LET US INTRODUCE OURSELVES

For over 30 years, Thrustmaster of Texas has been designing, manufacturing and supporting marine propulsion systems for a global network of customers. Thrustmaster is the largest manufacturer of marine thrusters in the U.S.A.

Thrustmaster propulsion units are manufactured in Houston, TX in a variety of configurations including self-contained and portable deck-mounted propulsion units, thru-hull azimuthing thrusters, Z-drives, water jets, retractable thrusters and tunnel thrusters.

Special expertise has been developed in designing and manufacturing equipment for maneuvering, navigating and positioning of slow-speed marine craft and barges in shallow water.

Thrustmaster builds a complete line of Z-Drive azimuthing thrusters from 500 HP to 4,000 HP for the inland towboat industry specifically designed to endure the demanding conditions when operating in brown water. Using Z-drives on towboats results in substantially improved fuel efficiency, shorter trip times, decreased maintenance downtime and higher customer satisfaction when compared to traditional shaft and rudder installations.
Z-DRIVE AZIMUTHING THRUSTERS

Vastly improved maneuverability without rudders
A Z-drive replaces the propeller, shaft, stern tube, marine gear, rudder and steering gear all with a single unit. Z-Drive azimuthing thrusters provide maximum thrust in any direction, independent of vessel speed, offering superior pinpoint maneuverability under all conditions. Rudders are completely eliminated. Rudder drag no longer exists.

Troublesome operations such as stopping while pushing a tow downstream are easy when piloting a towboat equipped with Z-Drives. It facilitates quick switching of barges and parallel parking. And all of this can be done with a lot less power. A 1,500 HP Z-drive boat can replace a 2,000 HP conventional towboat and a 3,000 HP Z-drive boat can replace a 4,000 HP conventional towboat.

Simple and clean towboat design
Z-drives require little space. The complete Z-drives drop in from the top. The absence of long propeller shafts, shaft alleys, steering gears and rudders greatly reduces the required machinery space and weight, thus increasing the usable volume and payload of the vessel. The need for propeller shaft alignment is eliminated.

Towboats with Z-drives are not significantly more expensive than conventional towboats. The initial cost of the Z-Drives is significantly offset by reduced construction costs and installation man-hours. Shipyards have reported that the cost of building Z-drive boats is actually less than building conventional boats.
P&O Maritime operates the Mburucuya in shallow draft conditions on the Paraguay-Parana waterway. The Mburucuya is used to push up to 12 bulk barges transporting grain and iron ore. The towboat is equipped with three 2,000 HP Thrustmaster Z-Drives model TH2000MZ.

* Drawing courtesy of Interocean
Due to the greatly improved maneuverability with Z-drives, costly collisions can be avoided. There is no longer any need to slow down in turns and bends in the river. Decreased time making lock, docks and fleets reduces trip times and each trip requires a lot less fuel. A study conducted by The Shearer Group, Inc. showed an average of 28% fuel savings during a set of controlled experiments with unit tows when using Z-Drives instead of conventional shafts and rudders.

The Carline Companies owns and operates the USS Cairo, a fleet boat measuring 68 ft by 34 ft with a depth of 10 ft. The towboat features twin Cummins QSK-19-M Tier 2 engines that drive custom Thrustmaster TH750MZ thrusters with 57-inch nozzled propellers for a total 1,500 hp.

When the Carline Companies set out to design a fleet boat specifically for its Burnside fleet, the major issue to address was the swift-moving current at Impala’s CBU during high water. Because fleet boats have to operate in tight quarters with precise timing and movement, Carline went with azimuthing thrusters from Thrustmaster. But Carline and CT Marine went beyond placing Z-drive thrusters in a traditional towboat hull. CT Marine designed a towboat hull especially designed to make the most of the maneuverability and operational efficiency prized in Z-drives. The USS Cairo is wider than other towboats of the same length to improve stability when moving laterally. The vessel’s operational depth is also greater for the same reason. The vessel’s bottom is essentially flat “so the thrust won’t cavitate along the bottom. It’s unimpeded,” said Brad Parks, Carline’s chief operating officer. Michael Duncan, captain of the mv. USS Cairo, said the vessel’s design functions perfectly in real-world working conditions.

“You couldn’t ask for a better boat in a tight quarters situation,” said Duncan, who’s been with Carline for more than 20 years. “It’s built wide for stability, and it’s real stable. You can do anything you want to with one of these boats.”

In tight turning maneuvers, a towboat steering with rudders will have to come to a stop mid turn and head in reverse to adjust the trajectory angle prior to heading forward again to complete the turn radius. The engine speeds up when steering the rudders and the tow loses speed.

A study conducted by The Shearer Group, Inc. showed an average of 11% trip time savings during a set of controlled experiments with unit tows when using Z-Drives instead of conventional shafts and rudders.

TRIP TIME SAVINGS

Z-DRIVES ELIMINATE COSTLY COMPONENTS

- No Drive line shaft
- No Steering rudders
- No Flanking rudder(s)
- No Rudder steering shafting, piping or tubing
- No Rudder steering power unit
- No main engine reduction gearbox,
- No intermediate shaft, tail shaft, shaft couplings, shaft support bearings, no stern tube and stern tube bearing, strut and strut bearing, tube and upper and lower bearings, flanking rudder tubes and upper and lower bearings, tiller arms, jockey bars, steering rudder hydraulic cylinder, flanking rudder hydraulic cylinder
**TECH SPECS**

<table>
<thead>
<tr>
<th>Model</th>
<th>HP</th>
<th>Motor RPM</th>
<th>Propeller Diameter</th>
<th>Thruster Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>TH500MZN</td>
<td>500</td>
<td>1800</td>
<td>51</td>
<td>13,000</td>
</tr>
<tr>
<td>TH750MZN</td>
<td>750</td>
<td>1800</td>
<td>57</td>
<td>17,000</td>
</tr>
<tr>
<td>TH1000MZN</td>
<td>1100</td>
<td>1800</td>
<td>57</td>
<td>21,000</td>
</tr>
<tr>
<td>TH1500MZN</td>
<td>1700</td>
<td>1600 / 1800</td>
<td>78</td>
<td>35,000</td>
</tr>
<tr>
<td>TH2000MZN</td>
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<td>1000 / 1600 / 1800</td>
<td>83</td>
<td>43,000</td>
</tr>
<tr>
<td>TH2500MZN</td>
<td>2750</td>
<td>1600 / 900</td>
<td>94</td>
<td>52,500</td>
</tr>
<tr>
<td>TH3000MZN</td>
<td>3350</td>
<td>1200 / 900</td>
<td>112</td>
<td>69,500</td>
</tr>
<tr>
<td>TH4000MZN</td>
<td>4000</td>
<td>1000 / 900</td>
<td>118</td>
<td>84,000</td>
</tr>
</tbody>
</table>

**Robust and Reliable. Designed and built in America.**

Thrustmaster knows and understands brown water applications. We have been building brown water propulsion equipment for more than 30 years. Thrustmaster Z-drives are designed based on conservative American standards observing ample safety margins. They are built to last even in the harshest operating environment. The units are built in our headquarters facility in Houston, Texas, using American materials, American components and American labor.

Each Z-drive is equipped with a husky stainless steel propeller running in a nozzle with stainless steel internals. The gears and transmission shafts are generously sized and are protected by a quick release coupling at the input shaft of the Z-drive. This quick release coupling acts as a mechanical fuse whenever the drive line is blocked, for instance when the propeller ingests a log, a tire or a rope. The mechanical fuse can be reset manually after the obstruction is removed out of the propeller.

**Easy Maintenance**

Routine maintenance is limited to periodic replacement of filter elements for the lubricating oil and the steering hydraulic fluid. Whenever major maintenance or repair is required, the complete Z-drive is lifted out of the vessel while the vessel is afloat. A replacement Z-drive can be dropped in and the boat is back to work within hours.
## Z-Drive Features

<table>
<thead>
<tr>
<th>Z-Drive Features</th>
<th>Z-Drive Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>360° steering of propeller provides omni-directional thrust for unequaled maneuverability at any vessel speed.</td>
<td>Collisions can be avoided. Much greater control of the tow going through turns and river bends. Quick switching of barges when going through locks. Downstream stopping and docking.</td>
</tr>
<tr>
<td>No need for steering and flanking rudders.</td>
<td>No rudder drag. Substantial fuel savings. Tows move faster, shortening trip durations.</td>
</tr>
<tr>
<td>Z-drive towboats can get equivalent performance with smaller power output allowing tug fleets to use smaller engines.</td>
<td>Lower capital investment and reduced fuel consumption.</td>
</tr>
<tr>
<td>The mechanical fuse instantly relieves any transmission overloads.</td>
<td>It protects the mechanical drive train when foreign objects are ingested by the thruster, preventing expensive downtime and repairs.</td>
</tr>
<tr>
<td>Z-drives can be installed and removed topside with a crane while the vessel is afloat.</td>
<td>In the event of a serious breakdown, the Z-drive can be replaced in a matter of hours.</td>
</tr>
<tr>
<td>Thrustmaster Z-drives are made in the USA.</td>
<td>American design using American parts readily available from Thrustmaster or from local parts distributors. American service technicians available 24/7. A network of support centers along all major rivers.</td>
</tr>
</tbody>
</table>
Support throughout the entire life of the product.

Thrustmaster offers comprehensive support throughout the entire product life-cycle.

The focus is always on customer satisfaction, efficient operation of the Thrustmaster product, and on short repair and maintenance times.

In order to ensure optimum service with minimal response times, Thrustmaster signed a service agreement with McGinnis Inc. - National Maintenance & Repair. Each of their four service centers are strategically located along major rivers in the USA with 24/7 availability. Their experienced service technicians are trained and authorized to provide installation, commissioning, maintenance, repairs and upgrades on our propulsion and control products.

Thrustmaster maintains a large inventory of spare parts at all times. Current parts inventory in our Houston plant is almost $30 million dollars.

Thrustmaster Services Include:
- 24/7 Service Response Hot line
- Propulsion System Trouble Shooting
- Mechanical, Hydraulic & Electrical Repairs
- Emergency Service Tiger Teams
- System Installation & Commissioning
- Technical Services & Field Engineering
- Upgrades & Modifications Equipment
- Efficiency Improvements
- Operational Training
1. South Point, Ohio
2. Paducah, Kentucky
3. Hartford, Illinois
4. Harahan, Louisiana
5. Houma, Louisiana
6. Houston, Texas
HYDRAULIC Z-DRIVES for FLEET BOATS

Thrustmaster’s hydraulic azimuthing Z-drive thrusters are especially suitable for fleet boats. A hydraulic Z-drive consists of a high-thrust, fixed pitch propeller on a husky propeller shaft directly coupled to Thrustmaster’s exclusive podded hydraulic motor.

Simple, Efficient & Reliable
The diesel engine drives a hydrostatic transmission pump at constant RPM. The propeller is driven by a variable speed hydraulic motor. In between are fluid conductors. There are no drive shafts, gears, bearings, or other mechanical components to fail. The drive is an infinitely variable torque converter. The hydraulics are virtually maintenance free and provide many years of reliable operation while performing in the harshest marine environments, as long as the hydraulic fluid is kept in clean and cool condition.

Highly Resistant to Damage
The hydraulic drive is extremely resistant to damage. Foreign objects ingested by the thruster are unlikely to damage the hydraulic drive train, as the hydraulic system instantly relieves any transmission overloads.

TECH SPECS

<table>
<thead>
<tr>
<th>Model</th>
<th>Input Power</th>
<th>Propeller Diameter</th>
<th>Thruster Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HP</td>
<td>in</td>
<td>lbs</td>
</tr>
<tr>
<td>TH500N</td>
<td>500</td>
<td>49</td>
<td>17,000</td>
</tr>
<tr>
<td>TH750N</td>
<td>750</td>
<td>57</td>
<td>21,000</td>
</tr>
<tr>
<td>TH1000N</td>
<td>1000</td>
<td>63</td>
<td>35,000</td>
</tr>
</tbody>
</table>
**Hydraulic Z-Drive Features** | **Hydraulic Z-Drive Benefits**
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No clutch required. When the hydrostatic pump goes to neutral (zero swashplate angle), the propeller comes to a complete standstill regardless of engine RPM. | No clutch wear. No clutch maintenance. There is no clutch.
Propeller speed can be infinitely controlled from zero to maximum regardless of engine RPM. | Incredible maneuverability when combining azimuthing steering with infinite thrust control by virtue of propeller speed control.
Engine runs at constant RPM, just like a generator. | Full engine torque available at any vessel speed for fast acceleration and stopping of the vessel. Low engine maintenance, just like a generator engine. Low emissions and no coking.
No shafts to align. The hydrostatic pump is installed on the bell housing of the engine and the only connection between the engine driven pump and the Z-drive is hydraulic hoses. | Very easy and quick installation. No alignment required. Equipment runs very smooth. No vibrations.
The engine driven pump, hydraulic reservoir and accessories can be installed at any convenient location. | Allows optimum utilization of space and weight distribution.
Complete system is supplied by Thrustmaster. | Single point of contact, single point of responsibility.
Thrustmaster hydraulic azimuth thrusters use a podded design concept. The propeller shaft is directly driven by the hydraulic motor in the thruster. | High propulsion efficiency, no gear losses. Reliable due to its simplicity & limited number of moving parts. Lateral & torsional critical speeds are far above operating speeds. Runs smooth, no vibration.
The hydraulic drive train can instantly relieve any transmission overloads making the Z-drive extremely resilient and durable. | Foreign objects ingested by the thruster are unlikely to damage the hydraulic drive train as the hydraulic system instantly relieves any transmission overloads.