Steering gear performance

Taking the regulations into the 21st century

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Solas has been with us since 1914 and continues to evolve. True performance-based regulations for steering gears within this instrument would improve safety.

It is time for these regulations to come into the 21st century.

'The vessel grounded due to steering failure.' How many times have mariners or other interested parties who follow accident trends seen this reported? Undoubtedly, there are as many causes to a steering gear failure as there are humans who operate them or design elements that make up such a system. But equally true, many of these failures have alarmingly similar causes.

Of course, the ever-present human factor can be counted as a contributing factor in many steering gear 'failures'. In these instances, as documented in many accident reports, the lack of procedural rigour and training are major contributors to the grounding or accident, not a failure of any particular part of the steering system. What was initially reported as a steering gear failure was, in fact, a human failure.

But from time to time, true steering gear failures do happen. Hydraulic hoses burst, electric relays short circuit, power is lost, directional control valves jam – and the list goes on. Many of these failures are detected promptly by the use of alarms. Once aware of the failure, crew can regain control of the vessel and adverse consequences are avoided. Even if early detection is not possible due to the nature of the failure, if the vessel is in the open sea adverse consequences rarely result. With no adverse consequence, the 'system' can be said to have worked. The risk reduction measures in place did their job. But what of those steering gear incidents that result in adverse consequences? This will often happen in areas that require special caution, such as when navigating in restricted waters. Although some collisions have been caused by steering failure, more often than not the result is grounding.

Vessel steering gear standards and performance are a product of the International Association of Classification Societies (IACS) rules, individual classification society requirements and the Solas 1974 Convention.

The IACS unified requirements concerning machinery installations includes a chapter on steering gears – Chapter M42. This covers such items as piping, materials and design considerations, among others. However, performance-based criteria are not set in the chapter but refer back to Solas for the information. One paragraph of interest within M42 is number 13, 'Operating instructions', which states that, where applicable, the following should be posted near the steering control post or incorporated into operating instructions:

> Caution – in some circumstances when two power units are running simultaneously the rudder may not respond to helm. If this happens stop each pump in turn until control is regained.
>
> The above signboard is related to steering gears provided with two identical power units intended for simultaneous operation, and normally provided with either their own control systems or two separate (partly or mutually) control systems which are/may be operated simultaneously.

In Solas, Regulations 29 and 30 of Chapter II-1 apply to steering gears, as well as Regulation 19-1 of Chapter V. Most of the details of these regulations are given over to design and construction specifications and few performance-based criteria are found. Only Regulation 29-3.2 comes close to being performance based; the well known 35° to 30° (hard-over to hard-over) to be accomplished in not more than 28 seconds. This time-honored requirement has been in Solas since 1960 – almost half a century.

Steering and rudder developments in the past 20 to 30 years are now beginning to eclipse Solas 29-3.2. Flap-type rudders have gained great popularity and give dramatically increased performance over traditional rudders. The side force produced by such rudders is almost 80 per cent greater than conventional rudders. Azimuth thruster steering/propulsion packages are also coming to the fore and provide steering performance that has no relationship with a conventional rudder. Even bow thrusters are beginning to change the steering possibilities of some vessels. The increased power of some of these units now brings into question the conventional rule-of-thumb whereby bow thrusters are considered ineffective if the vessel is making more than three or four knots. The steering performance afforded by the above mentioned factors, and others, are bringing ship manoeuvrability into a new paradigm. The 1960 Solas 'performance standard' of 28 seconds not only begins to appear arbitrary when juxtaposed against these developments, it is becoming increasingly debatable.

Risk reduction

Solas Regulation 19-1 of Chapter V also makes an effort at steering gear performance as well as risk reduction by specifying:

> In areas where navigation demands special caution, ships shall have more than one steering gear power unit in operation when such units are capable of simultaneous operation.

▲ A Rolls-Royce flap type rudder.

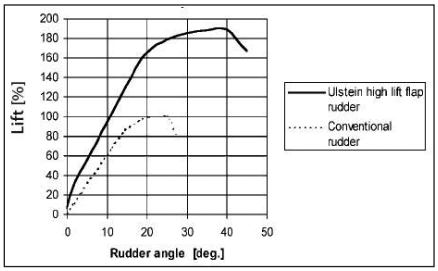
This requirement for redundancy and increased performance, now more than 20 years old, is somewhat dated and unnecessarily prescriptive given the advancements in technology and the performance of steering gear systems today. And what if the power units are not capable of simultaneous operation? One power unit is suddenly good enough? The regulation undermines its own credibility with such a qualification.

Ironically, Regulation 19-1 also introduces an additional risk into the equation – one that is recognised by IACS in M42.13. Even if the units are designed for simultaneous operation, the failure of one unit can create hydraulic lock within the system thus rendering the steering inoperative – and often without an accompanying alarm. Without an alarm, time could be lost before it is even realised the steering gear is inoperative. The rudder could be over to one side or the other, causing the vessel to shear out of the channel. Given the time and space restrictions when operating in confined waters the crew may not react adequately to prevent a grounding or collision, having to stop each pump in turn to isolate the defective unit – and assuming they have the wherewithal and steady hand to carry out this procedure as their vessel bears down on another oncoming behemoth.

New and improved steering gear regulations would be predicated on a desired outcome (dare I say goal-based?) and be risk-based as well. For example, when navigating in a channel, 15 to 20 seconds of steering malfunction are usually enough to cause serious trouble. Criteria that could be used to frame the outcome are, among others:

- Advance;
- Transfer;
- Efficacy of bow thrusters;
- Redundancy;
- Automatic transfer arrangements of steering gear power units; and
- Alarms for all systemic failures.

The manoeuvring characteristics such as advance and transfer would preferably be those for shallow water as this would be the likely area that a steering malfunction would cause adverse consequences.



▲ Performance comparison: flap versus conventional rudder.