



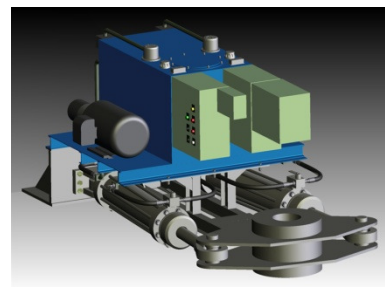
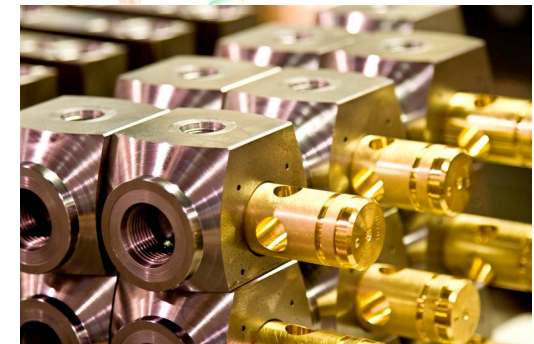
Jastram
ENGINEERING LTD.

Christophe Simon
May 2011

Engineered For Life At Sea

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ENGINEERING LTD.



Jastram Engineering
Wagner Engineering

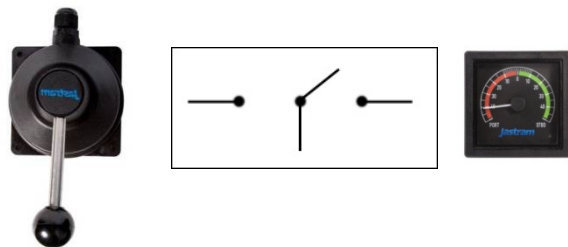
- Located in North Vancouver
- Design and Manufacturing

Steering Systems

NFU and FFU steering systems

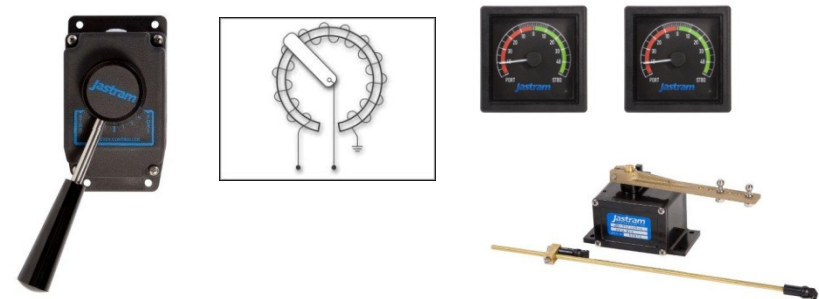
Non Follow Up steering system

- Jog steering, switch
- No feedback, no controller
- one rudder angle indicator

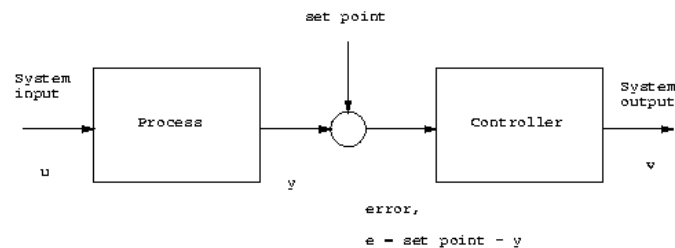


Full Follow Up steering system

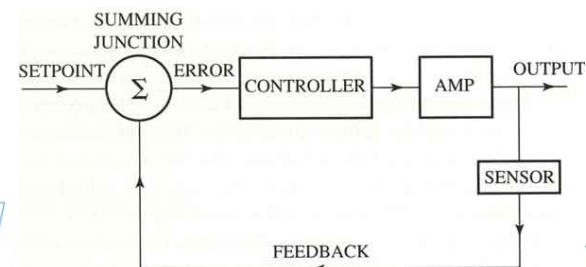
- Lever steering, potentiometer
- Feedback, controller required
- two rudder angle indicators



Open Loop system



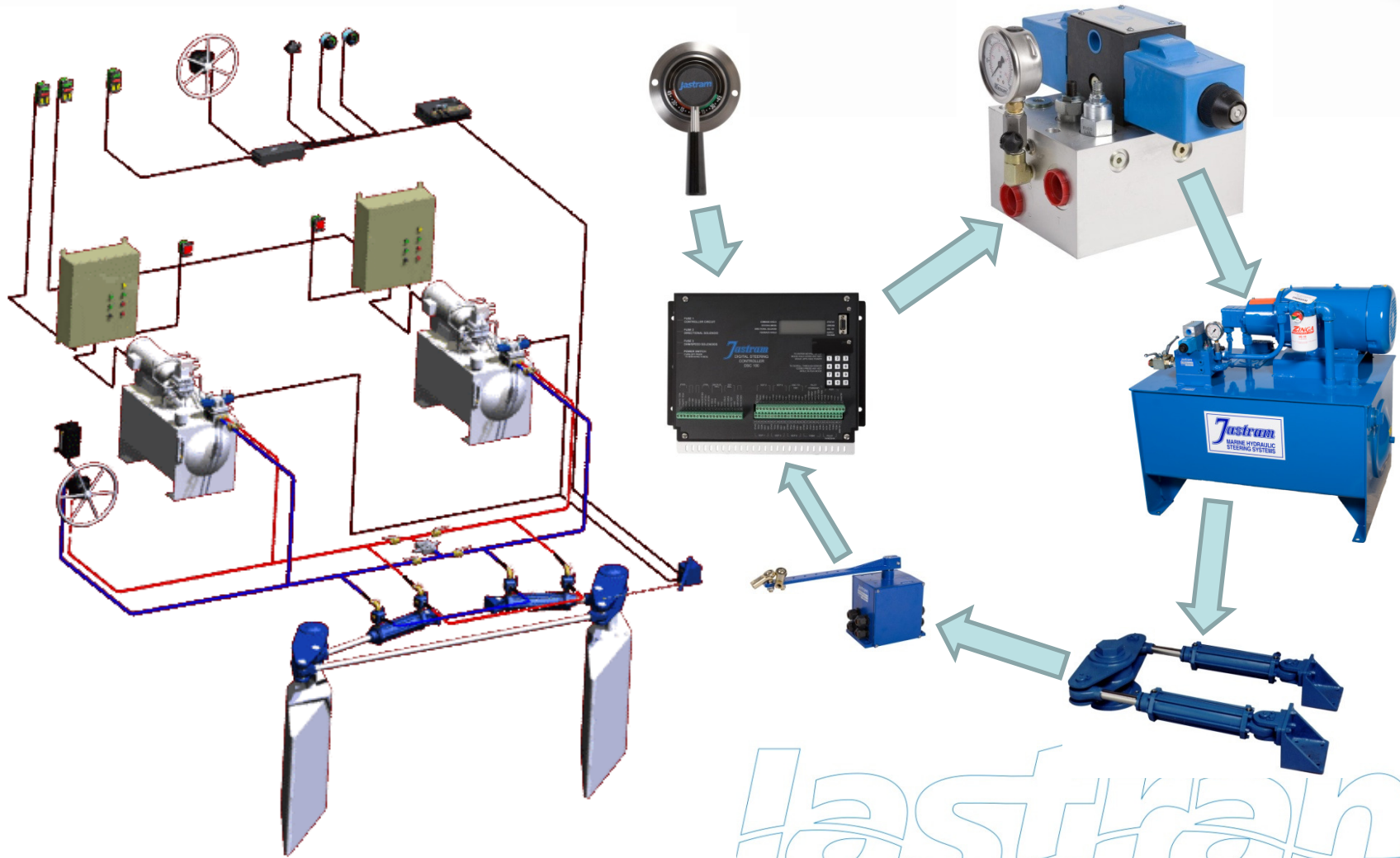
Closed Loop system



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Electronic full follow up

Jastram Full Follow Up – digital steering system



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Rudder types

Main rudder types:

- ❑ **Conventional rudder** - typically NACA profile
- ❑ **High-lift rudder** – fishtail profile
- ❑ **High-lift rudder** – flap design
- ❑ **Nozzle**
- ❑ **Active**

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Rudder types

Conventional rudder

Generally NACA profile



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Rudder types

Fishtail rudder



Generally better than flap rudder for course keeping

Copyright: Becker Marine Systems

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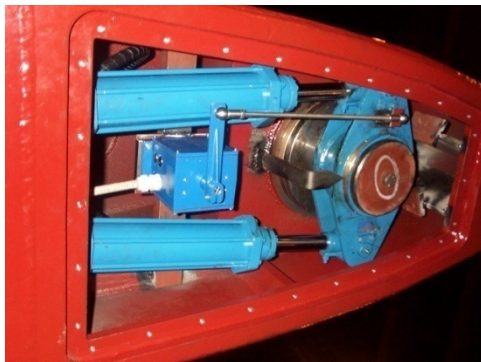
Rudder types

Flap rudder

Mechanically-actuated flap
(linkage)



Copyright: Becker Marine Systems



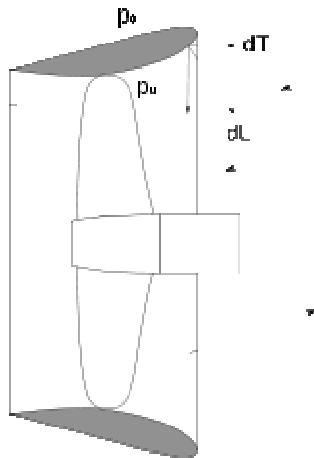
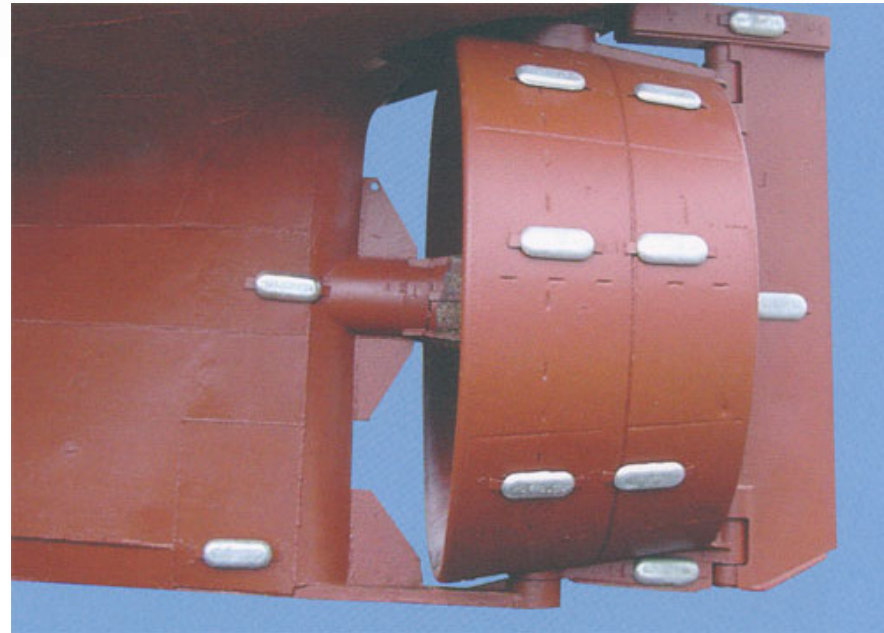
Hydraulically-actuated flap

Generally better than fishtail for
maneuvering

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Rudder types

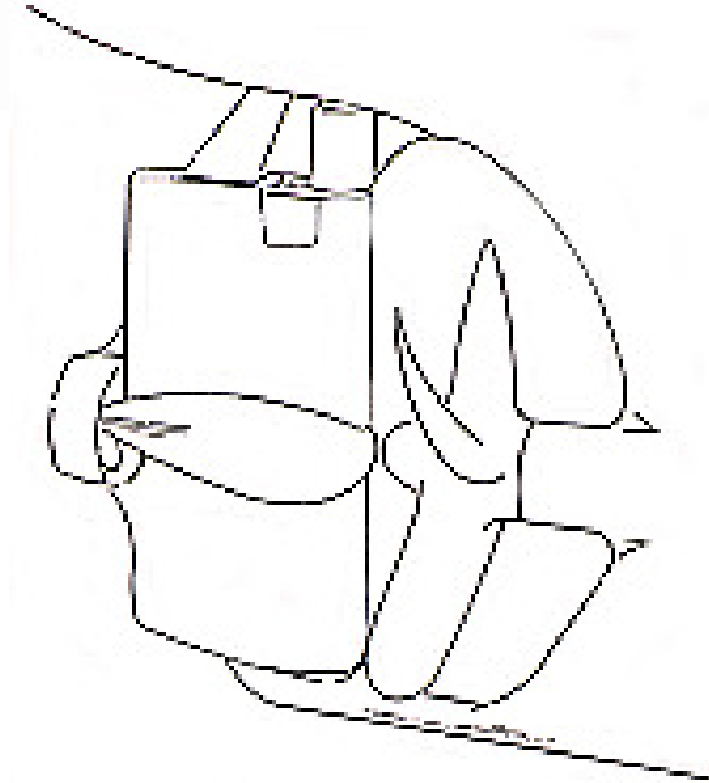
Nozzle



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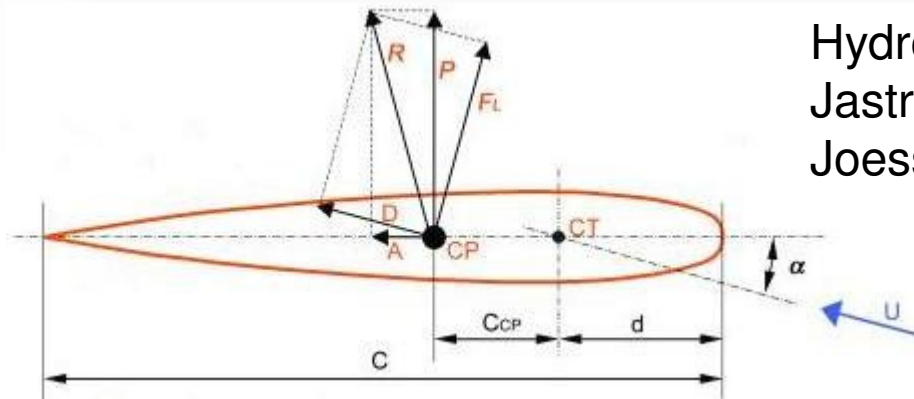
Rudder types

Active rudder



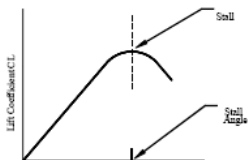
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Steering torque calculation

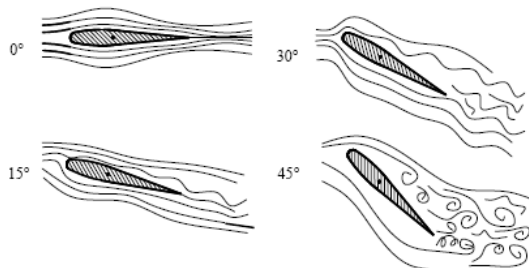


Hydrodynamic torque calculation:
Jastram calculation is based on
Joessel formula

Rudder balance: CP position to CT
Chord: length of rudder ("C")
Span: vertical height
Aspect ratio: ratio of span to chord
(most common 1.5 for merchant ships,
1.0 for high-speed vessels)



Stall angle



Lift coefficient: lift divided by area
times dynamic pressure

Main parameters influencing rudder forces:

- Reynolds number ($U \times C / \text{viscosity}$)
- Profile shape (tradeoff between lift and drag)
- Aspect ratio and stall

(greater aspect ratio increases lift for given angle - stall occurs earlier with higher ratio)

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Jastram Torque

Standard rudder

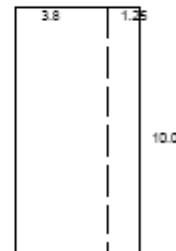
Torque Calculation



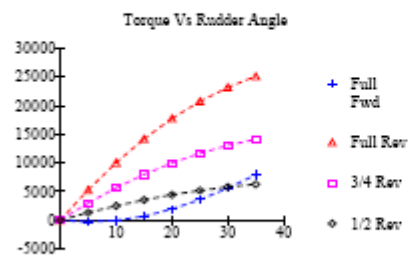
Project

Input Parameters

Formula	Jastram
Vessel Type	General Application
Rudder Type	Standard
Height	10.0 ft
Width	5.0 ft
C-Balance	1.25 ft
Rudder Angle	35 deg.
Vessel Speed	10 knots
No. of Rudders	1



Results



Rudder Area	50.00 ft ²
Counter balance	25.0 %
Aspect Ratio	2.0
Stall Angle (approx)	27 deg

	ftlb	kNm
Full Fwd @ 35.0 deg	7,925	10.75
Full Aft @ 35.0 deg	25,113	34.08

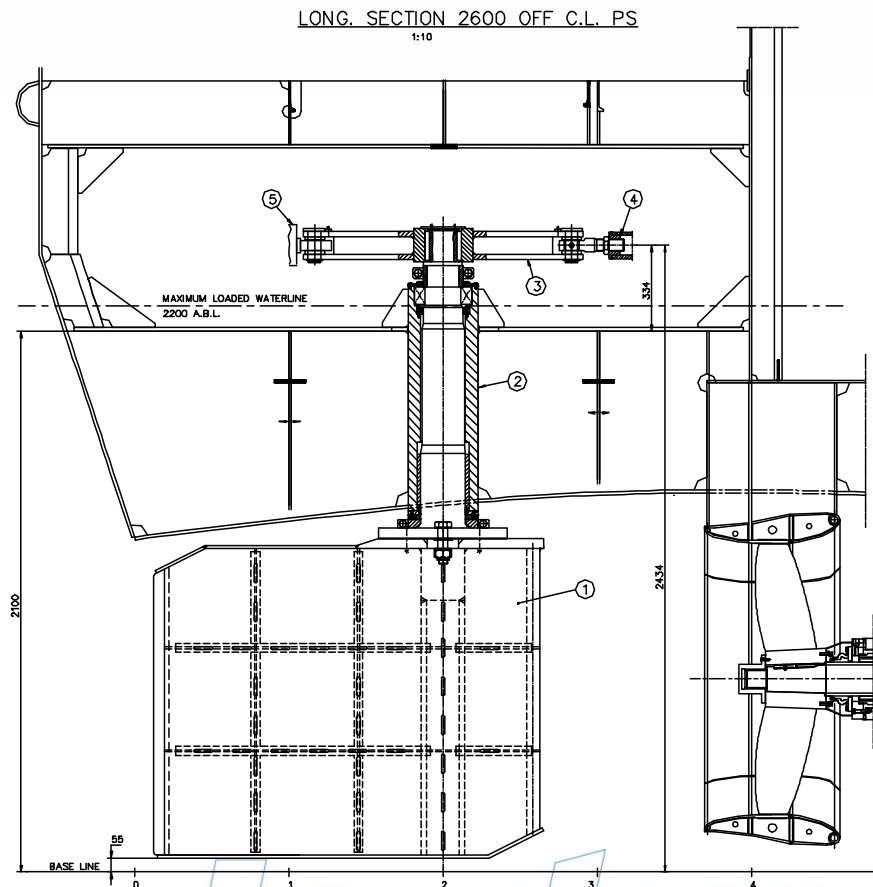
	ftlb	kNm
3/4 Aft @ 35.0 deg	14,126	19.16
1/2 Aft @ 35.0 deg	6,278	8.52



Rudder stock

Mechanical components:

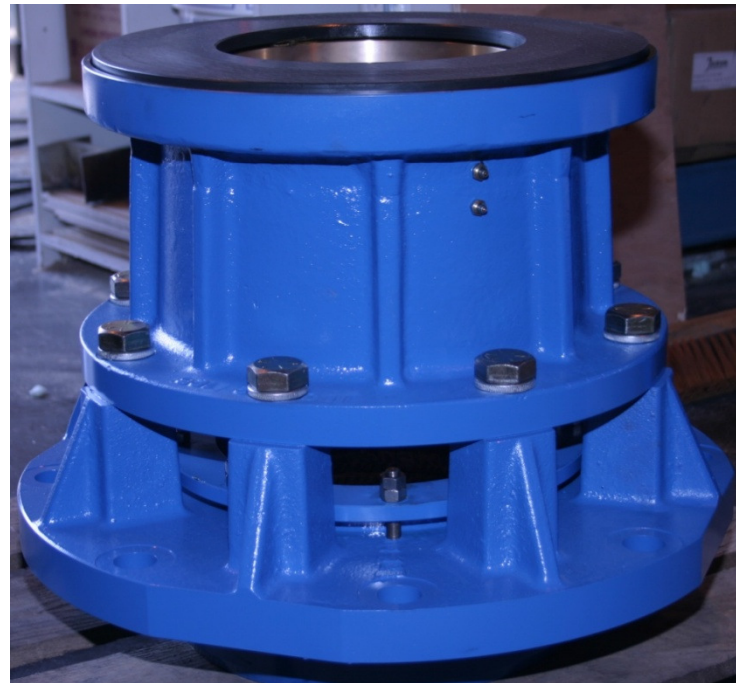
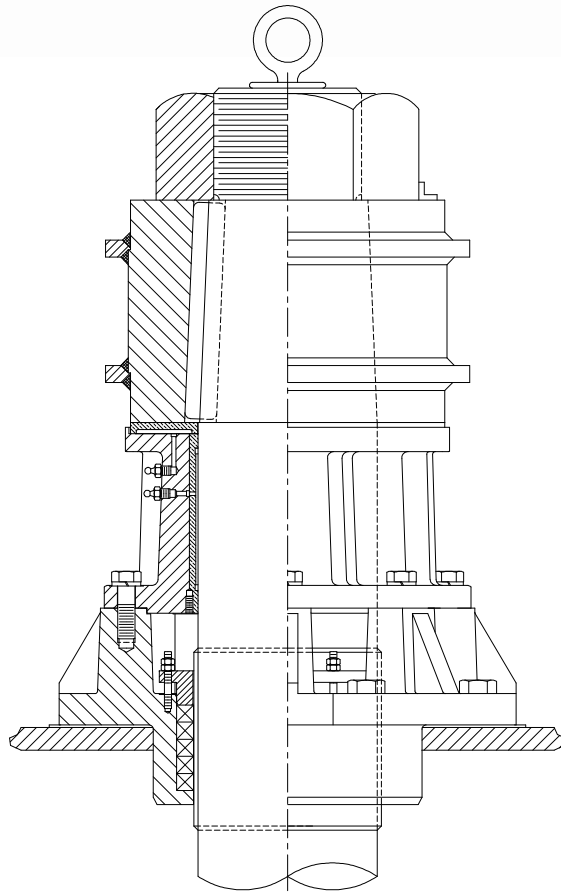
- Rudder blade
- Stock connection to rudder (flange, Hydraulic nut...)
- Rudder trunk
- Rudder stock and rudder stock liner
- Radial Carrier Bearing
- Stock connection to tiller (mechanical or hydraulic nut...)
- Tiller
- Tiller hard stops
- Tie bar (jockey bar) if applicable



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Radial Carrier Bearing

- Supports rudder and tiller
- Radial bearing
- Sealing



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Rudder stock / tiller connection

Four stock-to-tiller connection methods:

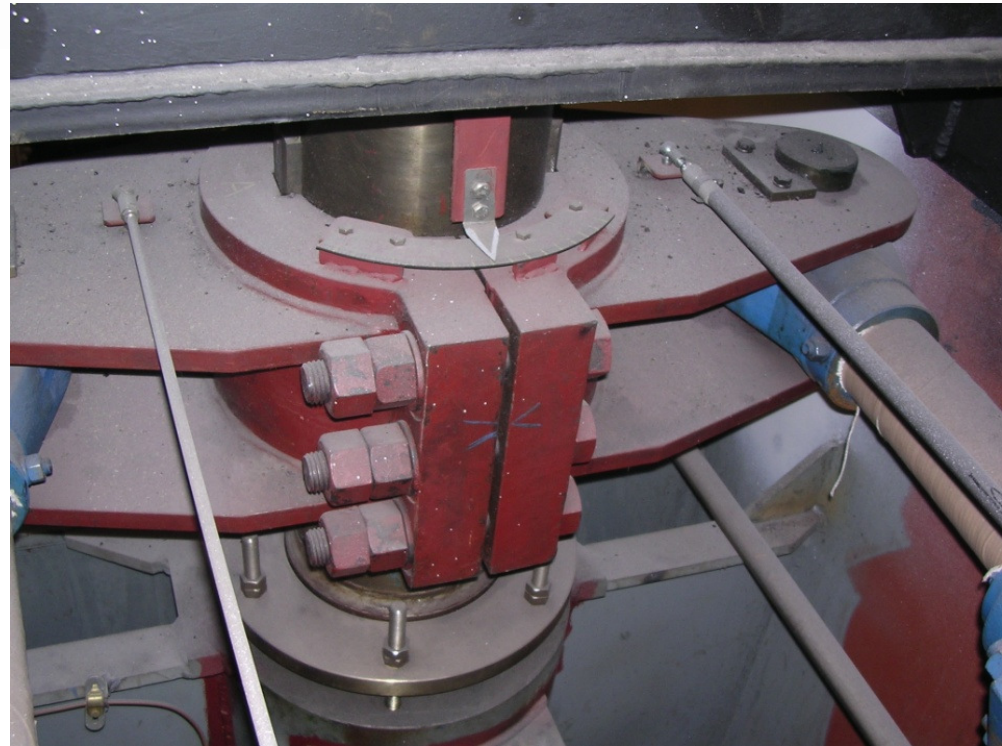
1. Tiller clamping
2. Locking rings
3. Mechanical nut
4. Hydraulic nut

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Rudder stock / tiller connection

Tiller clamping:

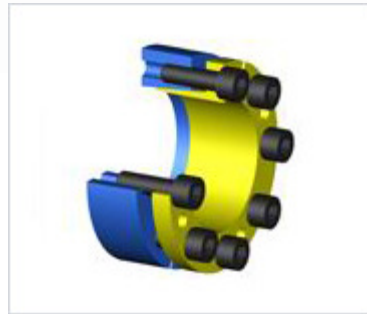
- Straight rudder stock
- Tiller height from Class
- One or two keyways
- Clamping force calculation



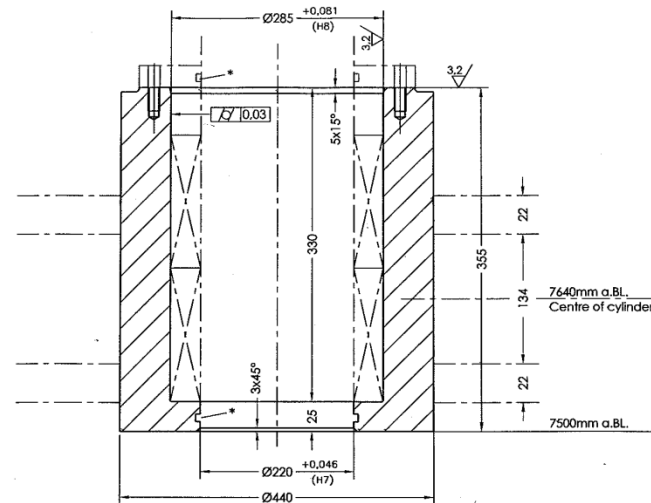
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Rudder stock / tiller connection

Locking rings



- Straight rudder stock
- No keyway

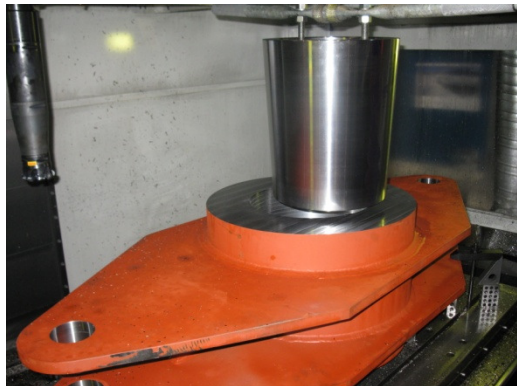
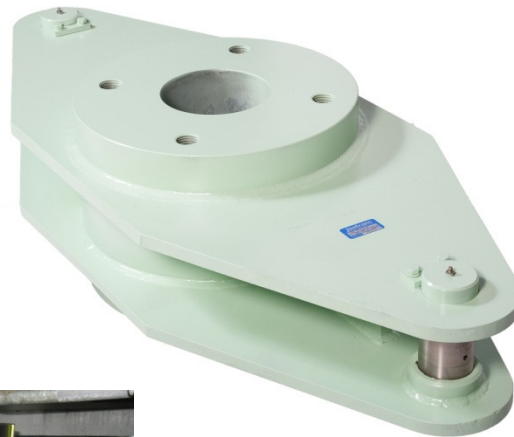


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Rudder stock / tiller connection

Mechanical nut:

- Tapered rudder stock (1:12 in dia.)
- One keyway
- Typically for stock up to 200mm

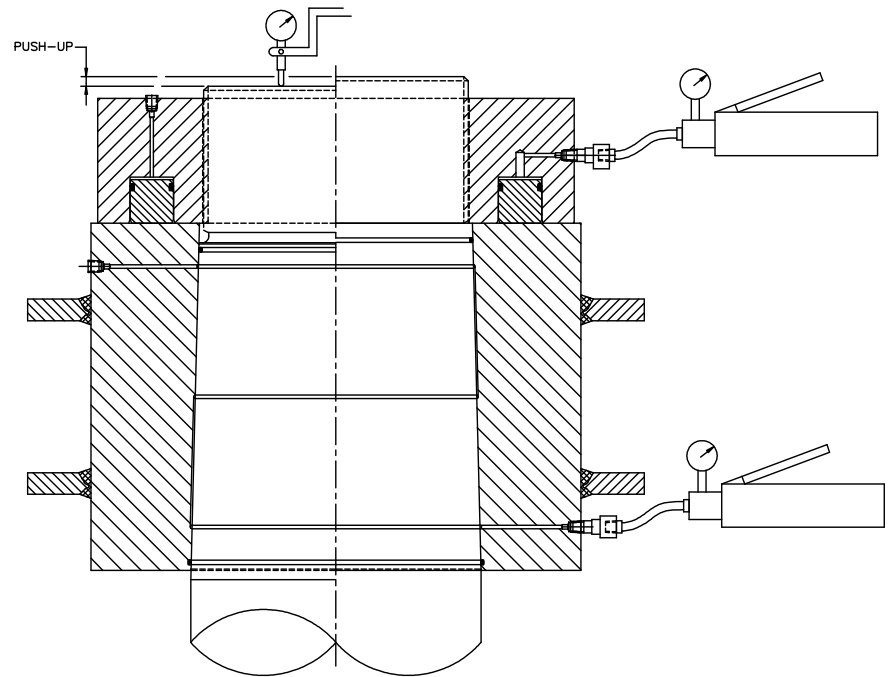


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Rudder stock / tiller connection

Hydraulic nut:

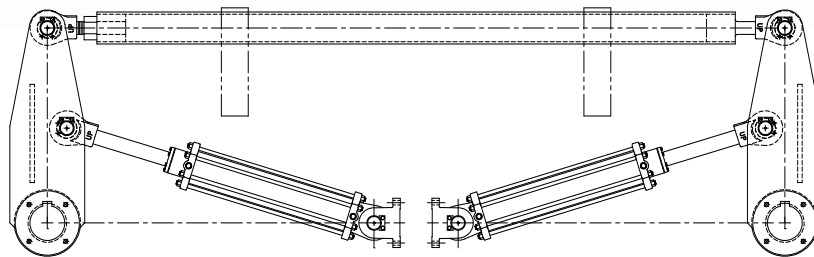
- Tapered rudder stock (1:20 in dia.)
- No keyway
- Push-up calculation from Class
- Preferred method for large dia.



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Rudder stock / tiller connection

Tie bar
(buckling calculation)



- stock-to-stock distance
- Rule-Required Upper Rudder Stock Diameter (RRURSD)

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Hydraulic actuators

Three types of hydraulic actuators



RAM steering

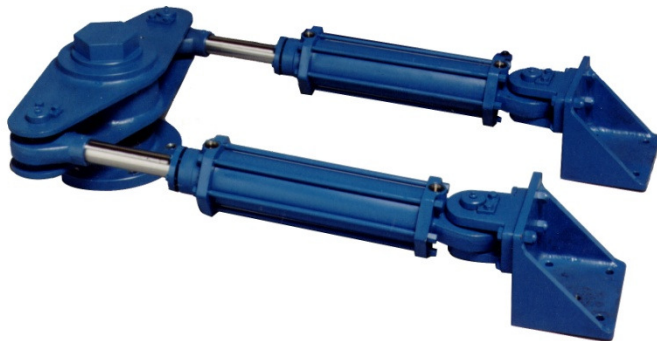
(two RAM cylinders)

Installation difficult, mechanical wear

Compact – installation and maintenance difficult



Rotary vane



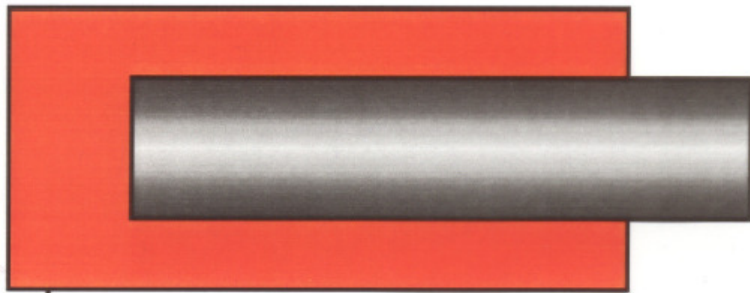
Hydraulic cylinders – *Jastram only design*

Simple; ease of installation and maintenance

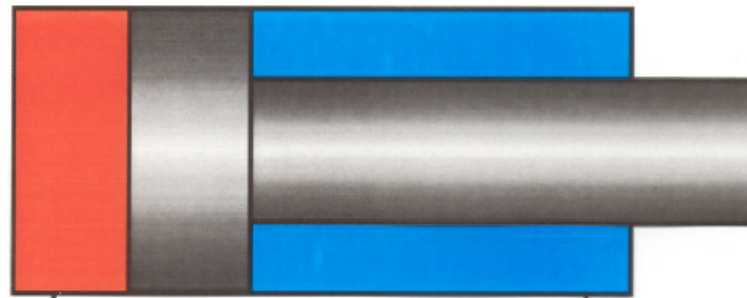
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Hydraulic cylinders

Jastram Hydraulic cylinders

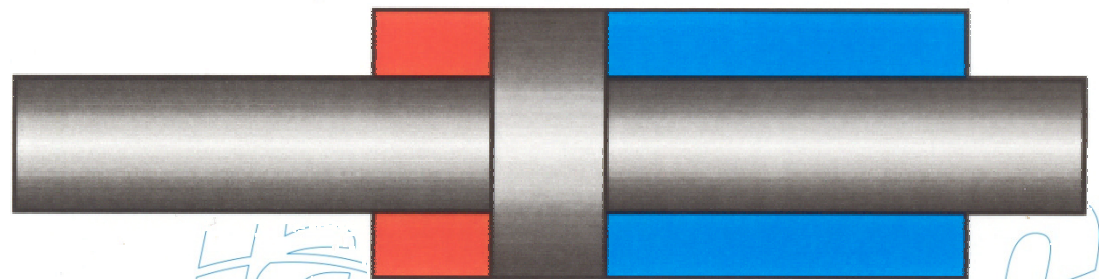


A |



A |

| B



A |

| B

Three types:

- RAM-type
- Unbalanced (Jastram)
- Balanced (Jastram)

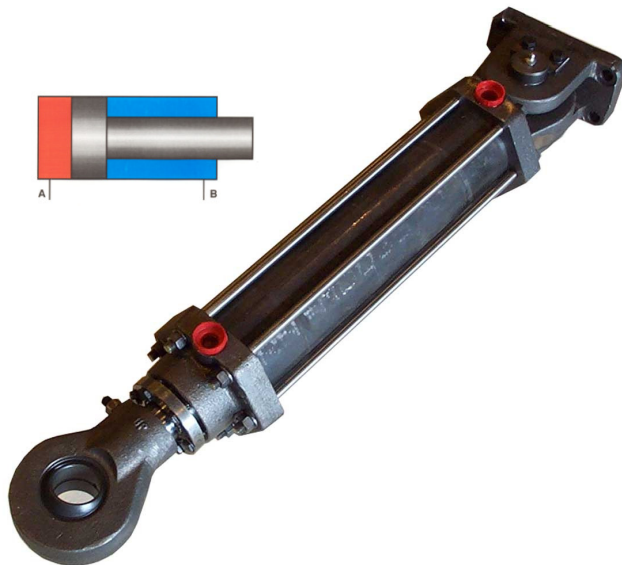
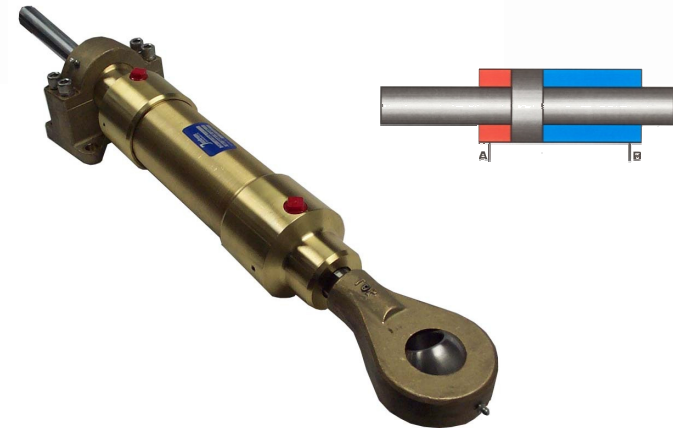
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Hydraulic cylinders

Jastram Hydraulic cylinders

Balanced cylinder (Brass-model):

- can be used singly
- Pleasure crafts and small work boats



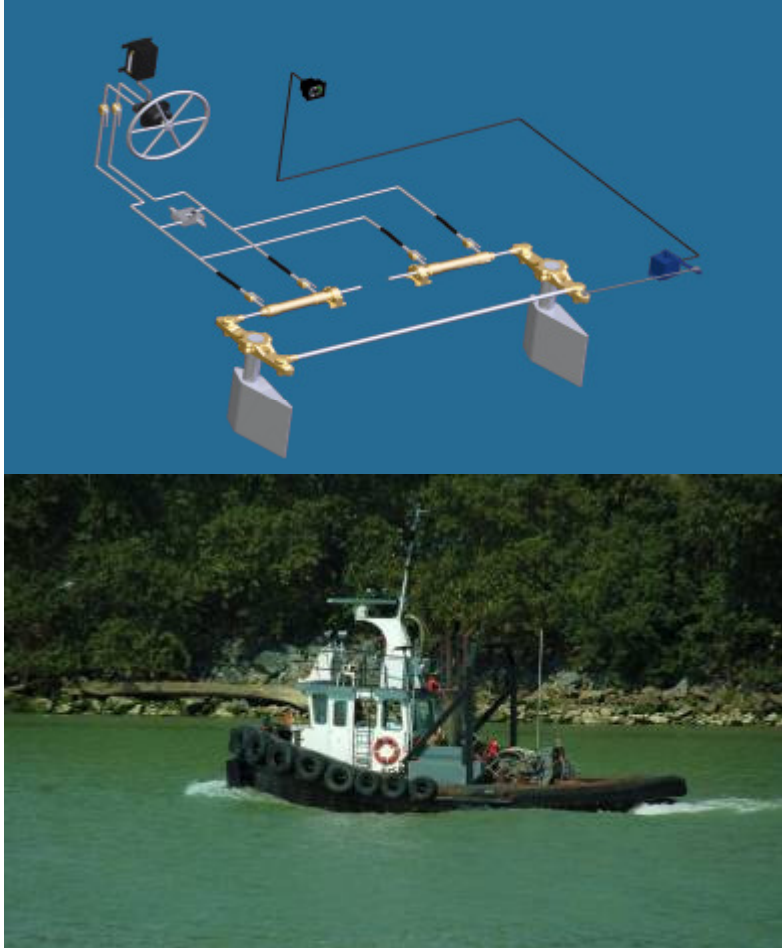
Un-balanced cylinder (Steel-model):

- must be used in pairs
- Commercial vessels and large yachts

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Manual

Manual System



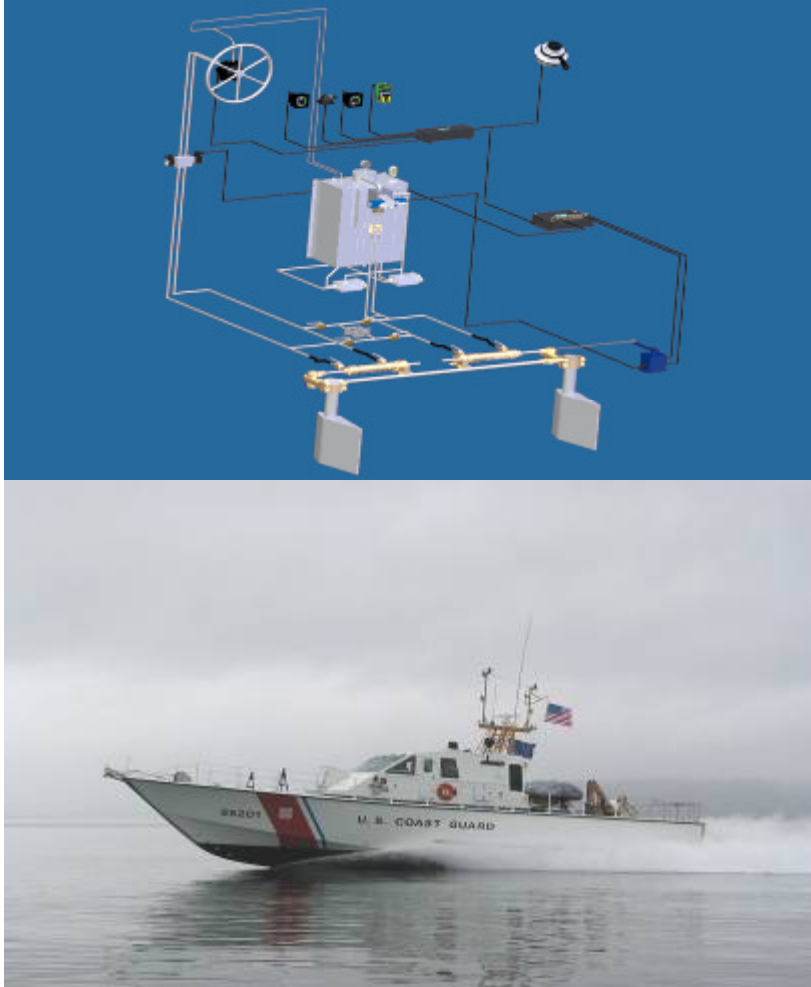
◆ Manual Steering

- ◆ Is the most basic form of hydraulic steering
- ◆ One of the most difficult to size properly
- ◆ Pro's
 - ◆ Low maintenance
 - ◆ Intuitive and easy to use
 - ◆ Easy to troubleshoot
- ◆ Con's
 - ◆ Not adequate for larger vessels

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Engine Driven

Engine Driven Digital Steering

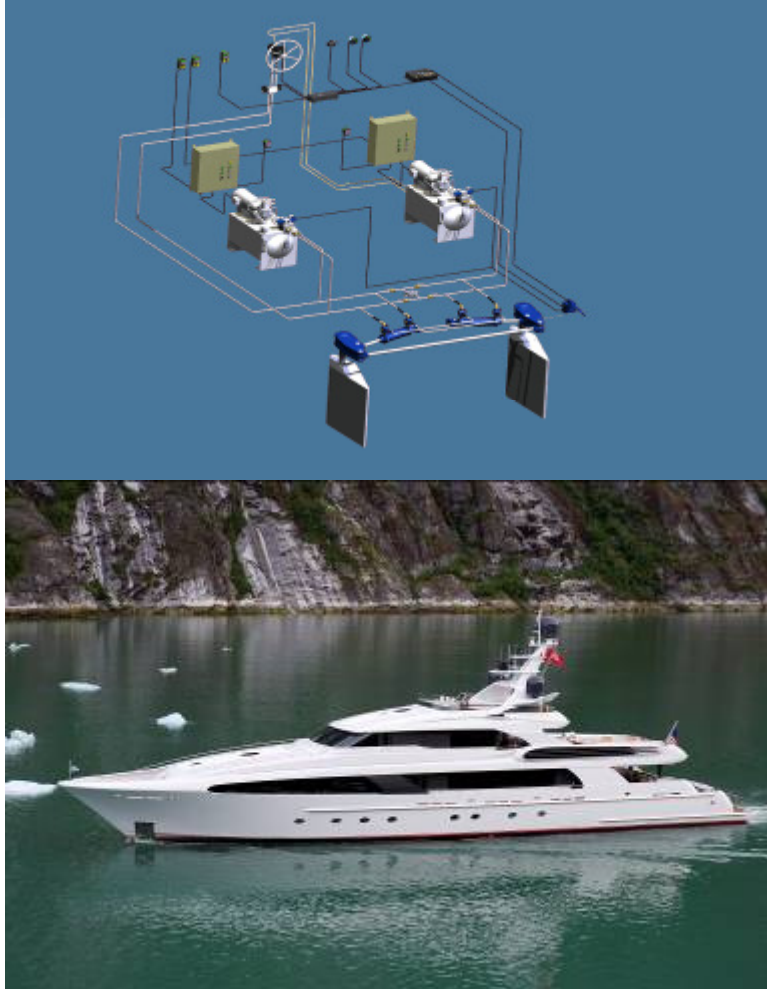


- ◆ Engine Driven systems provide an option for electro-hydraulic steering
 - ◆ There a number of myths associated with engine driven steering
 - ◆ It is a inexpensive option
 - ◆ It saves space
 - ◆ It is necessary for vessels without gensets

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Digital

Digital Tie Bar System



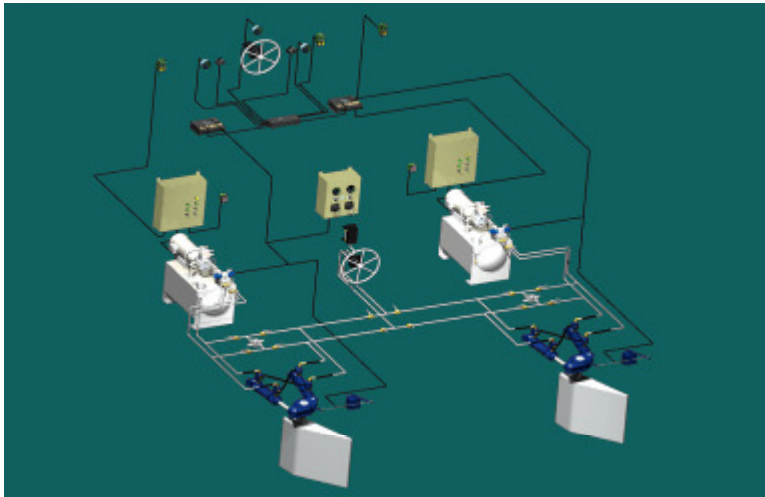
◆ Digital Steering Controls are the wave of the future

- ◆ Digital controls are an upcoming requirement by all major societies
- ◆ Provide more accurate control of the rudders
- ◆ Decrease the cost of cabling and commissioning the vessel
- ◆ Allow new types of input devices to be used

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Twin Independent

Twin Independent



- ◆ Twin Independent Steering Designs
 - ⊕ Used in vessels requiring
 - ◆ High maneuvering capabilities
 - ◆ Dynamic Positioning or Joystick systems
 - ◆ Hull design does not allow a tie bar
 - ⊕ Examples of vessels:
 - ◆ Off Shore Supply, AHT
 - ◆ Large Yachts
 - ◆ Catamarans

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Commercial

Large Commercial Applications



- ◆ These vessels tend to use hydraulics only
 - ◆ Steering Platforms provide a unique solution
 - ◆ Incorporates tillers, reservoirs, pumps, motors, valves and sometimes MSAs
 - ◆ Used on a variety of coastal vessels ie tankers, carriers, freighters, etc...

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Example Applications

Applications



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Quality Control

Expertise & QC



Jastram is committed to :

- ✦ In-house manufacturing conforming to ISO 9001:2008 standards.
- ✦ Continuous quality improvement
- ✦ QC processes
- ✦ Full service for commissioning and after sales support by factory trained technicians

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Classification Societies

Manufactured to Classification

- ❑ ABS
- ❑ Lloyd's Register
- ❑ U.S. Coast Guard
- ❑ Transport Canada
- ❑ RINA Group (Italy)
- ❑ Det Norske Veritas
- ❑ Nippon Kaiji Kyokai
- ❑ Germanischer Lloyd
- ❑ Bureau Veritas Group
- ❑ Russian River Register
- ❑ Russian Maritime Register
- ❑ China Classification Society
- ❑ Korean Register of Shipping
- ❑ The Indian Register of Shipping



RUSSIAN MARITIME REGISTER OF SHIPPING

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System Components

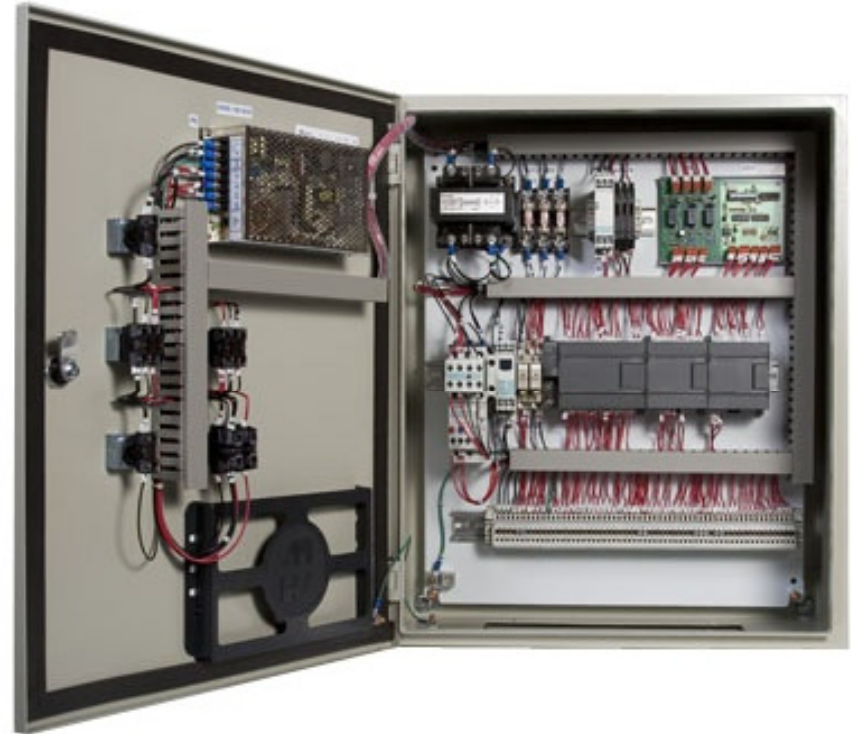
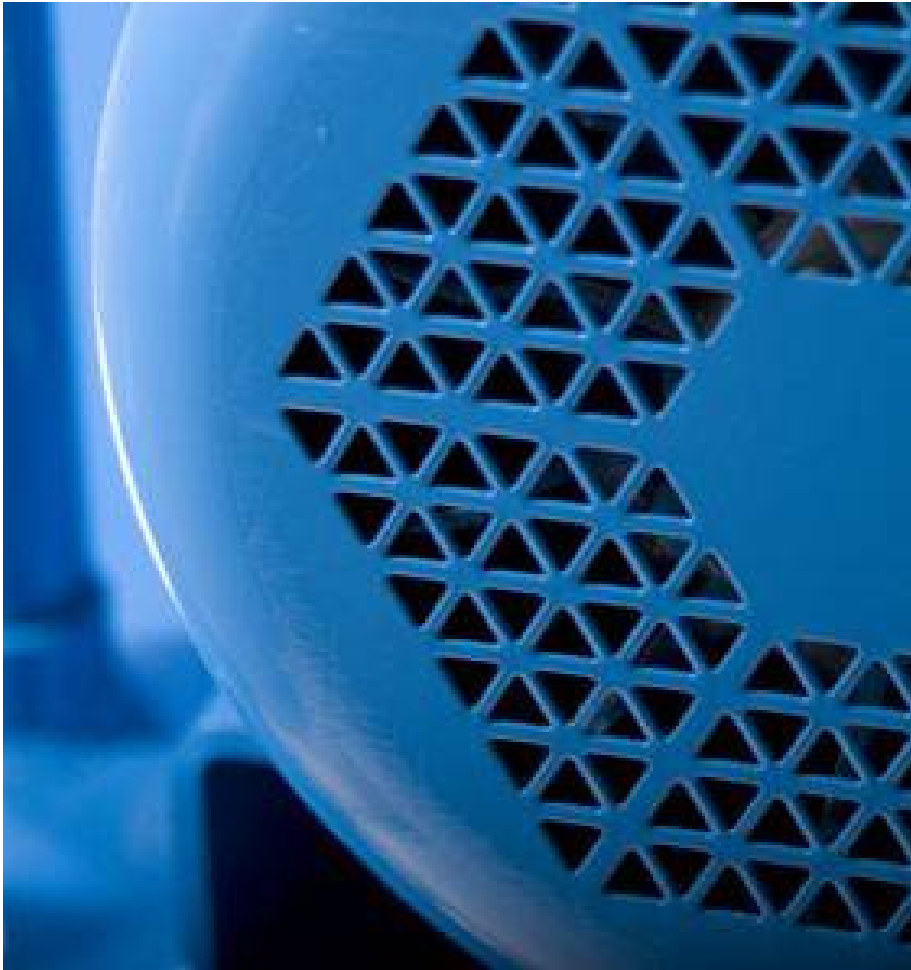
Core Steering Products

- ◆ Every Jastram steering system is custom designed as a complete unit, not just a compilation of components. However each system is built around a core group of time tested, field proven components.
- ◆ These components are grouped as follows:
 - ◆ Actuators
 - ◆ Hydraulic Power Units
 - ◆ Motor Starters and Alarms
 - ◆ Steering Control Systems
 - ◆ Input Devices
 - ◆ Rudder Angle Indicator Systems

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Motor Starters

Hydraulic Motor Starters



Digital MSA

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Steering Controls

Steering controls



Digital Steering Controller



Steering Control Amplifier
"steer by wire"



Steering Mode
Control Panel



Mode Control Processor

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Input Devices

Steering controls



Digital helm pump



Jog Switch



Yacht Lever
full follow-up



Lever full follow-up

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Rudder Angle

Steering controls



Panoramic rudder angle indicator



Rudder Angle Indicator

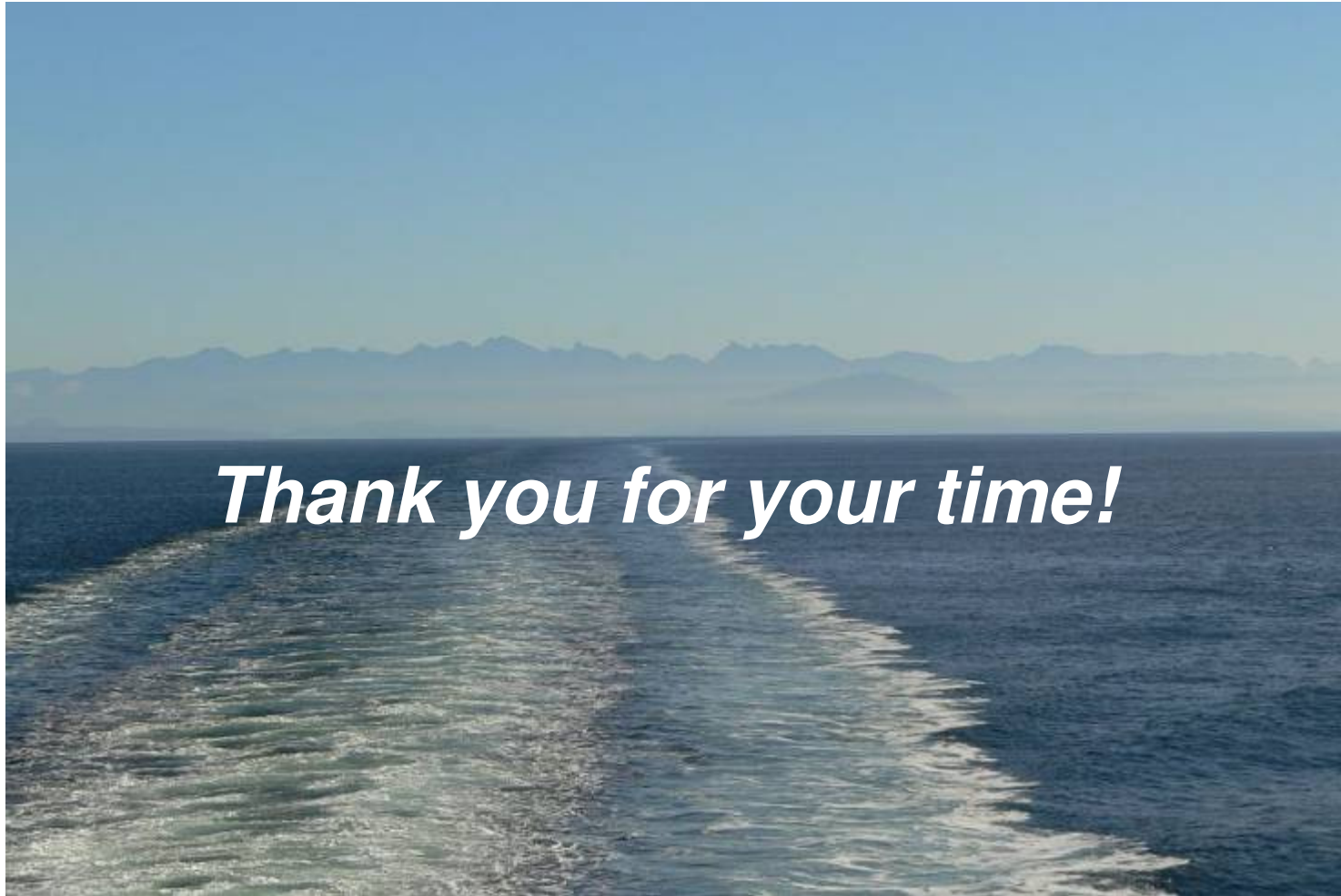


Rudder feedback unit



Rudder Angle Indicator

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Thank you for your time!

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