ANNEX 8

RESOLUTION MEPC.76(40)
adopted on 25 September 1997

STANDARD SPECIFICATION FOR SHIPBOARD INCINERATORS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(c) of the Convention on the International Maritime Organization concerning the function of the Committee,

RECALLING ALSO that Annex V of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78), provides regulations for the prevention of pollution by garbage from ships,

RECOGNIZING that the Assembly at its seventeenth session adopted resolution A.719(17) on prevention of air pollution from ships, and requested the Committee and the Maritime Safety Committee to develop environmentally based standards for incineration of garbage and other ship-generated waste,

RECOGNIZING ALSO that the Committee, at its thirty-third session, adopted resolution MEPC.59(33) - Revised Guidelines for the Implementation of Annex V of MARPOL 73/78, which included the original text of the Standard Specification for Shipboard Incinerators,

NOTING that the Conference of Parties to MARPOL 73/78, held in conjunction with MEPC 40, adopted the Protocol of 1997 to amend MARPOL 73/78, including its Annex VI - Regulations for the Prevention of Air Pollution from Ships,

BEING AWARE that the regulation 16(2) on shipboard incinerators within Annex VI to MARPOL 73/78 includes reference to mandatory operating limits for shipboard incinerators as contained in appendix IV to Annex VI and approval of such incinerators by the Administration to be based on the standard specification developed by the Organization,

ALSO BEING AWARE that regulation 16 of Annex VI of MARPOL 73/78 prohibits shipboard incineration of certain substances,

HAVING CONSIDERED the recommendations by the Sub-Committee on Ship Design and Equipment at its fortieth session regarding the Standard Specification for Shipboard Incinerators,

1. ADOPTS the Standard Specification for Shipboard Incinerators, the text of which supersedes Appendix 2 to the Revised Guidelines for the Implementation of Annex V of MARPOL 73/78, adopted by resolution MEPC.59(33), and which is set out at Annex to this resolution; and

2. URGES Governments to apply the Standard Specification for Shipboard Incinerators when implementing the provisions of Annexes V and VI of MARPOL 73/78.

ANNEX

STANDARD SPECIFICATION FOR SHIPBOARD INCINERATORS

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STANDARD SPECIFICATION FOR SHIPBOARD INCINERATORS

1 Scope

1.1 This specification covers the design, manufacture, performance, operation and testing of incinerators intended to incinerate garbage and other shipboard wastes generated during the ship's normal service.

1.2 This specification applies to those incinerator plants with capacities up to 1,500 kW per unit.

1.3 This specification does not apply to systems on special incinerator ships, e.g., for burning industrial wastes such as chemicals, manufacturing residues, etc.

1.4 This specification does not address the electrical supply to the unit, nor the foundation connections and stack connections.

1.5 This specification provides emission requirements in annex A1, and fire protection requirements in annex A2. Provisions for incinerators integrated with heat recovery units and provisions for flue gas temperature are given in annex A3 and annex A4, respectively.

1.6 This specification may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use, including possible port State limitations.

2 Definitions

2.1 Ship means a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air-cushioned vehicles, submersibles, floating craft and fixed or floating platforms.

2.2 Incinerator means shipboard facilities for incinerating solid wastes approximating in composition to household waste and liquid wastes arising from the operation of the ship, e.g., domestic waste, cargo-associated waste, maintenance waste, operational waste, cargo residues, and fishing gear, etc. These facilities may be designed to use or not to use the heat energy produced.

2.3 Garbage means all kinds of victual, domestic and operational waste excluding fresh fish and parts thereof, generated during normal operation of the ship as defined in Annex V to MARPOL 73/78.

2.4 Waste means useless, unneeded or superfluous matter which is to be discarded.

2.5 Food wastes are any spoiled or unspoiled victual substances, such as fruits, vegetables, dairy products, poultry, meat products, food scraps, food particles, and all other materials contaminated by such wastes, generated aboard ship, principally in the galley and dining areas.

2.6 Plastic means a solid material which contains as an essential ingredient one or more synthetic organic high polymers and which is formed (shaped) during either manufacture of the polymer or the fabrication into a finished product by heat and/or pressure. Plastics have material properties ranging

chamber. Neither heat, flame, nor particles should be able to pass through the observation port. An example of a safe observation port is high-temperature glass with a metal closure.

3.14 Electrical requirements[1]

3.14.1 Electrical installation requirements should apply to all electrical equipment, including controls, safety devices, cables, and burners and incinerators.

3.14.1.1 A disconnecting means capable of being locked in the open position should be installed at an accessible location at the incinerator so that the incinerator can be disconnected from all sources of potential. This disconnecting means should be an integral part of the incinerator or adjacent to it. (See 5.1)

3.14.1.2 All uninsulated live metal parts should be guarded to avoid accidental contact.

3.14.1.3 The electrical equipment should be so arranged so that failure of this equipment will cause the fuel supply to be shut off.

3.14.1.4 All electrical contacts of every safety device installed in the control circuit should be electrically connected in series. However, special consideration should be given to arrangements when certain devices are wired in parallel.

3.14.1.5 All electrical components and devices should have a voltage rating commensurate with the supply voltage of the control system.

3.14.1.6 All electrical devices and electric equipment exposed to the weather should meet the requirements of international standards acceptable to the Organization[2]

3.14.1.7 All electrical and mechanical control devices should be of a type tested and accepted by a nationally recognized testing agency, according to international standards.

3.14.1.8 The design of the control circuits should be such that limit and primary safety controls should directly open a circuit that functions to interrupt the supply of fuel to combustion units.

3.14.2 Overcurrent protection

3.14.2.1 Conductors for interconnecting wiring that is smaller than the supply conductors should be provided with overcurrent protection based on the size of the smallest interconnecting conductors external to any control box, in accordance with the requirements of international standards acceptable to the Organization[3].

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[1] International Electrotechnical Commission (IEC) Standards, particularly IEC Publication 92 - Electrical Installations in Ships and Mobile and Fixed Offshore Units, are applicable for this equipment.

[2] Refer to IEC Publication 92-201, Table V (1980 edition).

[3] Refer to IEC Publication 92-202 (1980 edition with amendment).

3.14.2.2 Overcurrent protection for interconnecting wiring should be located at the point where the smaller conductors connect to the larger conductors. However, overall overcurrent protection is acceptable if it is sized on the basis of the smallest conductors of the interconnecting wiring, or in accordance with the requirements of international standards acceptable to the Organization[4].

3.14.2.3 Overcurrent protection devices should be accessible and their function should be identified.

3.14.3 Motors

3.14.3.1 All electric motors should have enclosures corresponding to the environment where they are located, at least IP 44, in accordance with the requirements of international standards acceptable to the Organization[5].

3.14.3.2 Motors should be provided with a corrosion-resistant nameplate specifying information in accordance with the requirements of international standards acceptable to the Organization[6].

3.14.3.3 Motors should be provided with running protection by means of integral thermal protection, by overcurrent devices, or a combination of both in accordance with manufacturer's instruction that should meet the requirements of international standards acceptable to the Organization[7].

3.14.3.4 Motors should be rated for continuous duty and should be designed for an ambient temperature of 45 °C or higher.

3.14.3.5 All motors should be provided with terminal leads or terminal screws in terminal boxes integral with, or secured to, the motor frames.

3.14.4 Ignition system

3.14.4.1 When automatic electric ignition is provided, it should be accomplished by means of either a high-voltage electric spark, a high-energy electric spark, or a glow coil.

3.14.4.2 Ignition transformers should have an enclosure corresponding to the environment where they are located, at least IP 44 in accordance with the requirements of international standards acceptable to the Organization[8].

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[4] Refer to IEC Publication 92-202 (1980 edition with amendment).

[5] Refer to IEC Publication 529 (1976 edition with amendment).

[6] Refer to IEC Publication 92-301 (1980 edition).

[7] Refer to IEC Publication 92-202 (1980 edition with amendment).

[8] Refer to IEC Publication 529 (1976 edition with amendment).

3.14.4.3 Ignition cable should meet the requirements of international standards acceptable to the Organization[9].

3.14.5 Wiring

3.14.5.1 All wiring for incinerators should be rated and selected in accordance with the requirements of international standards acceptable to the Organization[10].

3.14.6 Bonding and grounding

3.14.6.1 Means should be provided for grounding the major metallic frame or assembly of the incinerators.

3.14.6.2 Noncurrent carrying enclosures, frames and similar parts of all electrical components and devices should be bonded to the main frame or assembly of the incinerator. Electrical components that are bonded by their installation do not require a separate bonding conductor.

3.14.6.3 When an insulated conductor is used to bond electrical components and devices, it should show a continuous green colour, with or without a yellow stripe.

4 Operating requirements

4.1 The incinerator system should be designed and constructed for operation with the following conditions:

Maximum combustion chamber flue gas outlet temperature	1,200°C
Minimum combustion chamber flue gas outlet temperature	850°C
Preheat temperature of combustion chamber	650°C

For Batch Loaded Incinerators, there are no preheating requirements. However, the incinerator should be designed that the temperature in the actual combustion space should reach 600°C within 5 minutes after start.

Prepurge, before ignition:	at least 4 air changes in the chamber(s) and stack, but not less than 15 seconds.

[9] Refer to IEC Publication 92-503 (1975 edition).

[10] Refer to IEC Publication 92-352 (1979 edition with amendments).

Time between restarts:	at least 4 air changes in the chamber(s) and stack, but not less than 15 seconds.
Postpurge, after shut-off fuel oil:	not less than 15 seconds after the closing of the fuel oil valve.
Incinerator discharge gases:	Minimum 6% 0_2 (measured in dry flue gas).

4.2 Outside surface of combustion chamber(s) should be shielded from contact such that people in normal work situations will not be exposed to extreme heat (20°C above ambient temperature) or direct contact of surface temperatures exceeding 60°C. Examples for alternatives to accomplish this are a double jacket with an air flow in between or an expanded metal jacket.

4.3 Incinerating systems are to be operated with underpressure (negative pressure) in the combustion chamber such that no gases or smoke can leak out to the surrounding areas.

4.4 The incinerator should have warning plates attached in a prominent location on the unit, warning against unauthorized opening of doors to combustion chamber(s) during operation and against overloading the incinerator with garbage.

4.5 The incinerator should have instruction plate(s) attached in a prominent location on the unit that clearly addresses the following:

4.5.1 Cleaning ashes and slag from the combustion chamber(s) and cleaning of combustion air openings before starting the incinerator (where applicable).

4.5.2 Operating procedures and instructions. These should include proper start-up procedures, normal shut-down procedures, emergency shut-down procedures, and procedures for loading garbage (where applicable).

4.6 To avoid building up of dioxins, the flue gas should be shock-cooled to a maximum 350°C within 2.5 metres from the combustion chamber flue gas outlet.

5 Operating controls

5.1 The entire unit should be capable of being disconnected from all sources of electricity by means of one disconnect switch located near the incinerator. (See 3.14.1.1)

5.2 There should be an emergency stop switch located outside the compartment which stops all power to the equipment. The emergency stop switch should also be able to stop all power to the fuel pumps. If the incinerator is equipped with a flue gas fan, the fan should be capable of being restarted independently of the other equipment on the incinerator.

5.3 The control equipment should be so designed that any failure of the following equipment will prevent continued operations and cause the fuel supply to be cut off.

7.2 Factory tests

For each unit, if preassembled, an operating test should be conducted to ensure that all of the control components have been properly installed and that all parts of the incinerator, including controls and safety devices, are in satisfactory operating condition. Tests should include those described in 7.3 below.

7.3 Installation tests

An operating test after installation should be conducted to ensure that all of the control components have been properly installed and that all parts of the incinerator, including controls and safety devices, are in satisfactory operating condition. The requirements for prepurge and time between restarts referred to in 4.1 should be verified at the time of the installation test.

7.3.1 Flame safeguard. The operation of the flame safeguard system should be verified by causing flame and ignition failures. Operation of the audible alarm (where applicable) and visible indicator should be verified. The shutdown times should be verified.

7.3.2 Limit controls. Shutdown due to the operation of the limit controls should be verified.

7.3.2.1 Oil pressure limit control. The lowering of the fuel oil pressure below the value required for safe combustion should initiate a safety shutdown.

7.3.2.2 Other interlocks. Other interlocks provided should be tested for proper operation as specified by the unit manufacturer.

7.3.3 Combustion controls. The combustion controls should be stable and operate smoothly.

7.3.4 Programming controls. Programming controls should be verified as controlling and cycling the unit in the intended manner. Proper prepurge, ignition, postpurge, and modulation should be verified. A stopwatch should be used for verifying intervals of time.

7.3.5 Fuel supply controls. The satisfactory operation of the two fuel control solenoid valves for all conditions of operation and shutdown should be verified.

7.3.6. Low voltage test. A low voltage test should be conducted on the incinerator unit to satisfactorily demonstrate that the fuel supply to the burners will be automatically shut off before an incinerator malfunction results from the reduced voltage.

7.3.7 Switches. All switches should be tested to verify proper operation.

8 Certification

8.1 Manufacturer's certification that an incinerator has been constructed in accordance with this standard should be provided (by letter, certificate, or in the instruction manual).

9 Marking

9.1 Each incinerator should be permanently marked indicating:

9.1.1 Manufacturer's name or trademark.

9.1.2 Style, type, model or other manufacturer's designation for the incinerator.

9.1.3 Capacity - to be indicated by net designed heat release of the incinerator in heat units per timed period; for example, British Thermal Units per hour, megajoules per hour, kilocalories per hour.

10 Quality assurance

Incinerators should be designed, manufactured and tested in a manner that ensures they meet the requirements of this standard.

A1 - EMISSION STANDARD FOR SHIPBOARD INCINERATORS WITH CAPACITIES OF UP TO 1,500 kW

Minimum information to be provided

A1.1 An IMO TYPE APPROVAL CERTIFICATE should be required for each shipboard incinerator. In order to obtain such certificate, the incinerator should be designed and built to an IMO approved standard. Each model should go through a specified type approval test operation at the factory or an approved test facility, and under the responsibility of the Administration.

A1.2 TYPE APPROVAL TEST SHOULD INCLUDE MEASURING OF THE FOLLOWING PARAMETERS:

Max capacity	:	kW or kcal/h kg/h of specified waste kg/h per burner
Pilot fuel consumption : kg/h per burner		
O_2 Average in combustion chamber/zone	:	%
CO Average in flue gas	:	mg/MJ
Soot number average	:	Bacharach or ringelman Scale
Combustion chamber flue gas outlet temperature average	:	°C
Amount of unburned components in ashes	:	% by weight

A1.3 DURATION OF TEST OPERATION

For sludge oil burning	:	6-8 hours
For solid waste burning	:	6-8 hours

A1.4 FUEL/WASTE SPECIFICATION FOR TYPE APPROVAL TEST (% BY WEIGHT)

Sludge oil consisting of:	75% sludge oil from heavy fuel oil 5% waste lubricating oil 20% emulsified water
Solid waste (class 2) consisting of:	50% Food Waste 50% rubbish Containing Approx. 30% paper, " 40% Cardboard, " 10% Rags, " 20% Plastic The mixture will have up to 50% moisture and 7% incombustible solids

Classes of waste

Reference: Waste Classification from Incinerator Institute of America (Information for type approval tests only)

Class 2 Refuse, consisting of approximately even mixture of rubbish and garbage by weight. This type waste is common to passenger ships occupancy, consisting of up to 50% moisture, 7% incombustible solids and has a heating value of about 10,000 kJ/kg as fired.

Calorific values	**kJ/Kg**	**kcal/kg**
Vegetable and putrescibles	5,700	1,360
Paper	14,300	3,415
Rag	15,500	3,700
Plastics	36,000	8,600
Oil sludge	36,000	8,600
Sewage sludge	3,000	716

Densities	**kg/m^3**
Paper (loose)	50
Refuse (75% wet)	720
Dry rubbish	110
Scrap wood	190
Wood sawdust	220

Density of loose general waste generated on board ship will be about 130 kg/m^3.

A1.5 REQUIRED EMISSION STANDARDS TO BE VERIFIED BY TYPE APPROVAL TEST

O_2 in combustion chamber	6 - 12%
CO in flue gas maximum average	200 mg/MJ
Soot number maximum average	BACHARACH 3 or RINGELMAN 1 (A higher soot number is acceptable only during very short periods such as starting up)
Unburned components in ash residues	Max 10% by Weight
Combustion chamber flue gas outlet temperature range	850 - 1200°C

Flue gas outlet temperature and O_2 content should be measured during the combustion period, and not during the preheating or cooling periods. For a batch loaded incinerator, it is acceptable to carry out the type approval test by means of a single batch.

A high temperature in the actual combustion chamber/zone is an absolute requirement in order to obtain a complete and smoke free incineration, including that of plastic and other synthetic materials while minimizing DIOXINE, VOC (Volatile Organic Compounds), and emissions.

A1.6 FUEL RELATED EMISSION

A1.6.1 Even with good incineration technology the emission from an incinerator will depend on the type of material being incinerated. If for instance a vessel has bunkered a fuel with high sulphur content, then sludge oil from separators which is burned in the incinerator will lead to emission of SOx. But again, the SOx emission from the incinerator would only amount to less than one per cent of the SOx discharged with the exhaust from main and auxiliary engines.

A1.6.2 Principal organic constituents (POC) cannot be measured on a continuous basis. Specifically, there are no instruments with provision for continuous time telemetry that measures POC, HCl, or waste destruction efficiency, to date. These measurements can only be made using grab sample approaches where the sample is returned to a laboratory for analysis. In the case of organic constituents (undestroyed wastes), the laboratory work requires considerable time to complete. Thus, continuous emission control can only be assured by secondary measurements.

A1.6.3 ON-BOARD OPERATION/EMISSION CONTROL

For a shipboard incinerator with IMO TYPE APPROVAL, emission control/monitoring should be limited to the following:

.1 Control/monitor O_2 content in combustion chamber (spot checks only; an O_2 content analyser is not required to be kept on board).

.2 Control/monitor temperature in combustion chamber flue gas outlet.

By continuous (auto) control of the incineration process, ensure that the above mentioned two parameters are kept within the prescribed limits. This mode of operation will ensure that particulates and ash residue contain only traces of organic constituents.

A1.7 PASSENGER/CRUISE SHIPS WITH INCINERATOR INSTALLATIONS HAVING A TOTAL CAPACITY OF MORE THAN 1,500 kW

A1.7.1 On board this type of vessel, the following conditions will probably exist:

.1 Generation of huge amounts of burnable waste with a high content of plastic and synthetic materials.

.2 Incinerating plant with a high capacity operating continuously over long periods.

.3 This type of vessel will often be operating in very sensitive coastal areas.

A1.7.2 In view of the fuel related emission from a plant with such a high capacity, installation of a flue gas sea water scrubber should be considered. This installation can perform an efficient after-cleaning of the flue gases, thus minimizing the content of:

HCl
SOx
PARTICULATE MATTER

A1.7.3 Any restriction on NITROGEN OXIDE (NOx) should only be considered in connection with possible future regulations on pollution from the vessel's total pollution, i.e., main and auxiliary machinery, boilers, etc.

A2 - FIRE PROTECTION REQUIREMENTS FOR INCINERATORS AND WASTE STOWAGE SPACES

For the purpose of construction, arrangement and insulation, incinerator spaces and waste stowage spaces should be treated as category A machinery spaces (SOLAS II-2/3.19) and service spaces, (SOLAS II-2/3.12), respectively. To minimize the fire hazards these spaces represent, the following SOLAS requirements in chapter II-2 should be applied:

A2.1 For passenger vessels carrying more than 36 passengers:

.1 regulation 26.2.2(12) should apply to incinerator and combined incinerator/waste storage spaces, and the flue uptakes from such spaces; and

.2 regulation 26.2.2(13) should apply to waste storage spaces and garbage chutes connected thereto.

A2.2 For all other vessels including passenger vessels carrying not more than 36 passengers:

.1 regulation 44.2.2(6) should apply to incinerator and combined incinerator/waste spaces, and the flue uptakes from such spaces; and

.2 regulation 44.2.2(9) should apply to waste storage spaces and garbage chutes connected thereto.

A2.3 Incinerators and waste stowage spaces located on weather decks (regulation II-2/3.(17)) need not meet the above requirements but should be located:

.1 as far aft on the vessel as possible;

.2 not less than 3 m from entrances, air inlets and openings to accommodations, service spaces and control stations;

.3 not less than 5 m measured horizontally from the nearest hazardous area, or vent outlet from a hazardous area; and

.4 not less than 2 m should separate the incinerator and the waste material storage area, unless physically separated by a structural fire barrier.

A2.4 A fixed fire detection and fire-extinguishing system should be installed in enclosed spaces containing incinerators, in combined incinerator/waste storage spaces, and in any waste storage space in accordance with the following table:

	Automatic sprinkler system	Fixed fire-extinguishing system	Fixed fire detection system
Combined incinerator and waste storage space	X		
Incinerator space		X	X
Waste storage space	X		

A2.5 Where an incinerator or waste storage space is located on weather decks it must be accessible with two means of fire extinguishment; either fire hoses, semi-portable fire extinguishers, fire monitors or combination of any two of these extinguishing devices. A fixed fire-extinguishing system is acceptable as one means of extinguishment.

A2.6 Flue uptake piping/ducting should be led independently to an appropriate terminus via a continuous funnel or trunk.

A3 - INCINERATORS INTEGRATED WITH HEAT RECOVERY UNITS

A3.1 The flue gas system, for incinerators where the flue gas is led through a heat recovery device, should be designed so that the incinerator can continue operation with the economizer coils dry. This may be accomplished with bypass dampers if needed.

A3.2 The incinerator unit should be equipped with a visual and an audible alarm in case of loss of feed-water.

A3.3 The gas-side of the heat recovery device should have equipment for proper cleaning. Sufficient access should be provided for adequate inspection of external heating surfaces.

A4 - FLUE GAS TEMPERATURE

A4.1 When deciding upon the type of incinerator, consideration should be given as to what the flue gas temperature will be. The flue gas temperature can be a determining factor in the selection of materials for fabricating the stack. Special high temperature material may be required for use in fabricating the stack when the flue gas temperatures exceed 430°C.

ANNEX

FORM OF IMO TYPE APPROVAL CERTIFICATE FOR SHIPBOARD INCINERATORS WITH CAPACITIES OF UP TO 1,500 KW

CERTIFICATE OF SHIPBOARD INCINERATOR

NAME OF ADMINISTRATION

BADGE
OR
CYPHER

This is to certify that the shipboard incinerator listed has been examined and tested in accordance with the requirement of the standard for shipboard incinerators for disposing of ship-generated waste appended to the Guidelines for the Implementation of Annex V of MARPOL 73/78.

Incinerator manufactured by .....
Style, type or model for the incinerator* .....

Max. capacity	.....	kW or kcal/h
	.....	kg/h of specified waste
	.....	kg/h per burner
0_2 Average in combustion chamber/zone	.....	%
CO Average in flue gas	.....	mg/MJ
Soot number average	.....	Bacharach or ringelman scale
Combustion chamber flue gas outlet temperature average	.....	°C
Amount of unburned components in ashes	.....	% by weight

A copy of this certificate should be carried on board a vessel fitted with this equipment at all times.

Signed .....
Official stamp Administration of .....
.....
Dated this ..... day of ..... 19 ..

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* Delete as appropriate

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