



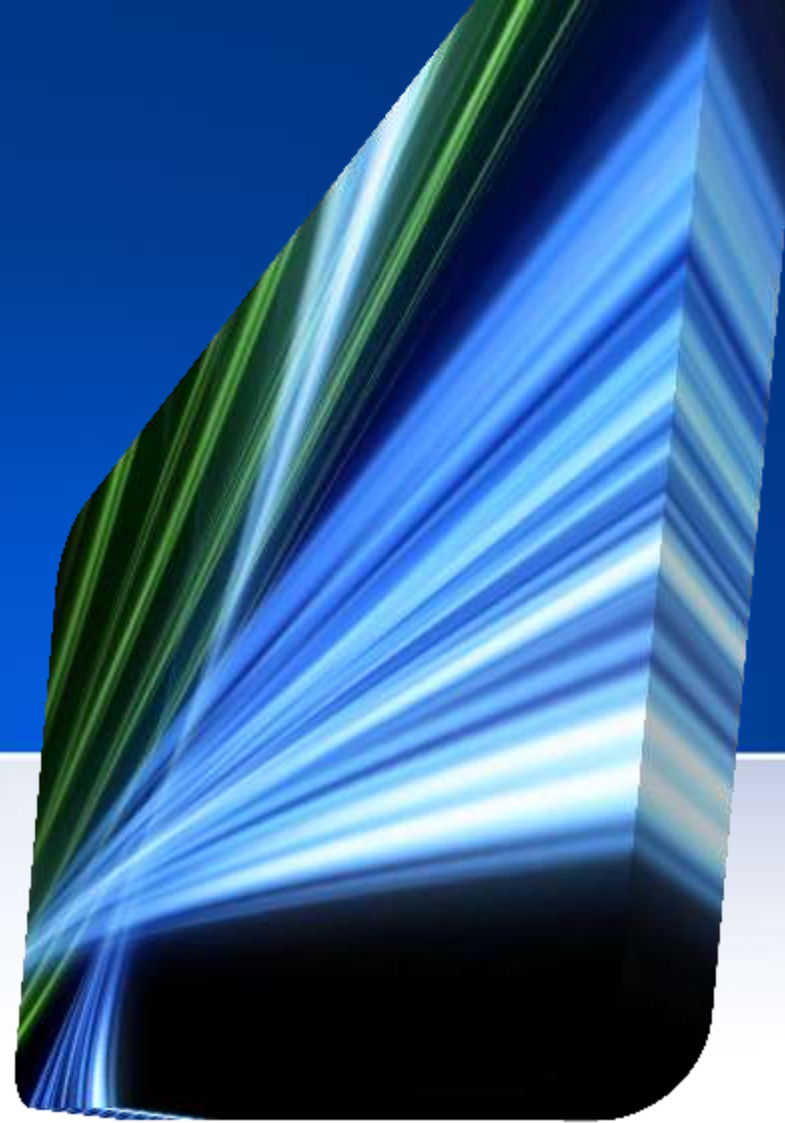
Mastermind Group & Cyprus Shipping Chamber present at the

**EU Stakeholder Meeting on MRV of
Greenhouse Gas Emissions from
Ships.**

*“The need to establish an EU Directive on
Marine Fuel Quality” and “The complexity
to measure consumption on ships.”*

05th December, 2012

Capt. Eugen-Henning Adami





Agenda



1. Mastermind Introduction.
2. Present regulation for Aviation Fuel Quality.
3. Present regulation for Automotive Fuel Quality.
4. Present regulation for Marine Fuel Quality.
5. Technical challenges in measuring consumption on ships.
6. Reliable measurements can only be done after arrivals.
7. Conclusion.



Mastermind Introduction



Our Diversified MSM Fleet



2+1 Super A-Class, 25,000mt



1 A-Class, 17,800 mt



3 Onego-Class, 8,000 mt



2+3 S-Class: 33,000 mt



1 Coaster A-Class: 4,200 mt



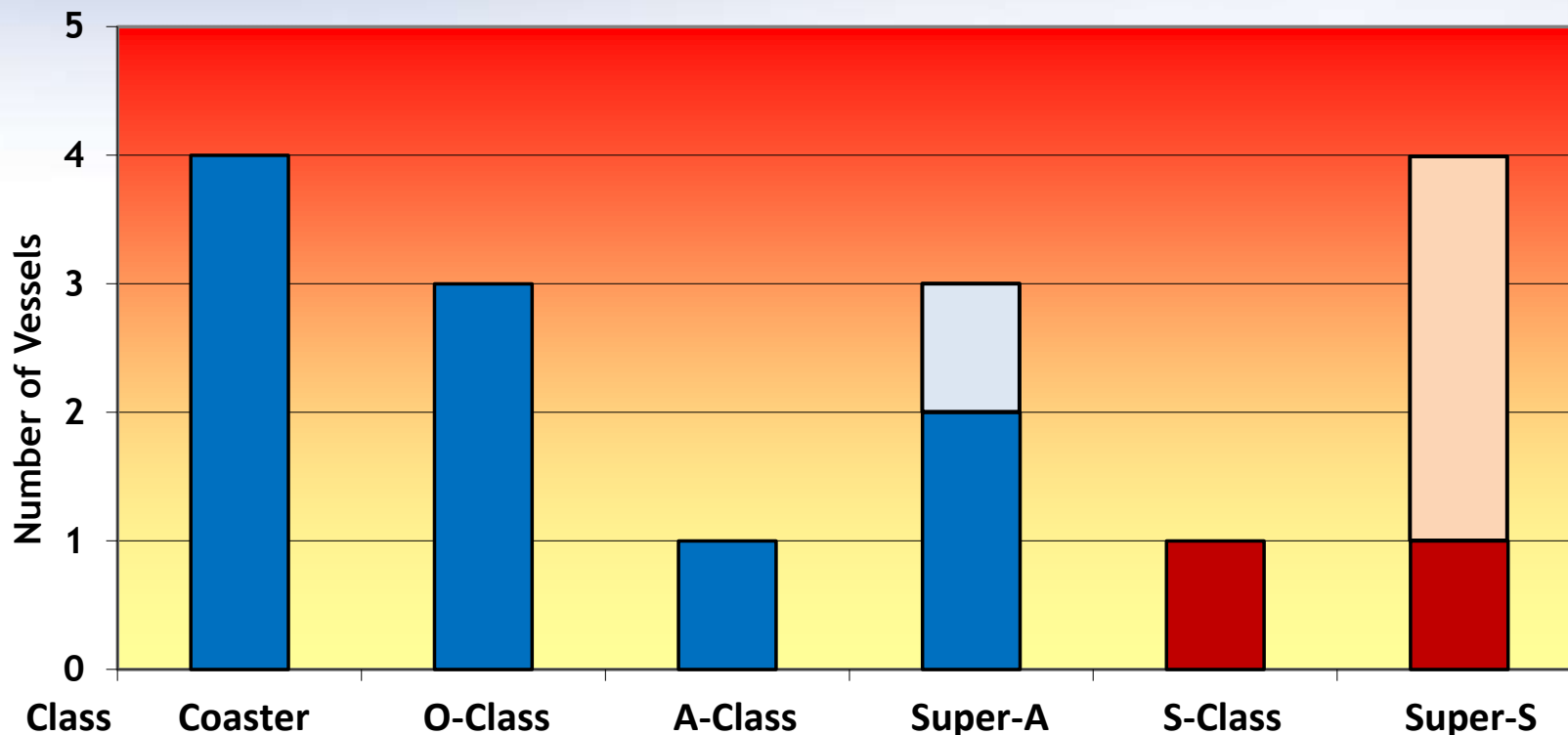
3 Coaster D-Class: 6,000 mt



Mastermind Introduction



Our Diversified MSM Fleet



Average Age of Total fleet: 3.2 years

Our Fleet today: 12 Vessels

Total Deadweight: 178,800 tons

Our Investment: ~200 mio \$



Present regulation for Aviation Fuel Quality



- ❑ The aviation fuel quality standards are set out by the Joint Inspection Group (JIG) www.jigonline.com

- ❑ **JIG Rules are 4 volumes** that regulate all aviation fuels.
 - Volume 1 - Issue 11 :Guidelines for Aviation Fuel Quality Control and Operating Procedures for Into - plane fuelling services
 - Volume 2 - Issue 11 :Guidelines for Aviation Fuel Quality Control and Operating Procedures for Joint Airport Depots
 - Volume 3 - Issue 11 :Guidelines for Aviation Fuel Quality Control and Operating Procedures for Jointly Operated Supply & Distribution Facilities

- ❑ Regulation of the companies supplying aviation fuel is done by independent inspectors or by auditing each other or through internal audits based on the JIG volumes.



Present regulation for Automotive Fuel Quality



❑ EU Directive 2003/17/EC, Article 8 which states :

1. Member States shall monitor compliance with the requirements of Articles 3 and 4, in respect of petrol and diesel fuels, on the basis of the analytical methods referred to in European standards EN 228:2004 and EN 590:2004 respectively.
2. Member States shall establish a fuel quality monitoring system in accordance with the requirements of the relevant European standard. The use of an alternative fuel quality monitoring system may be permitted provided that such a system ensures results of equivalent confidence.
3. Each year by 30 June, the Member States shall submit a report of national fuel quality data for the preceding calendar year.
4. The Commission shall ensure that the information submitted pursuant to paragraph 3 is promptly made available by appropriate means. The Commission shall publish annually ... a report on actual fuel quality in the different Member States ... aiming to provide an overview of the fuels quality data in the different Member States.



Present regulation for Marine Fuel Quality



- ❑ There are no EU or IMO rules to regulate the Quality of Marine Fuels !!!
- ❑ Vessels are totally on there own.
- ❑ Vessels need to have fuel cleaning and treatment plants to ensure serviceable fuel reaches engines.
- ❑ Without harmonized marine fuel quality standards all fuels have different calorific values and density. Any reliable calculations are almost impossible.





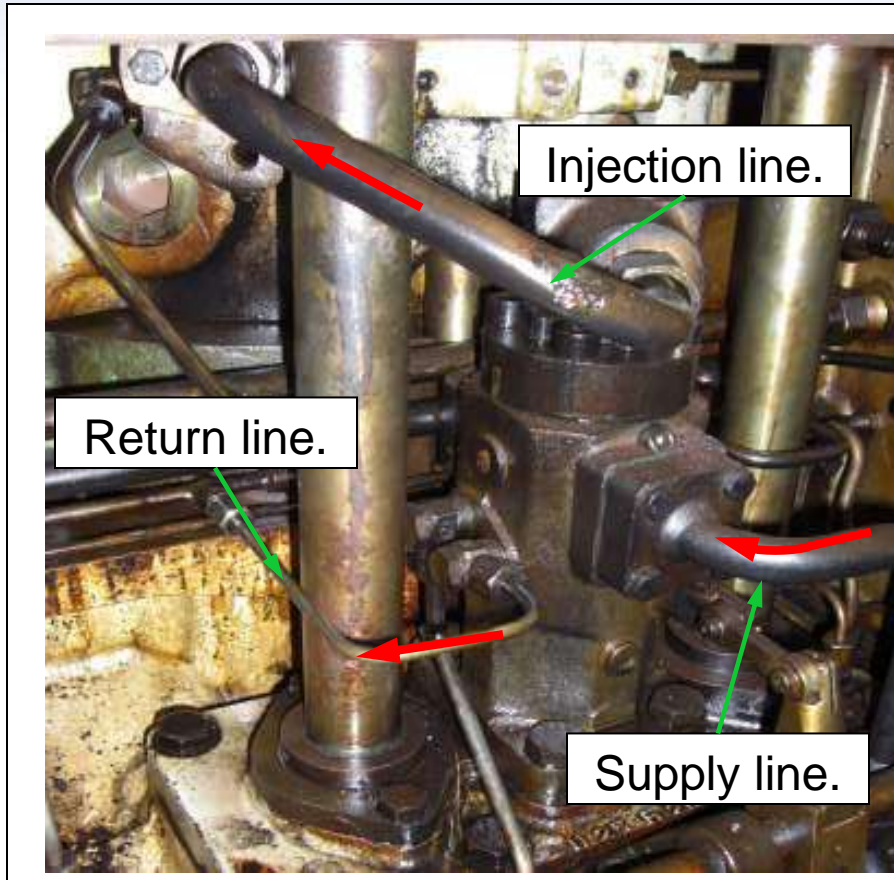
Present regulation for Marine Fuel Quality



- A Robust Monitoring, Reporting and Verification System must be based on Pan European marine fuel quality directive, like in the automotive industry.**



Technical challenges in measuring consumption on ships



Ships Diesel Engines need a Continuous Fuel flow to:

- Cool the injection pump.
- Flush the bubbles created by injection.

A normal Flow Meter in just the supply line will not give the actual Consumption!



Technical challenges in measuring consumption on ships



Centrifuges remove water and sludge from the fuel



Fuel Units heat, filter and presurmise the treated fuel

The Fuel Treatment Plants on ships can remove upto 3% water and sludge from delivered fuel.

**The costs for 3 years fuel supply equal to the ships price.
The fuel costs of a 2500 teu container vessel are 8 times higher than initial building costs.
But for the fuel oils are no quality regulations !!!**

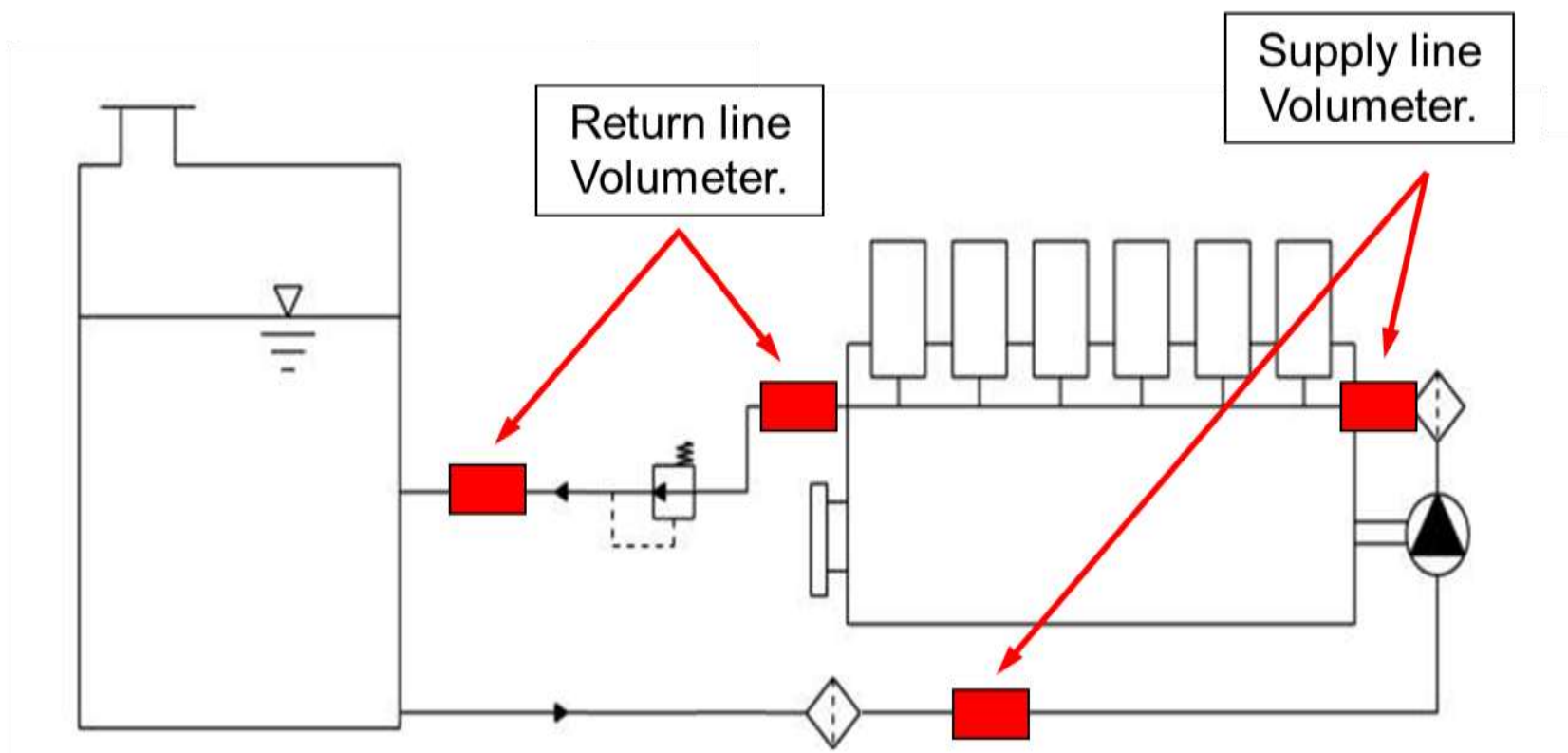


Technical challenges in measuring consumption on ships



Flow Meter Systems for vessels are very complex and extremely expensive (about 100K Euro)

Possible positions for Volumeters:



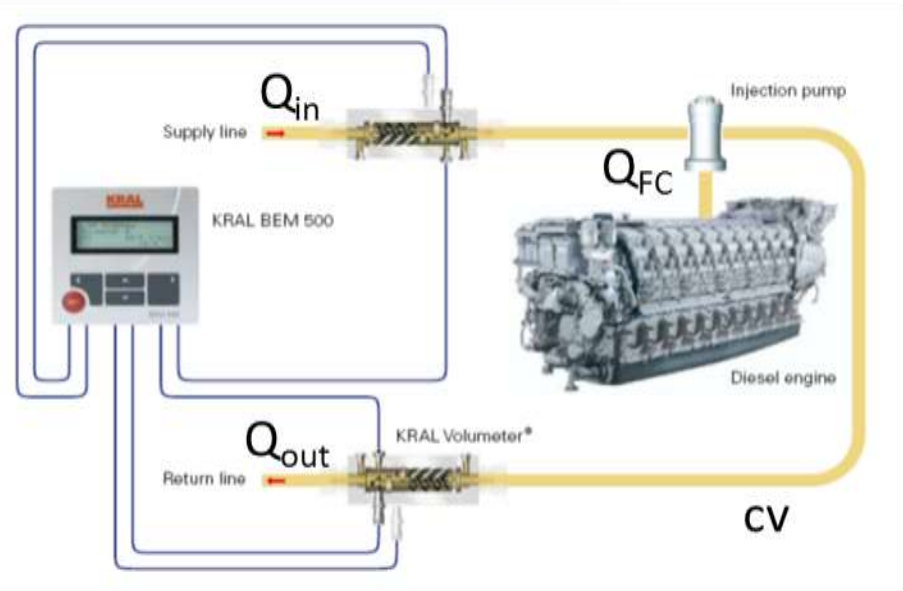
Source : Kral



Technical challenges in measuring consumption on ships



Error propagation



The measurement error of the system depends on the accuracy of the single meters and the circulation ratio. That is why the individual meter needs to be very accurate.

Estimation:

$$e_{FC} = 2 * e_{Volumeter} * c_v$$

- e_{FC} = Total error FCM
- c_v = Supply/Consumption
- $e_{Volumeter}$ = Error Volumeter

Source : Kral

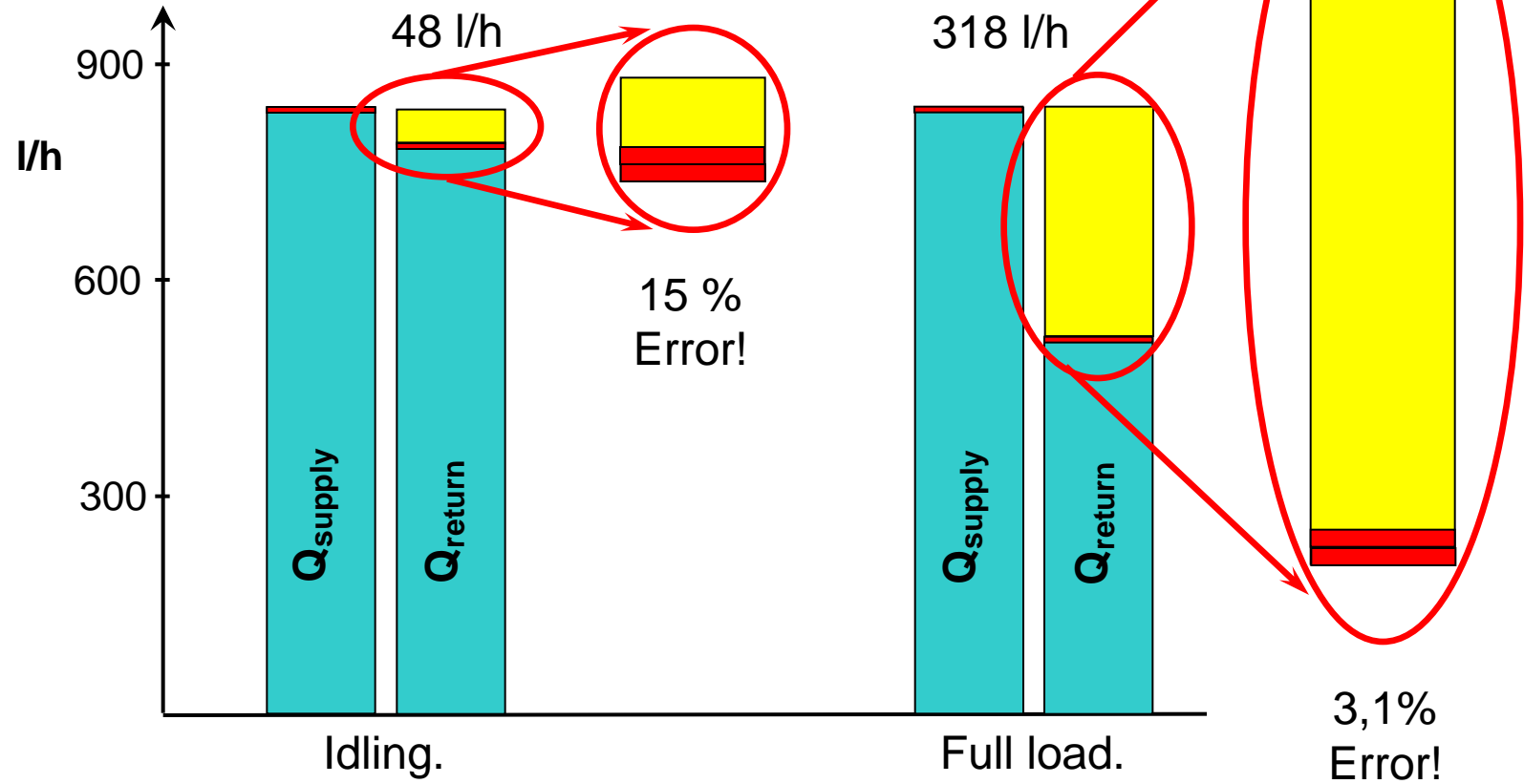


Technical challenges in measuring consumption on ships



Problems with a differential measurement.

Single Flowmeter accuracy 1 %.



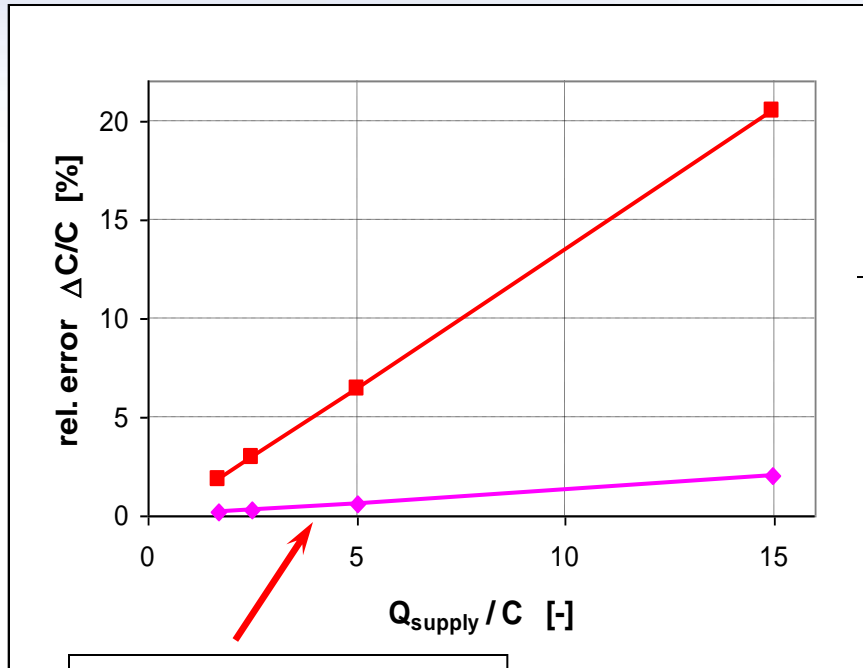
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Technical challenges in measuring consumption on ships



Problems with a differential measurement.



Calculated with
 $f_R(Q) = 0,1\%$

Error propagation with a differential measurement.

$$C = Q_{\text{supply}} - Q_{\text{return}}$$

$$\Delta C = \sqrt{\left(\frac{\delta C}{\delta Q_{\text{supply}}} \Delta Q_{\text{supply}}\right)^2 + \left(\frac{\delta C}{\delta Q_{\text{return}}} \Delta Q_{\text{return}}\right)^2}$$

$$\frac{\Delta C}{C} = f_R(Q) \sqrt{\frac{Q_1^2 + Q_2^2}{(Q_1 - Q_2)^2}}$$

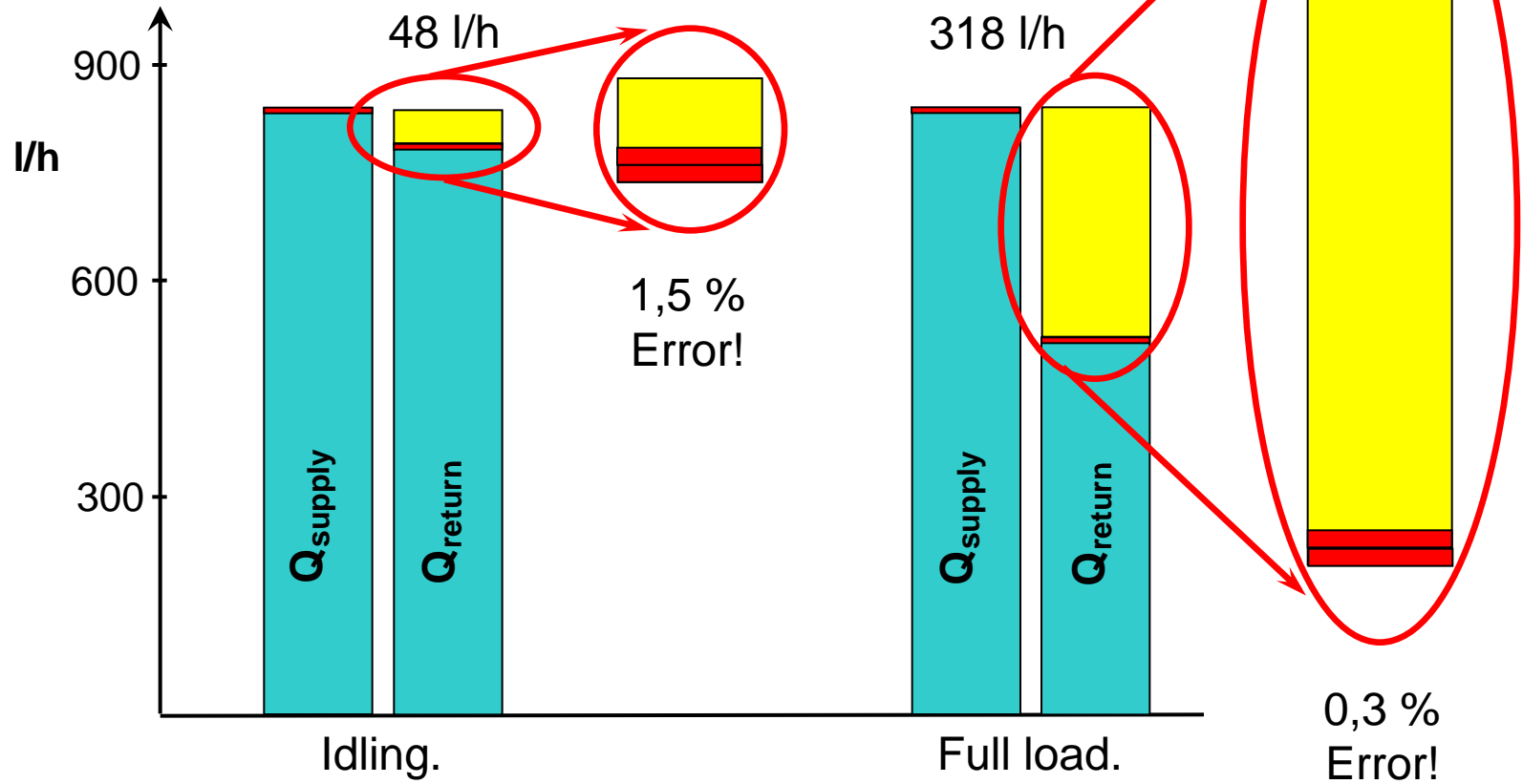


Technical challenges in measuring consumption on ships



Problems with a differential measurement.

Single flowmeter accuracy 0,1 %.





Technical challenges in measuring consumption on ships



System accuracy according to Gaussian error propagation.

Measurement errors* in differential measurement.

Idling		Full load	
Single flow measurement	System	Single flow measurement	System
0,1 %	2,2 %	0,1 %	0,4 %
0,3 %	6,2 %	0,3 %	1,0 %
0,5 %	10,3 %	0,5 %	1,8 %
1,0 %	20,5 %	1,0 %	3,6 %
3,0 %	61,0 %	3,0 %	10,8 %

* Measurement errors vary with the circulation rate. Here: idling 20, full load 4. Upon request we will gladly calculate your application.

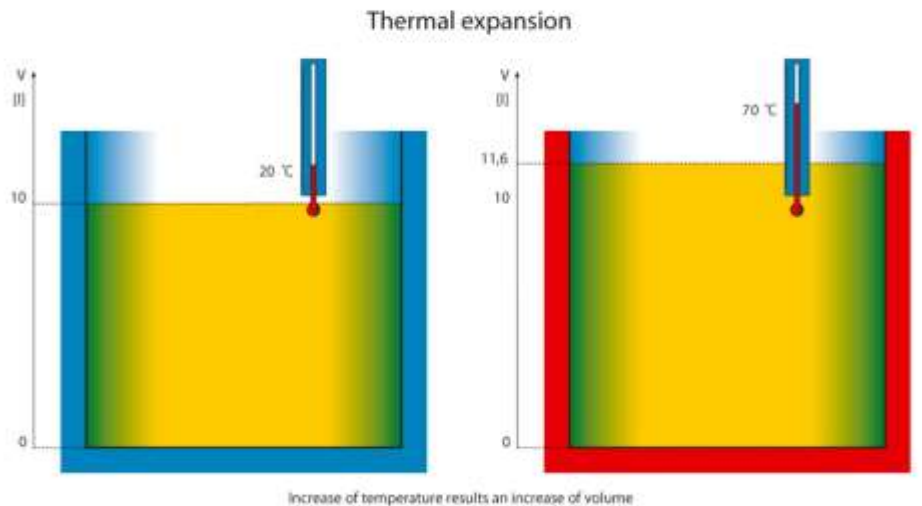
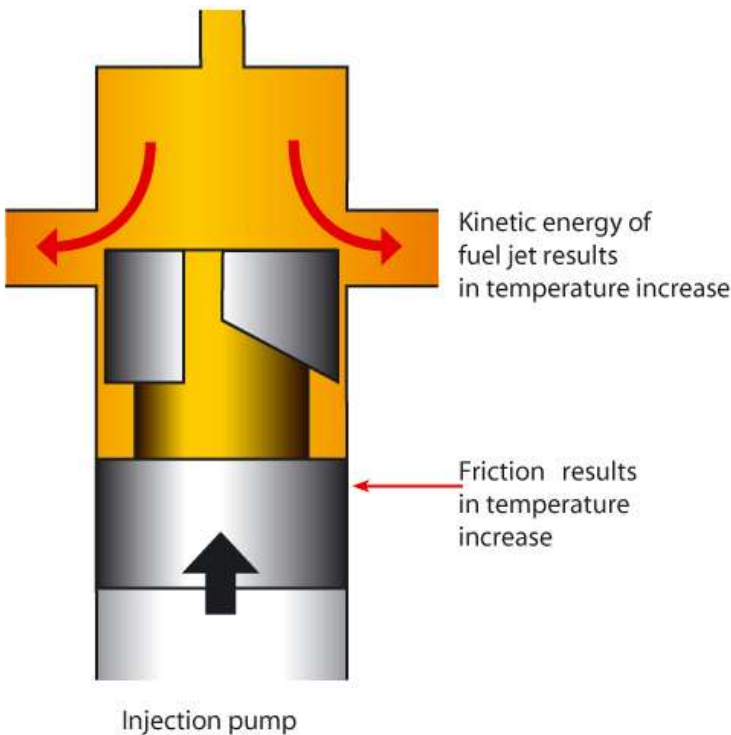
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Technical challenges in measuring consumption on ships



Why is temperature compensation so important?



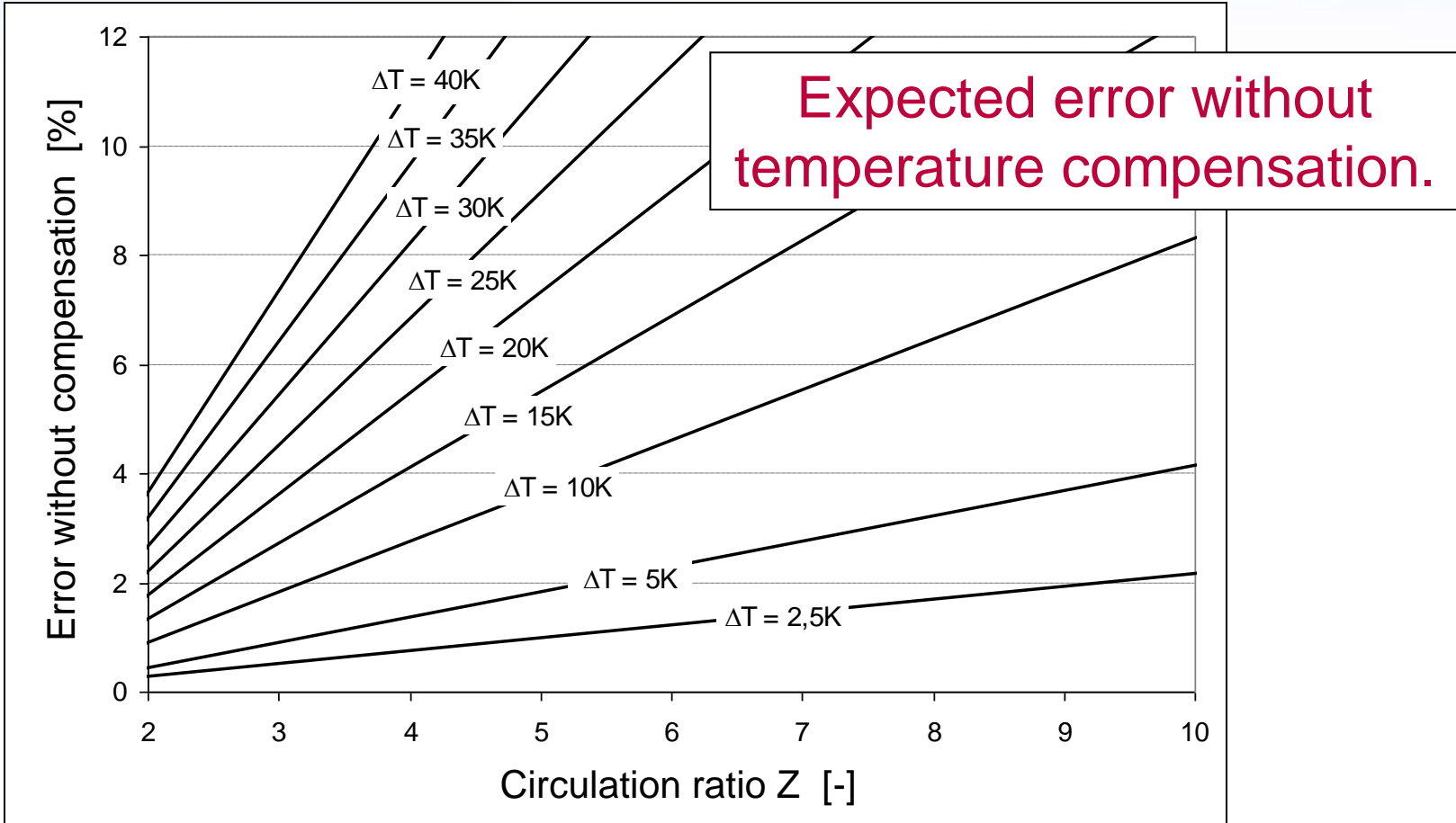
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Technical challenges in measuring consumption on ships



Why is temperature compensation so important?



Source : Kral

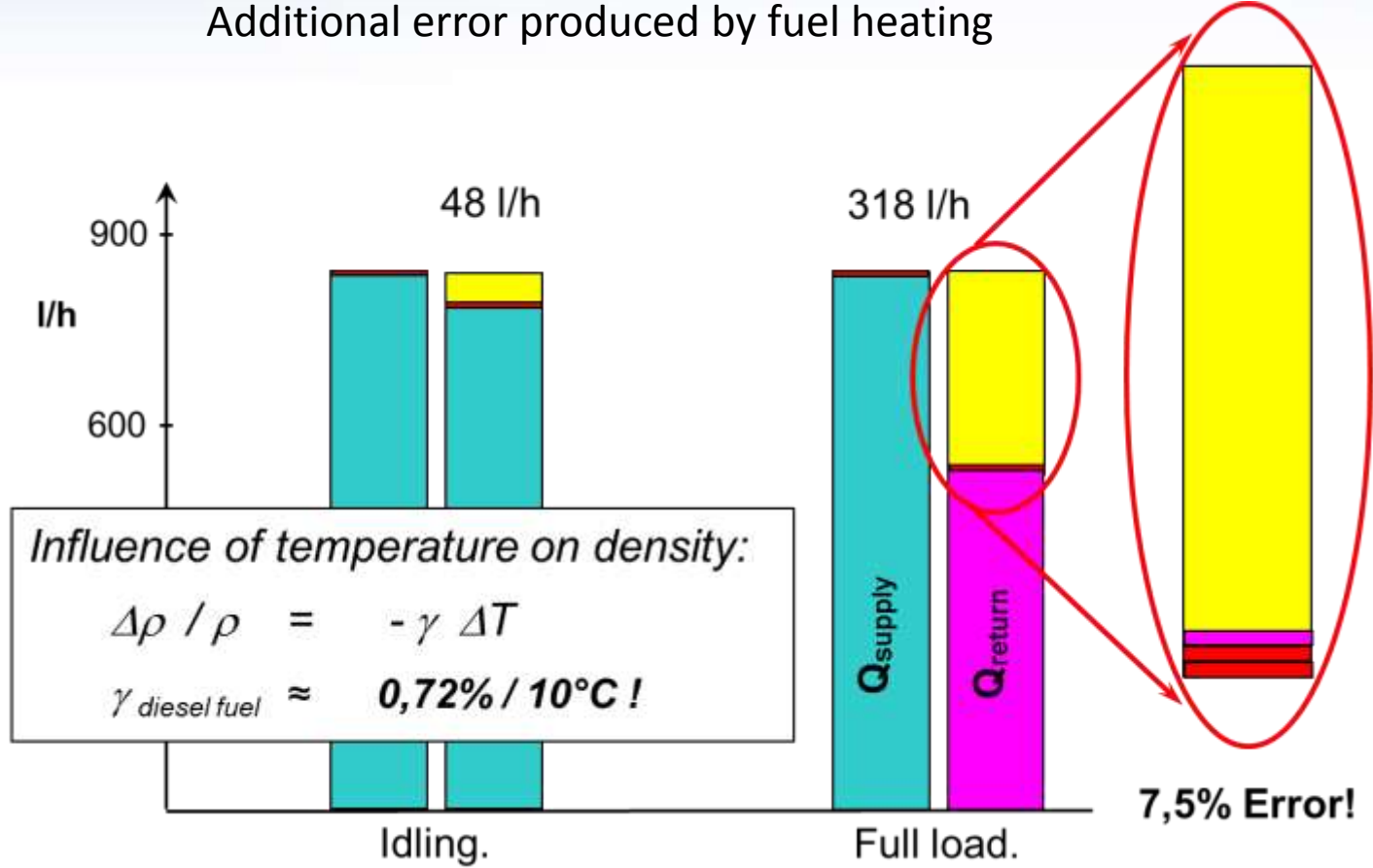


Technical challenges in measuring consumption on ships



Why is temperature compensation so important?

Additional error produced by fuel heating



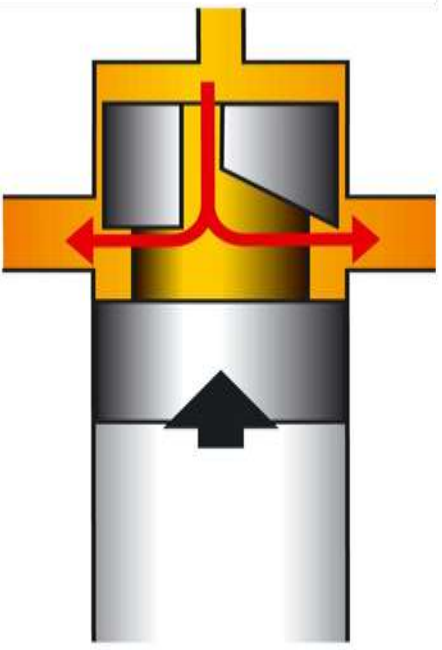
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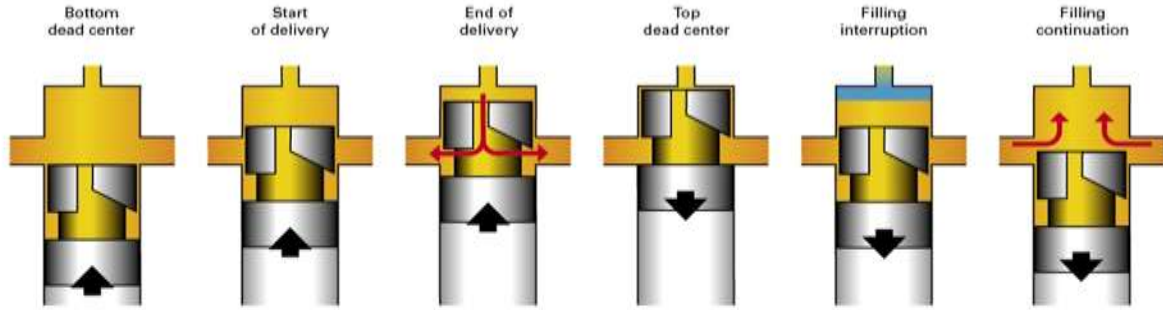
Technical challenges in measuring consumption on ships



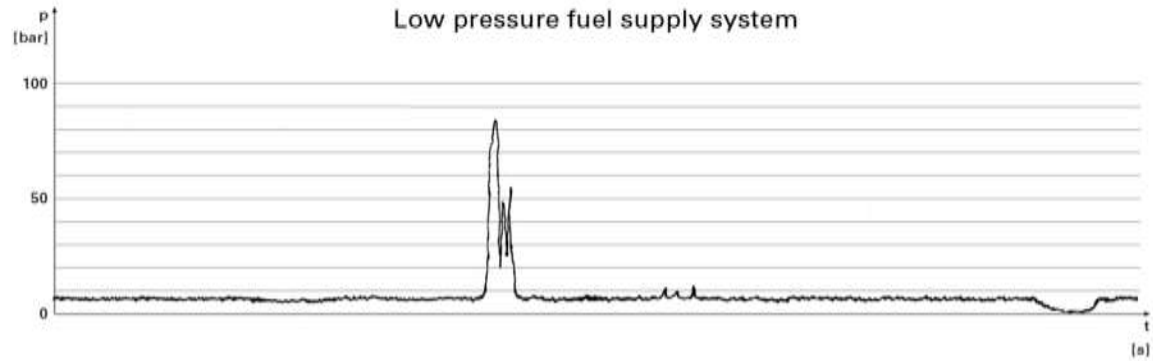
Why is pressure pulse compensation so important?



Injection pump plunger



Low pressure fuel supply system



Source : Kral

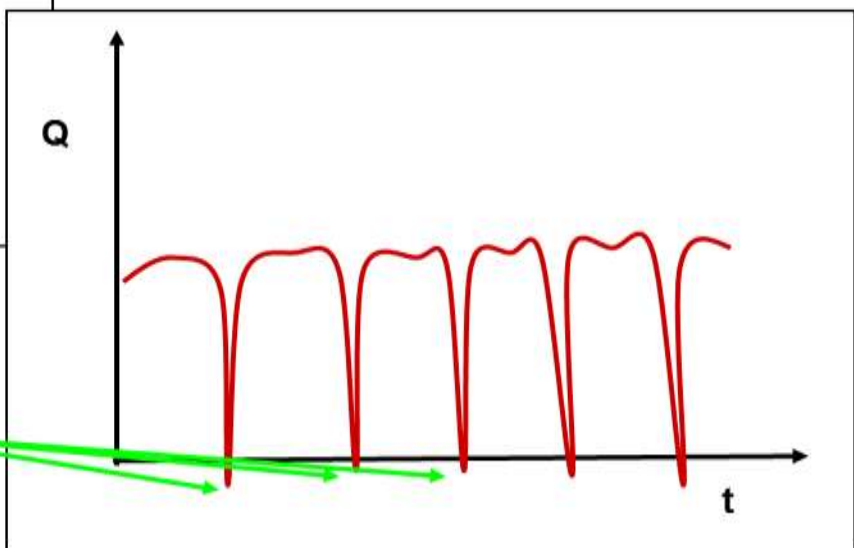
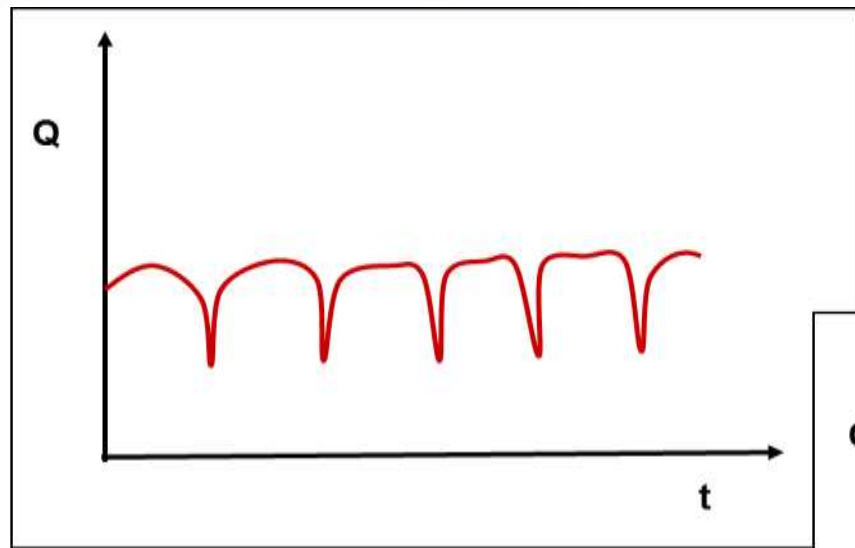


Technical challenges in measuring consumption on ships



Why is pressure pulse compensation so important?

Additional error produced by fuel fluctuations.



Possible flow reversing.



Source : Kral



Reliable measurements can only be done after arrivals



Ships are never static at sea. Fuels are sloshing in the tanks. Soundings are never reliable at sea.



A correct Fuel inventory can only be taken in ports! During the voyage only estimated calculations can be performed.



Conclusion



- ❑ An EU Marine Fuel Quality Directive needs to be established.
- ❑ Consumption measured by Flow meters is very complex and extremely expensive. (100.000 Euro per vessel with 4 diesel engines and 1 Boiler).
- ❑ A correct Fuel Inventory can only be taken in ports.



**Many thanks
For your kind attention**

Any questions ?