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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

**Open Loop** system

**Full Follow Up** steering system
- Lever steering, potentiometer
- Feedback, controller required
- two rudder angle indicators

**Closed Loop** system
Electronic full follow up
Jastram Full Follow Up – digital steering system
Main rudder types:

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

Conventional rudder
Generally NACA profile
Rudder types

Fishtail rudder

Generally better than flap rudder for course keeping

Copyright: Becker Marine Systems
Flap rudder

Mechanically-actuated flap (linkage)

Copyright: Becker Marine Systems

Hydraulically-actuated flap

Generally better than fishtail for maneuvering

Copyright: Jastram
Rudder types

Nozzle
Rudder types

Active rudder
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)

Main parameters influencing rudder forces:
- Reynolds number (UxS/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)

Stall angle

Lift coefficient: lift divided by area times dynamic pressure
Standard rudder

Torque Calculation

Project

Input Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formula</td>
<td>Jastram</td>
</tr>
<tr>
<td>Vessel Type</td>
<td>General Application</td>
</tr>
<tr>
<td>Rudder Type</td>
<td>Standard</td>
</tr>
<tr>
<td>Height</td>
<td>10.0 ft</td>
</tr>
<tr>
<td>Width</td>
<td>5.0 ft</td>
</tr>
<tr>
<td>Diagonal</td>
<td>1.00 %</td>
</tr>
<tr>
<td>Rudder Angle</td>
<td>35 deg.</td>
</tr>
<tr>
<td>Vessel Speed</td>
<td>10 knots</td>
</tr>
<tr>
<td>No. of Rudders</td>
<td>1</td>
</tr>
</tbody>
</table>

Results

- Torque vs Rudder Angle

<table>
<thead>
<tr>
<th>Condition</th>
<th>Torque (kNm)</th>
<th>Thrust (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Fwd @ 35.0 deg</td>
<td>7,925</td>
<td>10.75</td>
</tr>
<tr>
<td>Full Astern @ 35.0 deg</td>
<td>25,113</td>
<td>34.06</td>
</tr>
<tr>
<td>3/4 Astern @ 35.0 deg</td>
<td>14,128</td>
<td>19.16</td>
</tr>
<tr>
<td>1/2 Astern @ 35.0 deg</td>
<td>6,278</td>
<td>8.52</td>
</tr>
</tbody>
</table>

Rudder Area 50.00 ft²
Counter balance 25.0 %
Aspect Ratio 2.0
Stall Angle (approx) 27 deg
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
Radial Carrier Bearing

- Supports rudder and tiller
- Radial bearing
- Sealing
Four stock-to-tiller connection methods:

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

- Straight rudder stock
- Tiller height from Class
- One or two keyways
- Clamping force calculation
Rudder stock / tiller connection

Locking rings

- Straight rudder stock
- No keyway
Mechanical nut:

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

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

Tie bar
(buckling calculation)

- stock-to-stock distance
- Rule-Required Upper Rudder Stock Diameter (RRURSD)
Three types of hydraulic actuators

**RAM steering**
(two RAM cylinders)
Installation difficult, mechanical wear

**Rotary vane**
Compact – installation and maintenance difficult

**Hydraulic cylinders** – *Jastram only design*
Simple; ease of installation and maintenance
Three types:
- RAM-type
- Unbalanced (Jastram)
- Balanced (Jastram)
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
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
Engine Driven systems provide an option for electro-hydraulic steering

- There are a number of myths associated with engine-driven steering
  - It is an inexpensive option
  - It saves space
- It is necessary for vessels without gensets
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
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
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…
Example Applications
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
Classification Societies

- 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
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
Motor Starters

Digital MSA

Hydraulic Motor Starters
Steering Controls

Digital Steering Controller

Steering Control Amplifier “steer by wire”

Steering Mode Control Panel

Mode Control Processor
Input Devices

Steering controls

- Digital helm pump
- Jog Switch
- Yacht Lever full follow-up
- Lever full follow-up
Rudder Angle

Steering controls

Panoramic rudder angle indicator

Rudder Angle Indicator

Rudder feedback unit

Rudder Angle Indicator
Thank you for your time!