CHAPTER 4: MISCELLANEOUS VESSEL INSPECTION ACTIVITIES

A. GENERAL CONCERNS

Proper and reliable operation of a vessel's steering gear is vital to the safety of the ship, its personnel, and the marine environment. Coast Guard inspections of steering systems must be thoroughly and intelligently performed. Prior to any testing, the inspector should become familiar with the equipment and its operation. A review of the manufacturer's instruction manual may be necessary. The inspector should then carefully inspect and witness the testing of all equipment, controls, and alarms, remaining alert for signs of equipment failure, improper operation, defective equipment, or potentially hazardous conditions. The chief engineer and master should be interviewed concerning overall operation and reliability of the steering system. Attention should be given to steering operations and tests during review of the official logbook. A thorough knowledge of steering gear standards and their development is important to assess where to place inspection emphasis. For this reason, information on standards development, a list of references, and some vessel casualty and steering regulation history, are included in this section.

B. INSPECTION PROCEDURES

1. General

Prior to conducting operational tests of the steering system, it should be inspected as described below. The general objective is to closely examine all electrical, mechanical, and hydraulic connections and linkages of the main and auxiliary steering systems. The inspector should:

a. Sound the mounting bolts of all equipment.

b. Check all piping systems and attachments, equipment-securing brackets, protective guards, wire runs and cages, and other items prone to corrosion or vibration fatigue.

c. Inspect control linkages, linkage pins, and ram guides for wear.

d. Identify and closely examine feedback devices, differential units, or other components that may represent potential single-point failures (i.e., the weakest link). Refer to the steering system design philosophy and requirements in section 14.F below to help identify sections not required to be duplicated.

e. Ensure that all vital connections, pins, couplings, and control linkages have securing devices, such as cotter pins or double-nut locking arrangements, to prevent loosening from heavy vibration. Hydraulic transfer valves (such as a six-way valve) should lock in each position. Padlocks or other securing arrangements needing special keys or tools are not authorized.

f. Check emergency steering procedures and steering transfer diagrams for clarity and proper labeling of valves. Check that the steering procedures and steering transfer diagrams accurately reflect actual conditions in the steering gear room and wheelhouse, respectively (i.e., wheelhouse procedures should accurately reflect equipment/control actions required to change over to alternative or emergency steering).

g. Inspect carrier bearing (or equivalent) and rudder stock packing.

h. Inspect steering gear room for watertight integrity, cargo stowage, fire hazards, ventilation, missile hazards, or other hazardous conditions.

2. Electrical Equipment

With all power sources secured at the main and emergency distribution switchboards, the inspector should inspect all steering motor starters and switchgear in accordance with the appropriate provisions of 46 CFR 110.30 and 111. The inspector should be particularly alert for loose wiring connections, loose equipment mounting screws, frayed or broken control wiring (especially in way of door hinges), and dirt or debris. Mechanical operation of start/stop and transfer switches should be free and smooth. All switches and circuit breakers should be exercised. Electrical securing devices such as lugs, strain relief crimp connections, edge connectors, and terminal boards are prone to vibration and corrosion problems and should be closely examined. All connections, insulators, and switching devices should be secure and clean to prevent arcing or insulation breakdown. Excess spare fuses may indicate past problems with overloaded circuits.

3. Pumps and Motors

The inspector should hand rotate each motor and pump assembly, being alert for unusual noise, binding, or a feeling of roughness during rotation. Couplings should be examined for excessive play and evidence of grease slinging. Grease on the overhead near a coupling may be a sign of coupling wear or excessive lubrication. Check motor ventilation openings for cleanliness.

4. Hydraulics

All hydraulic hoses and connections must be carefully checked. The inspector shall check hydraulic oil for proper level, alarms, cleanliness, and signs of emulsion. On dual-power systems, interconnections or fittings that may fail and cause both systems to lose oil should be noted and particularly checked. The inspector should be alert for signs of oil leakage or cleanup just prior to inspection. Evidence of metal in strainers or filters may indicate imminent failure.

5. Control Linkages

Mechanical linkages between the rudder differential and pumps are not subjected to high loads, so strength is not a problem. However, repeated bi-directional movements, combined with vibration, can cause loosening of connections. All of these connections are generally in the open and readily visible for inspection. Because these linkages are critical to the operation of the steering system, inspectors should place considerable emphasis on control linkage examinations. The ship's crew also should inspect all connections on a routine basis.

6. Differential Control Units

The function of the differential unit is to compare the helm order with the rudder position and produce an output to control the hydraulic pump. Because of the vital nature of this system, which is composed of many moving parts and connections, emphasis should be placed on this unit during an inspection.

7. Relief Valves

Relief valves are used to limit hydraulic pressures under severe loading conditions, such as those encountered during heavy weather. Two basic types of relief valves are employed, a balanced piston or a check-valve (spring-loaded) type. The balanced piston is used for high pressures; check-valve types are used for applications such as filter bypasses, in which lower differential pressures are expected. These valves are not subjected to frequent cycling under normal service, and a common problem is freezing of the piston in the closed position. Preventive maintenance should include proper hydraulic filtration and periodic valve cycling. The manufacturer's data book should be consulted for recommended relief valve testing and setting.

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8. Piping and Fittings

The inspector should examine hydraulic pipes and fittings for condition, proper support, and alignment. Fittings should be closely examined for leaks and evidence of overtightening. Socket welded fittings are generally preferred in areas of high vibration. High-pressure piping is generally made from Schedule 80 seamless carbon steel and should be adequately supported. Tubing applications should be limited to minor services where exposure to rough handling is not a problem. Hoses with abrasions, kinks, twists, or soft spots should be replaced.

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9. Securing Devices

Securing devices that are most seriously affected by vibration are keys, set screws, and pins. Rollpins, grooved straight pins, or similar securing devices should be used in heavy vibration areas. Lockwire may be used in lighter duty areas.

a. Rollpins provide good resistance to loosening from vibration because the rollpin is pressed into place and exerts a spring force to keep it in. Rollpins are often used to attach a gear to a shaft when strength is not a problem.

b. Keys provide more strength than rollpins and are excellent for transmitting torque. Keys are held in place by friction and should not be relied on for maintaining axial position. Vibration can back keys out even when they have been tightly fitted.

c. Woodruff keys are not as satisfactory as straight pins although they offer more resistance to tipping. These keys require a tight fit to the hub, which makes them more prone to backing out than straight pins.

d. Set screws may be used as a type of key and retainer. This arrangement may not hold up well to reverse loadings. To secure set screws better, staking is often used for light loads. Staking must be done when the piece is assembled. Minor repairs to parts utilizing staked set screws may result in a missing or improper stake and subsequent failure of the securing device. Set screws are also used to better hold key arrangements.

e. Cotter pins provide a means of further retaining a bolt, pin, or other securing device. The pins must be properly bent (180) and secured to prevent failure or backing out.

f. Tapered pins of any kind are generally not accepted in steering systems.

g. Nuts are prone to backing off during vibration and should be used with additional retaining devices such as special lock washers, keys, pins, or double-nut arrangements.

C. OPERATIONAL TESTS

1. General Tests

The objective is to test thoroughly all steering systems, in all modes of operation from all control locations. This is best done with one inspector on the bridge and another in the steering gear room. The inspectors shall:

a. Verify that the system operates to design and regulation requirements;

b. Ensure that operating instructions are properly posted and accurate; (steering system controls and changeover procedures may be distinctive for the wheelhouse and steering gear room).

c. During operation of the steering apparatus, be alert for unusual noise, vibration, oil leakage, and abnormal hydraulic pressures. "Hunting" and erratic or jerky movements of the rudder, follow-up system, or synchro-repeater system may indicate control or feedback problems;

d. If underway, check for normal operation under load, with special attention to overheating of the operating motor and pump assembly; and

e. Test all alternate systems, alarms and indicators under simulated casualty conditions (such as tripping the main steering power breaker).

2. Pumps, Motors, and Controls

The inspectors shall:

a. Energize the equipment and test the operation of each motor and pump assembly, using both port and starboard control cables;

b. Operate each motor and pump assembly from the bridge, the alternative control station, and the steering gear room through the full range of rudder travel; and

c. Operate each motor and pump assembly on the normal, alternate, and emergency power supplies, checking for the proper operation of the manual feeder transfer switch and automatic bus transfers during this procedure.

3. Auxiliary Steering

Auxiliary steering arrangements should be thoroughly tested by simulating a main steering or power failure. Steering control and power should be readily switched to the auxiliary system.

4. Rudder Angle Indicators/ Feedback

The inspectors shall verify that the rudder angle repeaters on the bridge, alternative control station, and steering gear room are in alignment with each other and with the mechanical rudder angle indicator. Visibility from the steering station and night lights shall also be checked.

5. Alarms and Indicators

The inspectors shall verify that all required indicating lights, alarms, and emergency lighting in the pilothouse, machinery space, and in the steering gear room operate properly (See MSM II-C4.I below).

6. Comm-unications

The inspectors shall test for proper operation of all voice communication systems between the bridge, alternative control, and steering gear room.

7. Regulatory Compliance

Particular attention to detail is required during inspection of new installations, modifications, and major repairs to verify compliance with all steering gear standards and regulations (See MSM II-C4.F and G below). Some compliance tests, such as overloads or maximum design limits, may not be feasible or safe. Early communications between the officer in charge, marine inspection (OCMI), vessel owner, equipment manufacturer, and contractor, concerning testing requirements and alternatives are encouraged.

D. INSPECTION RECORDS

At the completion of a steering gear inspection, a detailed description of the tests and inspections performed should be included in the appropriate inspection book. If the inspection was split between hull and boiler inspectors, the hull book should summarize the entire inspection. The following are examples:

1. All Vessels, *Except* Small Passenger Vessels

"All accessible electrical, mechanical and hydraulic connections and linkages in the steering gear room were examined by the boiler inspector and found satisfactory. Tested the main and auxiliary steering systems and associated alarms in all modes of operation from all control locations. Checked rudder angle indicators. All inspections and tests sat. Interview of the chief engineer, master and review of the vessel's logbook indicate past reliable operation of all steering systems."

2. Small Passenger Vessels

"Steering system is a rod-to-gear and chain assembly. Examined the entire system while exercising the helm. All couplings, sprockets, and chains are aligned, well lubricated, and operate freely. Examined securing devices and connections; all satisfactory. Rudder post, packing and tiller examined and found sat. Operational tests of bridge and flying bridge steering stations sat. Emergency tiller readily accessible and tested sat."

E. CONSIDERATIONS FOR SPECIFIC STEERING SYSTEMS

1. Ram Systems

These generally consist of single or paired double-acting hydraulic rams, connected by a link or Rapson Slide mechanism to the tiller.

(a) Link systems use connecting rods or linkages from the ram to the rudder post. They are common in dual-rudder arrangements and installations with less space surrounding the rudder post.

(b) The Rapson Slide unit is a common ram arrangement consisting of a block or sleeve (trunnion block) pivoted on a ram that is guided by a cross-head (yoke) fitted to the rudder stock. An advantage of this arrangement is that as the rudder angle increases, the ram's mechanical advantage increases.

2. Rotary Vane Systems

A rotary vane-type steering gear consists of a vane actuator connected directly to the rudder stock. Power and control is similar to hydraulic ram systems, but this system operates at lower pressures and has fewer moving parts than a ram system. Radial vane systems have proven to be as reliable as ram systems. Single actuator systems may be considered equivalent to the required dual apparatus with many of the same provisions as hydraulic rams. Preventive maintenance and routine inspections of the hydraulic system and strainers are especially important to rotary vane systems. Historically, a serious failure was prevented when metallic slag was found in the hydraulic system strainers. In this incident, sheared vane bolts had scored the pump cylinder walls. Investigation revealed that the bolts had sheared due to stresses at a notch created by tapered bolt heads fitted into unchambered bolt sockets.

3. Orbitrol Systems

Orbitrol steering systems are a type of hydraulic helm unit that may be found on offshore supply vessels (OSV's) and small passenger vessels. This system has been accepted for cargo vessels of less than 500 GT, under certain conditions, if the vessel is capable of steering with its screws. Deck winch motors may also run off the Orbitrol system if specifically approved on vessels of less than 100 GT. When testing Orbitrol systems, all auxiliary hydraulic motors should be running simultaneously.

4. Systems Aboard Small Passenger Vessels

Problems with small passenger vessel steering systems are frequently caused by a lack of maintenance, corrosion, or the loss of fasteners due to wear and vibration. The inspector should inspect the entire steering system visually, from behind the operator's console to the rudder post. The system should be exercised during the inspection to ensure that all pulleys, sprockets, cables, guides, etc., are free, well lubricated, and properly aligned. All linkages, pins, and fasteners should have locking devices. Steering system components that are not easily accessible may present potential failure points and should be carefully evaluated. The removal of protective guards, coverings, or other interferences may be necessary to inspect the system completely.

5. Auxiliary Steering Systems

Auxiliary steering and communication systems should be tested as outlined on posted directions. The inspector should check all labels and markings for compliance with these instructions. A deck winch to block and tackle arrangement need not be physically exercised, but all required equipment should be inventoried and examined. Auxiliary hand tiller arrangements should be checked for easy access, fit, and capacity. Trick wheel arrangements are easily tested and should be fully exercised. Hand pumps should be tested in both directions (but need not be run through the entire rudder range).

6. Integrated Steering/ Propulsion Systems

Such systems maneuver a vessel solely by changes to propulsion settings and do not use a rudder. Two examples are cycloidal propellers (a Voith system) and the Z-drive/Z-peller. Such systems provide a full 360-degree propulsion thrust output, which is especially advantageous on dredges, ferries, and towboats. The same essential design philosophy and inspection criteria apply to these systems. The inspector should consult the manufacturer's data book and plan approval letters to become familiar with the system.

F. STEERING GEAR STANDARDS AND DESIGN PHILOSOPHY

1. Coast Guard Regulations

For vessels built after 1 June 1982, the Coast Guard's standards apply a philosophy of duplication and separation to steering gear design standards so that, in the event of a casualty, a backup unit or operating position is available. A summary of duplication requirements in 46 CFR, Subchapters F and J are listed below:

Steering Apparatus

a. A main and auxiliary steering gear is required. However, a more common arrangement on larger vessels uses a dual-power system that has been accepted as equivalent to the separate auxiliary steering gear.

Acceptable Substitutions

b. Dual-powered hydraulic systems are an acceptable substitute for the auxiliary steering gear requirement, provided each power unit meets the capacity of the main steering gear. A dual-power hydraulic steering system is comprised of:

- Two cylinders or actuator chambers.
- Two independent pumps with independent piping to the cylinders. Cross-connects may be provided, in which case valving shall be provided to allow any pump/cylinder combination.
- Separate power leads to the pump prime movers for the source of power. Separate feeder circuits are required for electrohydraulic steering gears.
- Each independent steering power unit has the required power to meet the rudder movement requirements of 46 CFR 58.25-10(a).
- An independent control system for each hydraulic power unit.
- Two reservoirs, each of sufficient capacity. Cascade overflow types are acceptable, provided each half has sufficient capacity.

Steering Station

c. Two stations are required for controlling the main steering gear: one in the pilothouse, the other on the after weather deck, unless duplicate controls are provided to the pilothouse. Generally, duplicate controls are provided and the alternative steering station is in the steering gear room.

Steering Gear Control Systems

(1) A steering control system is defined as all equipment by which helm orders are transmitted from the bridge to the steering gear power units. The 1 June 1982 revision of Subchapter I has expanded this definition to include transmitters, receivers, feedback devices, differential units, hydraulic control pumps and all associated motors, cables, shafting, and piping for steering gear control.

Separate and Independent Control Systems

(2) Two separate and independent control systems are required: one in the pilothouse, the other at the alternative steering station. Control systems external to the steering gear compartment are required to be duplicated. For vessels constructed prior to 31 May 1982, some essential control system elements, such as feedback devices and differential control units, may not be duplicated.

Steering Gear Feeder Circuits

(3) One feeder circuit must be from the ship's service switchboard. The other circuit must generally be fed from the emergency or alternative power source. The circuits must be separated as widely as possible from one another.

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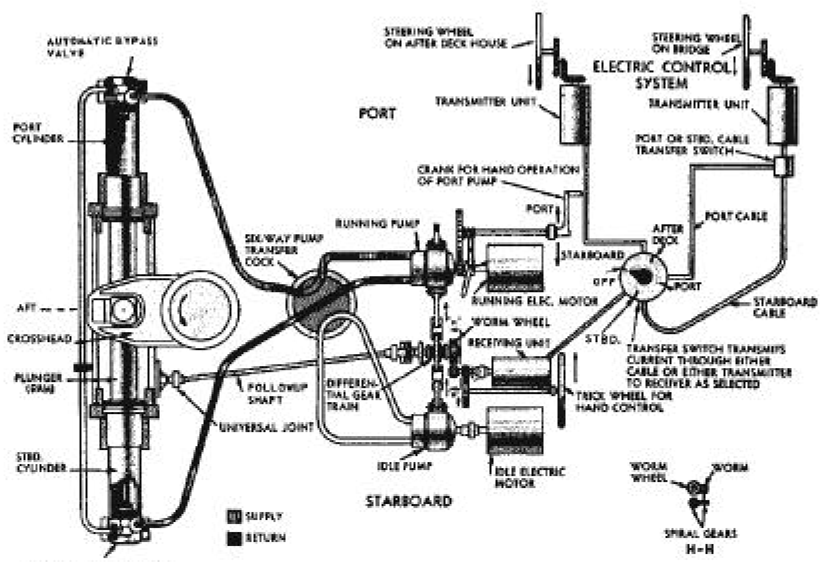
2. International Standards

The international standards for steering gear are set forth in the International Convention for the Safety of Life at Sea (SOLAS). Historically, standards have been more specific and detailed for passenger ships than for cargo ships (including tankers). SOLAS 48 requirements (Chapter II, Part F, Regulation 56) only applied to passenger ships. SOLAS 60 (Chapter II, Regulation 29) had some requirements for cargo vessels but continued to concentrate on passenger ships. The 1978 Protocol to the 1974 Convention removed the distinction between passenger and cargo ships and placed additional steering gear requirements on tankers. The first amendments to SOLAS 74/78 have further improved steering standards for all vessels. However, the problems of common systems still exist and should be recognized during vessel inspections. (For further details on SOLAS requirements, See MSM II-C4.H.3 below.)



Single-ram electrohydraulic steering gear.

G. STANDARDS AND REFERENCES

1. 46 CFR, Subchapter F (Marine Engineering)

Marine engineering requirements have not appreciably changed since 1963, when the concept of a steering station located on the after weather deck was permitted to be replaced by an alternative steering station with duplicated pilothouse controls. These requirements are as follows:

	SYSTEM COMPONENT	CFR CITE
a.	Piping	46 CFR 56
b.	Steering gear requirements	46 CFR 58.25
c.	Special steering apparatus (such as cycloidal propellers)	46 CFR 58.25-65
d.	Steering gear periodic tests	46 CFR 61.20-1
e.	Fluid control testing	46 CFR 61.20-3

2. 46 CFR, Subchapter H (Passenger Vessels)

	SUBJECT	CFR CITE
a.	Steering gear installation details	46 CFR 77.03
b.	15 Steering gear examination, testing, and logging by ship's officers	46 CFR 78.17-15
c.	Instructions for changing steering gear	46 CFR 78.47-55

3. 46 CFR, Subchapter J (Electrical Engineering)

These regulations were substantially revised in 1982. The revision reflects many recommendations of the National Transportation Safety Board (NTSB), requirements of the Port and Tanker Safety Act (PTSA) and the first amendments to SOLAS 74:

	SYSTEM COMPONENT	CFR CITE
a.	Electric steering systems and controls	46 CFR 111.93
b.	Emergency lighting in steering gear room	46 CFR 112.15-1
c.	Emergency power source for steering	46 CFR 112.15-5
d.	Communication requirements for steering gear room	46 CFR 113.30
e.	Rudder angle indicator systems	46 CFR 113.40
f.	Steering failure alarm systems	46 CFR 113.43

4. 46 CFR, Subchapter T (Small Passenger Vessels (<100 GT))

Steering gear requirements for T-Boats (Small Passenger Vessels) may be found in the following cites:

	SUBJECT	CFR CITE
a.	Examination and testing of steering system by inspector	46 CFR 176.25-35
b.	Steering gear requirements	46 CFR 182.30

5. Steering Gear, Foreign Tankers

The regulation cited in 33 CFR 164.39 contains the requirements from the PTSA. Enacted on 17 October 1978, the PTSA specifically prescribed new steering gear requirements of the 1978 Protocol to SOLAS 74, for both new and existing tankers. The requirements of the PTSA, which became a Final Rule on 19 November 1979, are applicable to U.S. tankers and foreign tankers trading in U.S. ports. These regulations, essentially the same as those adopted by the International Conference on Tanker Safety and Pollution Prevention (TSPP), apply to tankers of more than 10,000 GT. New tank vessels were required to meet additional standards after 1 June 1980. Additional requirements became effective 29 October 1984.

6. Navigation and Vessel Inspection Circular (NVIC) 1-81

NVIC 1- 81, "Guidance for Enforcement of the Requirements of the Port and Tanker Safety Act of 1978," provides a comparison of existing and new steering gear regulations.

7. International Standards

SOLAS 60 and 74

a. The 1960 and 1974 SOLAS Convention reproduced the steering standards of SOLAS 60 verbatim because final agreement had not been reached on new standards, which were under consideration at the time.

International Conference on Tanker Safety and Pollution Prevention (TSPP)

b. International Conference on Tanker Safety and Pollution Prevention (TSPP). The TSPP, held in London during 6-17 February 1978, among other important actions, recommended improved steering gear standards for tankers. These were adopted in the 1978 Protocol to SOLAS 74.

SOLAS 74/78 & Amendments

c. The 1978 Protocol to SOLAS 74 was ratified on 1 November 1980 and entered into force on 1 May 1981. Steering gear standards for tankers of more than 10,000 GT became effective for new vessels when the Protocol entered into force, and allowed an additional two years for existing tank vessels to comply. Together with SOLAS 74, these standards that are referred to as SOLAS 74/78, have been amended with an effective date of 1 September 1984.

	SUBJECT	SOLAS CITE
a.	Steering gear standards	Chapter II-1, Regulation 29
b.	Additional requirements for electric and electrohydraulic steering gears	Chapter II-1, Regulation 30
c.	Steering gear operation requirements	Chapter V, Regulation 19-1
d.	Steering gear testing requirements	Chapter V, Regulation 19-2

H. REQUIRED LOGS AND TESTS FOR ALL VESSELS

1. Steering Gear Testing and Drills

Within 12 hours of departure, or within 48 hours prior to entering U.S. waters, the ship's steering gear shall be checked and tested by the crew. The test procedure shall include, where applicable, operation of the following:

- The main steering gear;
- The auxiliary steering gear;
- The remote steering gear control system;
- The steering positions located on the navigating bridge;
- The emergency power supply;
- All rudder angle indicators in relation to the actual position of the rudder;
- All steering gear control system power failure alarms (*46 CFR 113.43)*; and
- The steering gear power failure alarms (*46 CFR 113.43)*.

> **INSPECTION NOTE:** <u>These checks and tests shall include:</u> (1) the full movement of the rudder according to the required capabilities of the steering gear; (2) a visual inspection of the steering gear and its connecting linkage; (3) and operation of the means of communication between the navigating bridge and the steering gear compartment.

2. Emergency Steering Drills

Emergency steering drills shall take place at least once every 3 months to practice emergency steering procedures. These drills shall include testing of direct control from the steering gear room, communications, and operation of any alternate power supplies. All officers concerned with the operation or maintenance of steering gear shall be familiar with the operation of the steering systems fitted on the ship, and with the procedures for changing from one system to another (see SOLAS 74/78).

3. Logging of Steering Gear Tests

All tests and inspections shall be recorded in the Official Logbook (See 33 CFR 164 and SOLAS 74/78, Chapter V, Regulation 19-2).

I. SUMMARY OF REQUIREMENTS FOR STEERING GEAR ALARMS AND INDICATORS

Alarm/Indicator	Alarm Type	Required By *
Rudder angle indicator	Visual	F, J, 164, SOLAS, AMEND
Motor pilot (running) light	Visual	J, SOLAS, AMEND
Feeder circuit breaker open	Audible	J*
Feeder circuit fuse open	Audible	J*
Motor overload	Audible & Visual	Rev. J, AMEND
Electrical power failure to steering gear control system	Audible & Visual	Rev. J, 164, Protocol, AMEND
Power failure to steering gear power unit	Audible & Visual	Rev. J, 164, Protocol, AMEND
Low hydraulic oil level	Audible & Visual	Rev. J, AMEND
Phase failure (3-phase power supply)	Audible & Visual	Rev. J, AMEND
Steering failure alarm	Audible &Visual	Rev. J

KEY:

F = 46 CFR Subchapter F
J = 46 CFR Subchapter J
Rev. J = Revisions to Subchapter J, effective 1 JUN 1982
J* = For existing vessels (i.e., contracted for prior to 1 MAY 1978), an electrical power failure alarm may be accepted as an alternate.
164 = 33 CFR 164.39 (tankers over 10,000 GT) (contains essentially the same requirements as the 1978 Protocol)
SOLAS = SOLAS 74 (same as SOLAS 60), effective 25 MAY 1980
Protocol = SOLAS Protocol (tankers only) effective 1 MAY 1981 for new tankers over 10,000 GT, and 1 MAY 1983 for existing tankers over 10,000 GT
AMEND = Amendment to SOLAS 74/78, effective 1 SEP 1984

FIGURE C4-1: Major Events Contributing to Improved Steering Gear Standards.

Date	Event
1963	46 CFR, Subchapter F is revised.
OCT 1971	Seventh Intergovernmental Maritime Consultative Organization (IMCO) Conference. 2 JUN 73 S/S SEAWITCH loses steering control due to the loss of a keeper pin in a shaft coupling to the differential echanism and collides with the S/S ESSO BRUSSELS: 16 fatalities, $23 million in damage.
6 MAY 76	CG proposes rule to require manning of steering gear room in certain waters; proposal withdrawn on 31 JAN 77 in favor of redundant system controls.
1976-1977	"Winter of the Tankers" (ARGO MERCHANT, SANSINENA, ELSA ESSBERGER). A series of disasters involving U.S. and foreign tank vessels prompts President Carter to propose tanker safety and pollution prevention initiatives, including emergency steering requirements.
24 FEB 77	S/S MARINE FLORIDIAN rams Benjamin Harrison Bridge in Virginia when steering power is lost due to a manual transfer switch jarring open.
NOV 1977	Ninth IMCO Assembly recommends improved steering gear standards.
28 JUL 77	M/V SITALA collides with moored barges near New Orleans due to loss of steering hydraulic fluid caused by leaking fittings in a single reservoir system.
6 FEB 78	IMCO sponsors International Conference on Tanker Safety and Pollution (TSPP), which accepts improved steering gear standards for SOLAS 74.
16 MAR 78	Very large crude carrier (VLCC) AMOCO CADIZ grounds off Portsall, France, following severe damage to the steering gear, after the loss of hydraulic fluid from a flange failure allows the rudder to swing free in heavy seas: millions of dollars in environmental damages, cleanup costs exceed $2 billion.
17 OCT 78	Enactment of the Port And Tanker Safety Act (PTSA).
30 AUG 79	M/V INCA CAPAC YUPANQUI collides with a moored butane barge after 0.8 ampere fuse opens on the vessel's only steering control system: 12 dead, $10.5 million in damage.
25 MAY 80	1974 SOLAS Convention enters into force.
1 MAY 81	The 1978 Protocol to SOLAS 74 comes in force.
8 APR 82	CG revises 46 CFR, Subchapter J, Electrical Engineering Regulations, and incorporates improved steering standards.
22 MAY 82	IMCO becomes the International Maritime Organization (IMO).
1 JUN 82	Effective date of revised Subchapter J for vessels contracted for after 1 MAY 1978.
1 OCT 84	First set of amendments to SOLAS 74 effective this date.
29 OCT 84	Final rule for 33 CFR 164, which incorporates provisions of 1978 TSPP Conference (Regulations 19-1 and 19-2 of SOLAS).