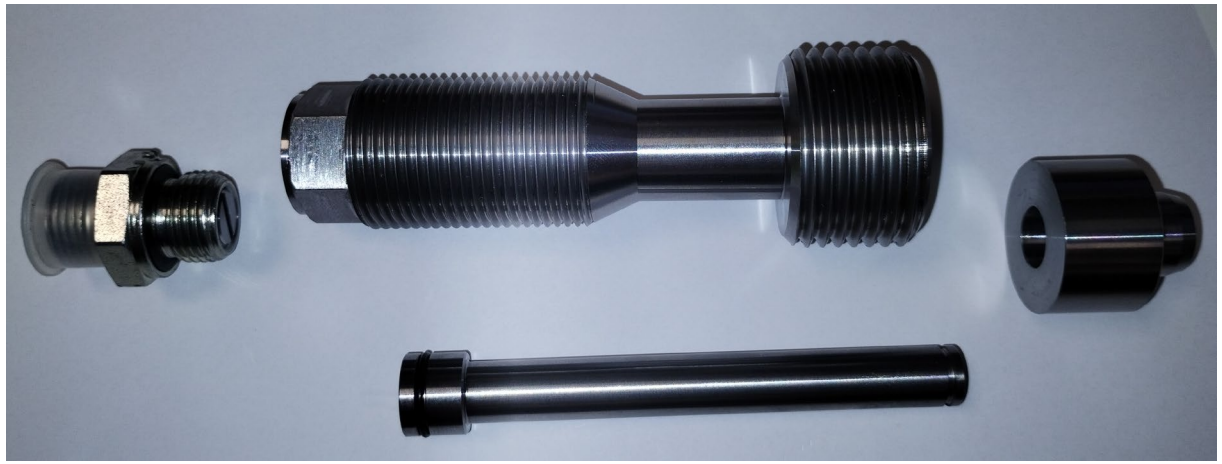
original parts

HYDRAULICA – EXAMPLE (2/3)

SULZER ZA40S injector with exchangeable HYDRAULICA parts



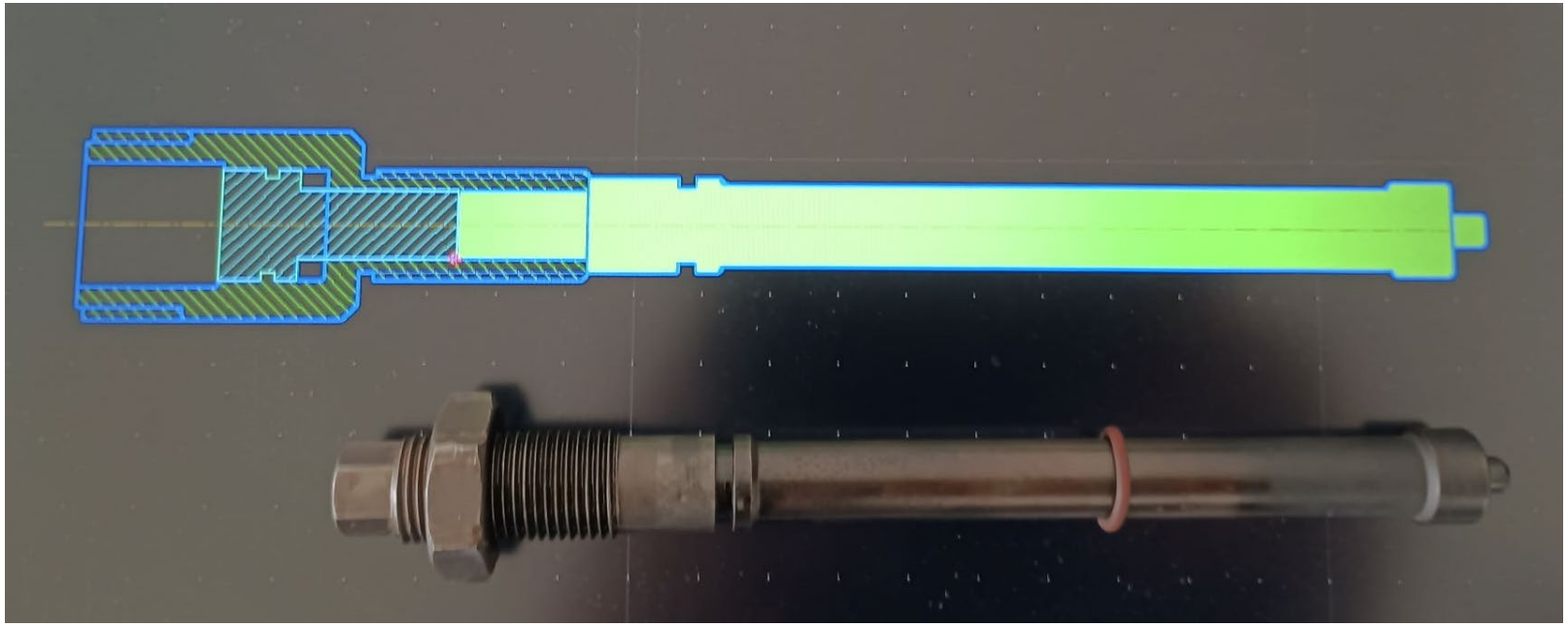
HYDRAULICA parts



HYDRAULICA – EXAMPLE (3/3)

MAN 28/32H injector with exchangeable HYDRAULICA parts

HYDRAULICA parts



original parts

ARGUMENTS FOR HYDRAULICA SYSTEM (1/5)

- a Standard Fuel Valve is designed to work at a fixed MCR around 85-100% depending on the application
- when running the engine in partial load, the poorer atomization of the fuel results in drips, coating and deposits of coke leading to a bad combustion
- this results in a high fuel consumption and worse emission values

=> Installing the HYDRAULICA system will solve this problems

ARGUMENTS FOR HYDRAULICA SYSTEM (2/5)

DNV

DNV Ship Classification
Engines & Pressurized Equipment
Brooktorkai 18
20457 Hamburg
Germany

Date:	Our reference:	Your reference:
2023-03-22	10701727-2	Email dated 2023-01-17

Technical evaluation of the HYDRAULIX system for Diesel engines

Dear Sir,

We have received your above-mentioned request to check and validate your product HYDRAULIX for safety on Diesel engines.

The aim of the product, accordingly to your information, is to save fuel and reduce the CO_2 emissions. We have received your Sales Presentation as well as a further confidential technical drawing regarding the modification in the fuel injector as data basis for review.

Due to the wide range of Marine engines and applications, DNV can at this stage not comprehensively check and validate this product but has in principle no objections against an installation of the HYDRAULIX system on Diesel Engines.

We would like to point out that, each modification of class relevant components on board a vessel is subject of a case-by-case approval.

Sincerely
for DNV

Digitally Signed By: Neddenien, Sven
Location: DNV Hamburg, Germany
Signing Date: 2023-03-22

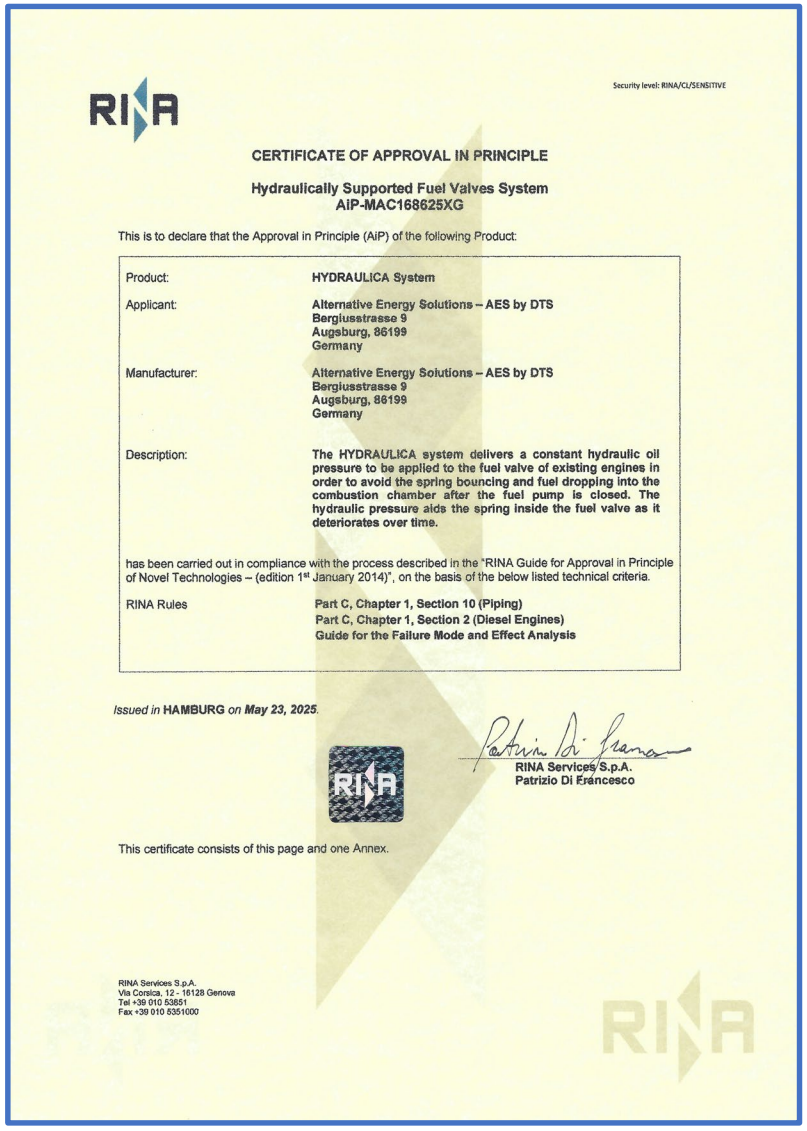
Sven Neddenien

Mobile: +49 173 6141968
sven.neddenien@dnv.com

DNV Headquarters, Veritasveien 1, P.O.Box 300, 1322 Høvik, Norway. Tel: +47 67 57 99 00. www.dnv.com

- DNV has issued a “Letter of No Objection” in principle for our HYDRAULICA system on Diesel engines
- no IMO relevant components will be changed or modified
- our customers will always be supported is case of any Class questions

ARGUMENTS FOR HYDRAULICA SYSTEM (3/5)



RINA

Security level: RINA/CL/SENSITIVE

CERTIFICATE OF APPROVAL IN PRINCIPLE

Hydraulically Supported Fuel Valves System
AiP-MAC168625XG

This is to declare that the Approval in Principle (AiP) of the following Product:

Product:	**HYDRAULICA System**
Applicant:	**Alternative Energy Solutions – AES by DTS** **Bergiusstrasse 9** **Augsburg, 86199** **Germany**
Manufacturer:	**Alternative Energy Solutions – AES by DTS** **Bergiusstrasse 9** **Augsburg, 86199** **Germany**
Description:	**The HYDRAULICA system delivers a constant hydraulic oil pressure to be applied to the fuel valve of existing engines in order to avoid the spring bouncing and fuel dropping into the combustion chamber after the fuel pump is closed. The hydraulic pressure aids the spring inside the fuel valve as it deteriorates over time.**

has been carried out in compliance with the process described in the "RINA Guide for Approval in Principle of Novel Technologies – (edition 1st January 2014)", on the basis of the below listed technical criteria.

RINA Rules	**Part C, Chapter 1, Section 10 (Piping)** **Part C, Chapter 1, Section 2 (Diesel Engines)** **Guide for the Failure Mode and Effect Analysis**

Issued in **HAMBURG** *on* ***May 23, 2025.***

RINA Services S.p.A.
Patrizio Di Francesco

This certificate consists of this page and one Annex.

RINA Services S.p.A.
Via Corsica, 12 - 16128 Genova
Tel +39 010 53851
Fax +39 010 8351000

- RINA has issued a Class Approval for our HYDRAULICA system on Diesel engines
- no IMO relevant components will be changed or modified
- our customers will always be supported is case of any Class questions

ARGUMENTS FOR HYDRAULICA SYSTEM (4/5)

- a comparison of the **3 pressure curves** between

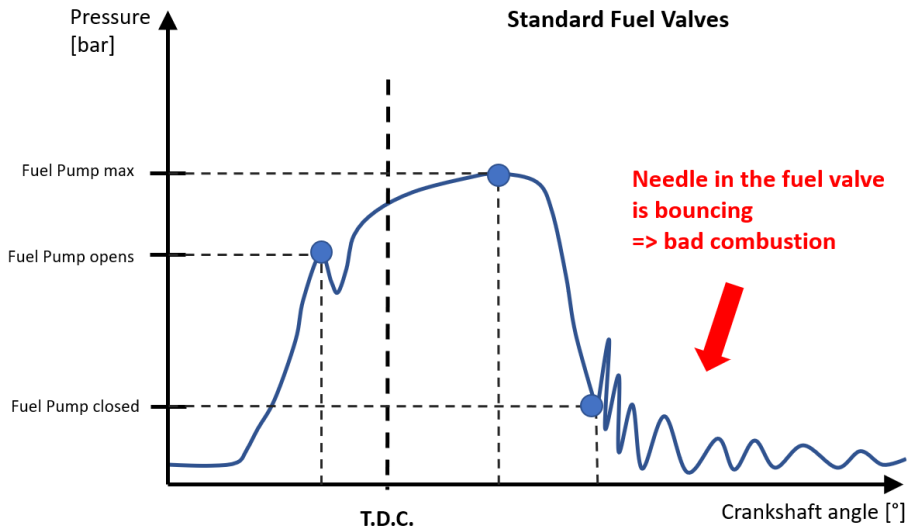
  a Standard Fuel Valve,

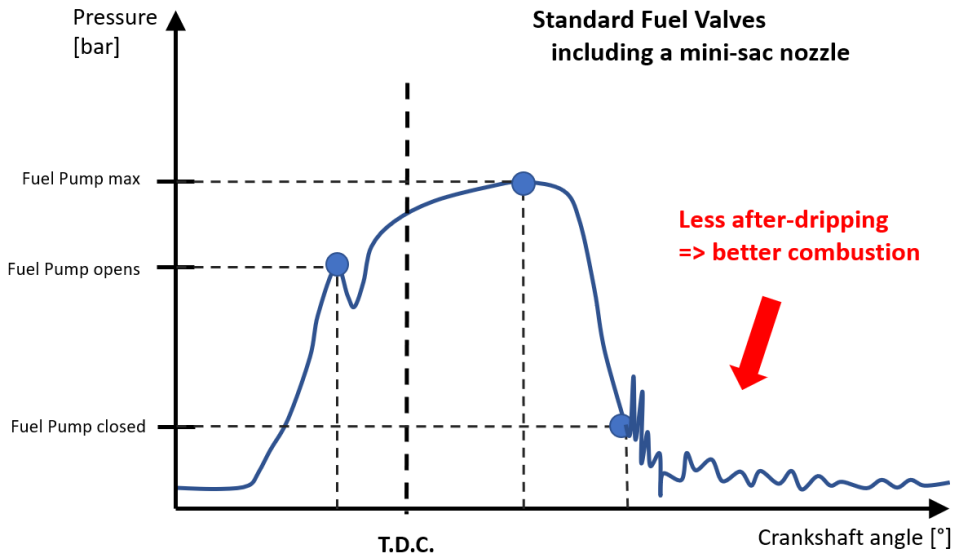
  a Standard Fuel Valve with a mini-sac nozzle

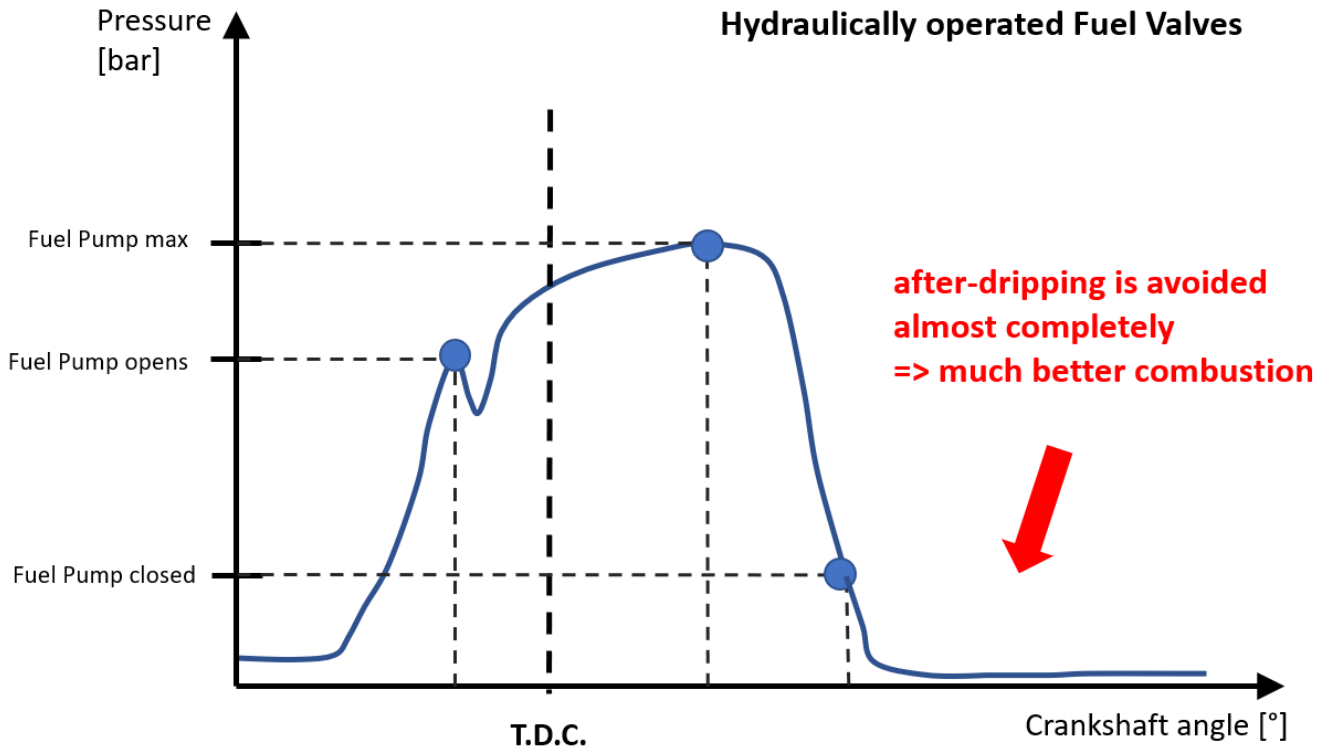
  and the hydraulically operated Fuel Valve show,

  that only the HYDRAULICA system leads to a better combustion resulting in less fuel consumption and lower emissions (curves are shown on the next slide)

ARGUMENTS FOR HYDRAULICA SYSTEM (5/5)





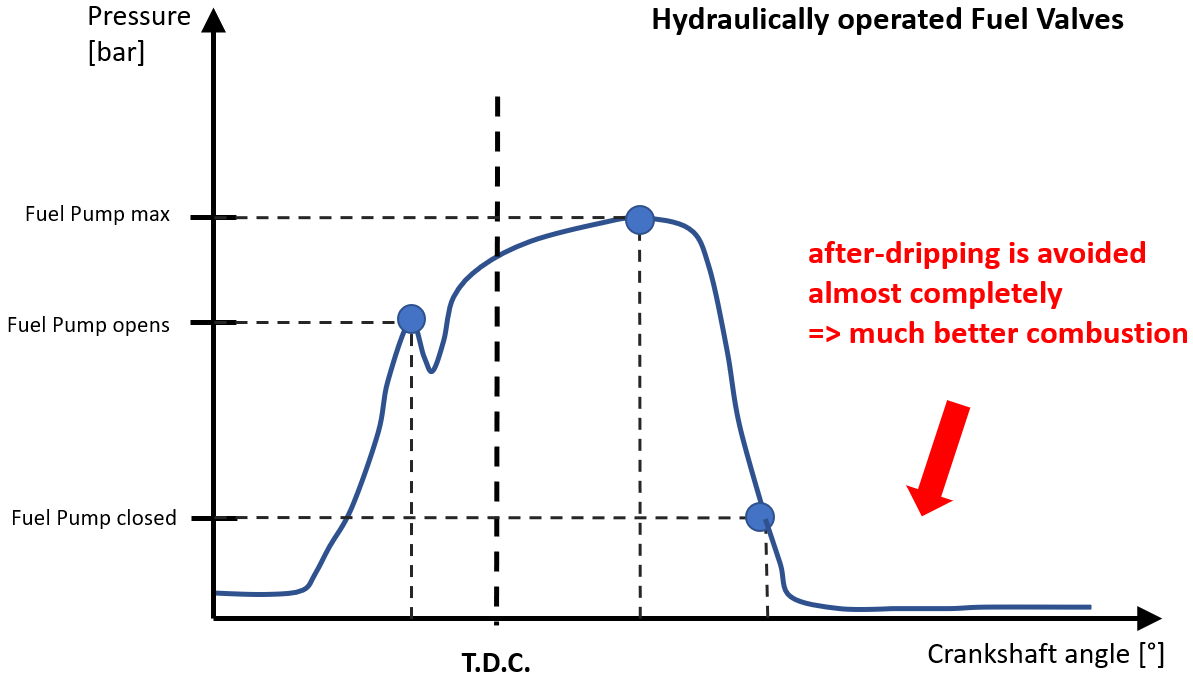


Experience with this technology 1/3

Roll-On/Roll-Off cargo ship with 2x Pielstick 12V PC2.5 main engines (Diesel-Mechanic application)

Performance of the HYDRAULICA:

- High Fuel savings
- CO_2 reduction according to Fuel savings
- particles visibly reduced



Alternative Energy Solutions
AES by DTS

Experience with this technology 2/3

HYDRAULICA **Business Case calculation with Fuel Savings** (not considered: reduced need for maintenance & spare parts)	Unit	CONTAINER SHIP 812 TEU ME 1x MaK 9M43 8.4 MW, 4-stroke, 75%, 5.540 rh, North and Baltic Sea	CONTAINER SHIP 862 TEU ME 1x MaK 9M43C 8.5 MW, 4-stroke, 85%, 4.315 rh, North Sea	CONTAINER SHIP 2.272 TEU ME 3x Götaverken 58 MW, 2-stroke, xx%, 7.000 rh, world wide	COASTAL TANKER ME 1x 6 MW, 4-stroke, xx%, 5.000 rh, North and Baltic Sea	RO-RO FERRY ME 2x Pielstick PC 2.5 12 MW, 4-stroke, xx%, 4.600 rh, North and Baltic Sea
Input						
Date	[-]	**24.02.2022**	**24.02.2022**	**24.02.2022**	**24.02.2022**	**24.02.2022**
	comment	last 12 months average values	last 12 months average values	last 12 months average values	last 12 months average values	last 12 months average values
Fuel price / Bunker price Rotterdam for MGO 0,1% S [2]	[USD / metric t]	**622,50**	**622,50**	**622,50**	**622,50**	**622,50**
Exchange rate USD to EUR [3 & 4]	[-]	**0,8548**	**0,8548**	**0,8548**	**0,8548**	**0,8548**
Fuel consumption per year	[t / year]	**5.652**	**5.590**	**70.000**	**4.320**	**5.621**
Fuel savings [1]	[%]	**6**	**5**	**2**	**4**	**8**
Investment for Fuel Saving product incl. Parts & Service (budget price)	[Euro]	**160.000**	**160.000**	**485.000**	**155.000**	**330.000**
Output						
Fuel price / Bunker price	[Euro / metric t]	**532,11**	**532,11**	**532,11**	**532,11**	**532,11**
Fuel costs per year	[Euro / year]	**3.007.503**	**2.974.512**	**37.247.910**	**2.298.728**	**2.991.114**
Fuel savings per year	[t / year]	**339**	**280**	**1.400**	**173**	**450**
Fuel costs savings per year	[Euro / year]	**180.450**	**148.726**	**744.958**	**91.949**	**239.289**
Payback / ROI	[years]	**0,89**	**1,08**	**0,65**	**1,69**	**1,38**

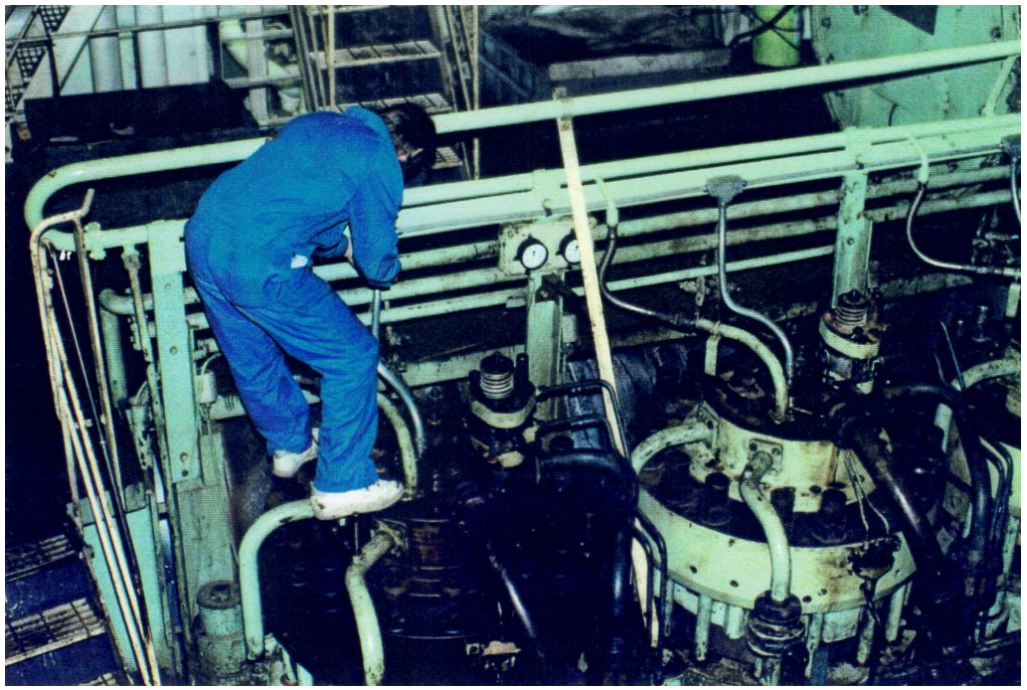
[1] Depending one engine maker and setup; for more detailed information please fill out our Customer Data Sheet.

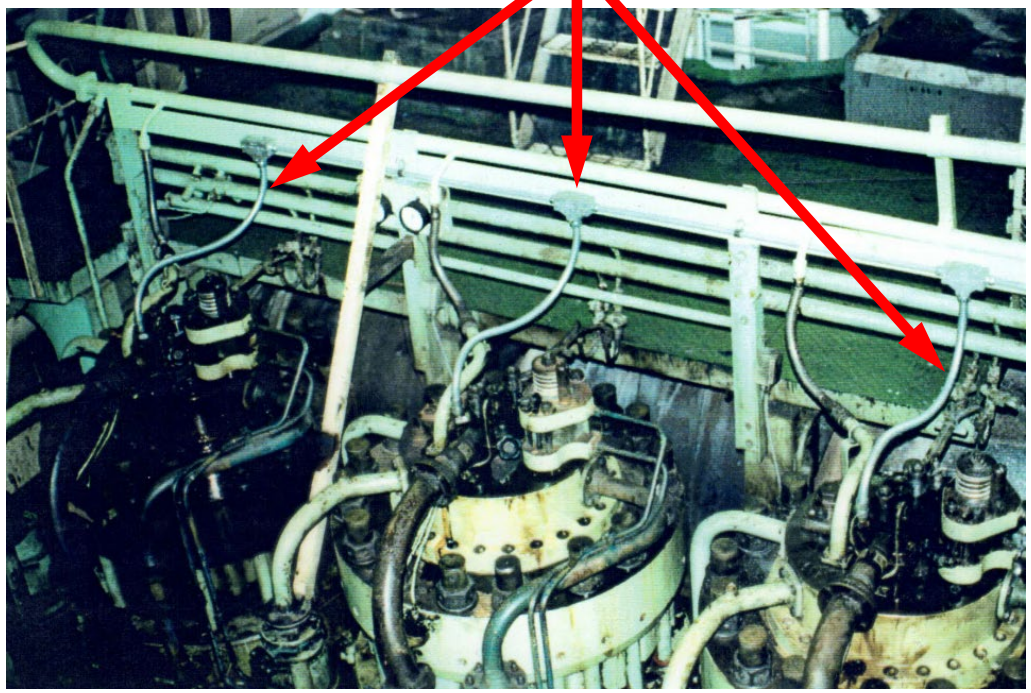
[2] Source: https://shipandbunker.com/

[3] Source: https://www.oanda.com/currency-converter/de/?from=USD&to=EUR&amount=1

[4] Source: https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-usd.en.html

Experience with this technology 3/3





HYDRAULICA installation on a 2-stroke Sulzer RND90 Diesel engine

Reference List
1/2

Why are all our references from the 1990s?

The original technical principle of the HYDRAULICA system was installed on **45 engines** from 1989 to 1995.

From 1996 this system was outsourced to a bigger company and they have installed around 80 systems. In total, more than 120 HYDRAULICA systems have been installed on different Diesel engines in the field. Due to competing interest with the OEM spare part sales, the system was shelved in 2001.

We have recognized the demand from the market to reduce fuel consumption due to upcoming emission regulations and started in 2025 with a technically upgraded HYDRAULICA system in order to save fuel and reduce emissions even for newer engine types.

Reference List
2/2

Project No.	Type	Company	Country	Name	Engines		Fuel type	Installation date
					Amount	Type		
1	Marine	Frigomaris GmbH	Germany	SNOW DRIFT	1	Sulzer 8RND90	IF360	1989
2	Marine	Stena Marine Management AB	Sweden	STENA FREIGHTER	2	Pielstick 12PC2.5V	IF180	1990
3	Marine	Nordstrom & Thulin	Sweden	GRAIP	2	Pielstick 12PC2.5V	IF180	1991
4	Marine	Wallenius Lines AB	Sweden	ANIARA	2	Pielstick 16PC2.5V	IF180	1991
5	Stationary	Gotlands Energieverk K. S. V.	Sweden	Power Plant	2	Pielstick 8PC4 .2V	IF180	1991
6	Marine	Northern Marine Managemenf Ltd.	UK	KYOWA	1	Sulzer 6RND68M	IF360	1991
7	Marine	Scandi Line A/S	Norway	SANDEFJORD	2	Pielstick 12PC2.0V	IF180	1992
8	Marine	Stena Marine Management AB	Sweden	STENA CARRIER	2	Pielstick 12PC2.5V	IF180	1992
9	Marine	Stena Marine Management AB	Sweden	STENA NORDICA	4	Pielstick 12PC2.5V	IF180	1992
10	Marine	DFDS A/S	Denmark	PRINCE of SCANDINAVIA	4	Pielstick 12PC3.0V	IF360	1992
11	Marine	Star Cruise	Malaysia	STAR AQUARIUS	2	Sulzer 9ZAL40S	IF180	1992
12	Marine	Ferm Int. Ship Management	Sweden	UNITED STAR	2	Wichman 9AXAG	IF180	1992
13	Marine	The National Swedish Adm. of Shipping & Navigation	Sweden	SCANDIA	2	Hedemora Vl 6A/l 2	MDO	1993
14	Stationary	Bermuda Electric Co, Ltd	Bermuda	Power Plant	1	Pielstick 18PC3. OV	Hago	1993
15	Stationary	PT Indocement Tungal Prakarssa	Indonesia	Power Plant	9	Pielstick 18PC4.0V	IF180	1993
16	Marine	Barber Ship Management A/S	Norway	TAPIOLA	1	Sulzer 9RND90M	IF360	1993
17	Marine	Mediterranean Shipping Company	Italy	MSC CARLA	3	Götaverken 850/1700 VGS	IF360	1994
18	Marine	Leif Hoegh & Co. A/S	Norway	HOEGH CAIRN	1	MAN 8KSZ70/125	IF360	1994
19	Marine	DFDS A/S	Denmark	HAMBURG	2	Stork 20TM410	IF360	1995
					45			

SOLUTIONS IN A NUTSHELL

The HYDRAULICA system helps …

• **better combustion**	➔ to achieve a better and cleaner combustion
• **reduction of fuel consumption**	➔ for a short amortization and fuel cost savings
• **emission improvements**	➔ for unrestricted/unlimited operation performance
• **reduced costs for spare parts**	➔ extended service life of spare parts and engine
• **reduced service hours at maintenance**	➔ due to extended maintenance intervals

Disclaimer

All data provided by AES in this document is non-binding. This data serves informational purposes only and is especially not guaranteed in any way. Depending on the subsequent specific individual projects, the relevant data may be subject to changes and will be assessed and determined individually for each project. This will depend on the particular characteristics of each individual project, especially specific site and operational conditions.