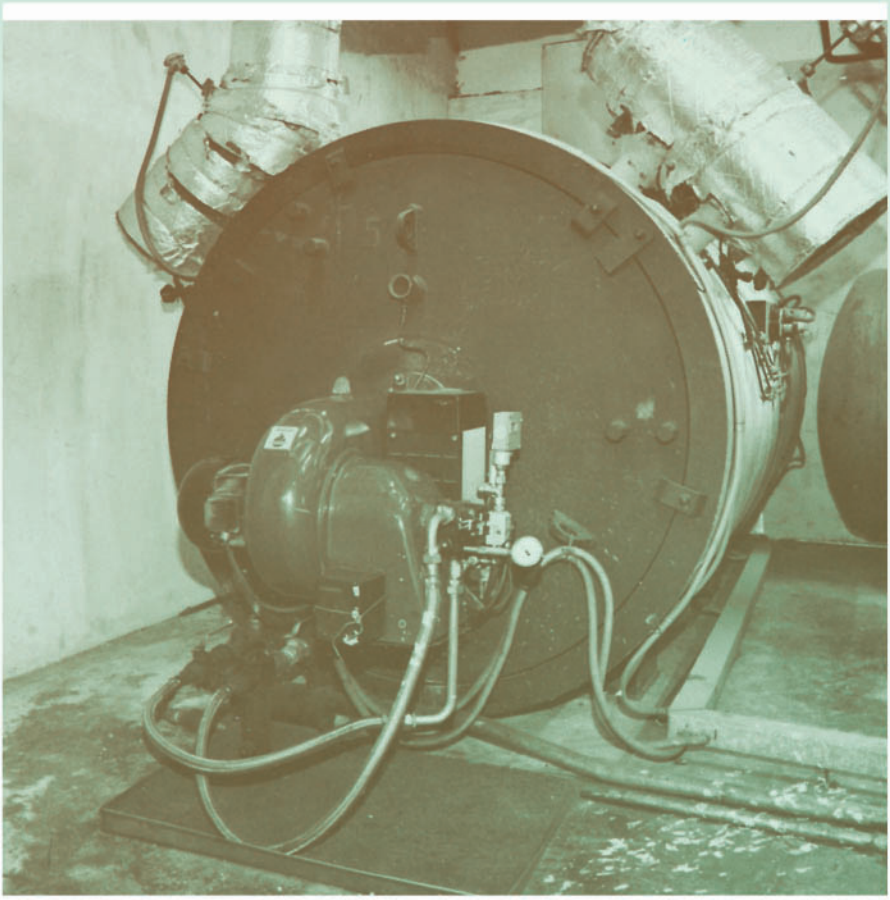
CODE OF PRACTICE FOR THERMAL OIL HEATERS

Issued under Section 18A of
the Boilers and Pressure Vessels Ordinance



Occupational Safety and Health Branch
Labour Department

CODE OF PRACTICE
FOR
THERMAL OIL HEATERS

(Issued under Section 18A of the
Boilers and Pressure Vessels Ordinance)

Boilers & Pressure
Vessels Authority
Hong Kong
1992

CONTENTS

INTRODUCTION

I. The Boilers and Pressure Vessels Ordinance, Cap. 56, sets out inter alia the provisions to control the use and operation of boilers and pressure vessels. The boilers, as defined in the Ordinance, cover the equipment also referred to as thermal oil heaters in the industry.

II. This Code of Practice is issued in pursuant to Section 18A of the Ordinance for the purpose of the ensuring acceptable standards in the design, manufacture, installation, maintenance, examination, testing and operation of boilers and pressure vessels.

III. This Code explains the main provisions of the Ordinance as applicable to thermal oil heaters. Insufficient knowledge of statutory requirements and lack of good operating practice has caused fatal accidents. Personnel engaged in the use of this equipment are advised to familiarise themselves with this Code.

IV. Under Section 18A(2) of the Ordinance, any person who fails to observe the provisions of this Code shall not render himself liable to criminal proceedings of any kind, but any such failure may, in any proceedings whether civil or criminal and including proceedings for an offence under the Boilers and Pressure Vessels Ordinance, be relied upon by any party to the proceedings as tending to establish or to negative any liability which is in question in those proceedings.

V. All references to the "Authority" in the Code refer to the "Boilers and Pressure Vessels Authority".

VI. The Boilers and Pressure Vessels Authority, currently the Commissioner for Labuor, has delegated certain powers under the Ordinance to the Principal Surveyor of the Pressure Equipment Division, Labour Department. Enquires may, therefore, be directed to the Principal Surveyor or his staff.

CHAPTER 1

GENERAL

CURRENT LEGISLATION

1.1 Provisions are made in law to control the use and operation of boilers and pressure vessels, to provide for the holding of inquiries into accidents in or to boilers and pressure vessels and to provide for all other connected matters. This is through:-

(a) Boilers and Pressure Vessels Ordinance, Cap.56;

(b) Boilers and Pressure Vessels Regulations;

(c) Boilers and Pressure Vessels (Forms) Order; and

(d) Boilers and Pressure Vessels (Exemption) (Consolidation) Order.

Copies of the above can be purchased from any of the Government Publications Sales Centres.

POWERS OF THE AUTHORITY AND THE AUTHORISED OFFICERS

1.2 The Authority may authorize in writing any public officer to perform or exercise all or any of the functions, duties and powers which are imposed or conferred on the Authority or an authorized officer. In the discharge of the above legal responsibilities, the Authority and the authorized officer shall have the following powers:-

(a) at any time to enter any premises or place in which he knows or has reason to believe that there is a thermal oil heater;

(b) at any time, to examine and test any thermal oil heater and its auxiliary equipment;

(c) to require the production of any document, certificate or Certificate of Fitness concerned with the thermal oil heater and to make copies of the same; and

(d) to require any person to answer each inquiries as he considers it necessary to make.

REGISTRATION OF A THERMAL OIL HEATER

1.3 The owner of a new thermal oil heater shall, not less than 30 days before he intends to put the thermal oil heater into use, deliver to the Authority:-

(a) one copy of the maker's certificate and one copy of the certificate of inspection during construction issued in respect of the thermal oil heater by a recognized inspection body; or

(b) documentary evidence, to the satisfaction of the Authority, that the thermal oil heater complies with a recognized engineering standard or code in respect of:-

(i) the welders employed and welding procedures used in the construction and erection of and, if repairs have been carried out, in the repairs to, the thermal oil heater;

(ii) heat treatment before and after welding;

(iii) tests and inspections carried out on the thermal oil heater;

(iv) kind and grade of material used in the pressure parts of the thermal oil heater;

(v) any other relevant technical details that the Authority may, by notice in writing, specify; or

(c) where the owner cannot deliver either the documents referred to in paragraph (a) or the documents referred to in paragraph (b), details of the design and methods of construction, inspection and testing of the thermal oil heater and its auxiliary equipment.

1.4 All above documents must be endorsed by a Boiler Inspector to the effect that they relate to the equipment under registration. Where a document is not written in English or Chinese, it should be accompanied by an English translation. If these documents are not produced or do not give the Authority sufficient information to enable him to assess the maximum permissible working pressure, he may require the owner to have the thermal oil heater surveyed by a Boiler Inspector for collecting manufacturing and other details required in the preparation of documents for registration of the boiler.

1.5 On completion of the necessary formalities described in the above paragraphs the Authority will register the thermal oil heater and allot a registration number which must be engraved by the owner in a conspicuous position on the equipment before it is put into use.

1.6 Forms of application for registration can be obtained free from the Pressure Equipment Division (PED) of the Labour Department.

CERTIFICATE OF COMPETENCY

1.7 The Authority may, upon application in writing, together with documentary proof of passing a recognized examination and upon payment of a prescribed fee, issue a Certificate of Competency to any person who satisfies him of his suitability to operate thermal oil heaters.

1.8 Incorrect operation of thermal oil heater and its fittings can cause accidents resulting in injury or loss of life.

1.9 The Ordinance requires that a Competent Person must be present at all times to directly supervise the operation of the thermal oil heater to ensure safety in its operation. An employer should arrange for additional persons to receive the necessary training and to obtain Certificate of Competency so that such persons can stand in as a relief person during the absence of the boiler operator. In no circumstances whatsoever should a thermal oil heater be operated without a competent boiler operator.

1.10 The Competent Person who operates or supervises the operation of thermal oil heaters must be in possession of a valid Certificate of Competency issued by the Authority. Appendix I lists the equipment which holders of different Certificates of Competency can operate.

PERIODIC EXAMINATION

1.11 All thermal oil heaters must be properly maintained in accordance with provisions laid down in the Ordinance and its Subsidiary Regulations and must be examined periodically by a Boiler Inspector. The interval between examinations for most thermal oil heaters is 14 months.

CERTIFICATE OF FITNESS

1.12 Section 33 of the Ordinance prescribes the conditions for issue by a Boiler Inspector of a Certificate of Fitness for a thermal oil heater. If the Boiler Inspector is satisfied with the condition of the equipment which he has examined, he should issue a Certificate of Fitness for the same on a prescribed form and deliver two copies of this certificate to the owner. The owner must then deliver the two copies of this certificate to the Authority within 7 days. The original Certificate of Fitness must be kept in the premises where the thermal oil heater is installed.

1.13 Section 49(1) of the Ordinance allows an equipment to be operated only when its Certificate of Fitness is still valid.

CLOSURE ORDER

1.14 The Authority may, by notice in writing served upon the owner, issue a closure order to prohibit further use of a pressure equipment where it appears that:-

(a) a boiler or any of its auxiliary equipment is not, or may not be, in safe working order;

(b) a boiler or any of its auxiliary equipment has not been examined or tested in accordance with this Ordinance;

(c) a boiler is being, or has been operated at a pressure greater than its approved maximum permissible working pressure; or

(d) the seal attached to a safety valve by a Boiler Inspector has been broken or the setting of a safety valve has been altered by a person who is not a Boiler Inspector.

1.15 Upon receiving the closure order, the owner and the operator must stop using the boiler immediately and rectify the faults for which the closure order is issued. The owner should engage a Boiler Inspector to examine thoroughly the equipment and issue a fresh Certificate of Fitness. This Certificate of Fitness should be produced to the Authority, who will permit the resumption of the use of the equipment concerned.

SALE, HIRE OR REMOVAL OF APPLIANCES

1.16 If a thermal oil heater is hired or sold, the owner must notify the Authority within 7 days of the name and address of the person to whom it has been hired or sold, and must report whether the sale or hiring involves removal.

1.17 Any thermal oil heater which has been removed either to new premises or to another part of the same premises must be examined by a Boiler Inspector before it is put into use again. The owner should also notify the Authority the new installation address.

1.18 The owner of a registered thermal oil heater must notify the Authority within 7 days if he changes his address.

EXAMINATION AFTER EXTENSIVE REPAIRS

1.19 If extensive repairs have been carried out to a boiler or to its auxiliary equipment, fittings and attachments, the boiler must be examined by a Boiler Inspector and issued with a Certificate of Fitness before being put back into use. Extensive repairs means alterations or welding repairs to the pressure parts of the boiler or its controls and safety devices.

ACCIDENTS

1.20 If an accident occurs to a boiler or to its auxiliary equipment or if the owner becomes aware of any defect that is likely to endanger life or property, he must at once take the equipment out of use and notify the Authority of the accident or defect within 24 hours. A copy of the latest Certificate of Fitness must be sent to the Authority at the same time together with detailed information abut the equipment and the accident or defect. (See Chapter Six of this Code)

OFFENCES AND PENALTIES

1.21 The Ordinance and the Regulations set forth penalties for various breaches as briefly summarised below:-

Section 15A
Failure to submit application for registration.
Maximum fine:- $10,000

Section 22
Failure to ensure the proper maintenance of pressure vessel.
Maximum fine:- $20,000

Section 49(1)
Operating boiler/pressure vessel not having been examined in accordance with the Ordinance.
Maximum fine:- $30,000

Section 49(6)
Failure to comply with prohibition order issued by the Authority.
Maximum fine:- $50,000

Section 49(7)
Operating boiler/steam receiver without the direct supervision of competent persons.
Maximum fine:- $30,000

Section 55
Utters or makes use of any notice, form or document knowing the same to be forged or false.
Maximum fine:- $10,000 and imprisonment for 12 months

Section 56
Corruptly solicits or receives any advantage whatsoever as an inducement for certification or forbearing to make any report or notification required to be made under the Ordinance.
Maximum fine:- $50,000 and imprisonment for 5 years

Regulation 4(1)(a)
Steam receiver not fitted with suitable steam reducing valve.
Maximum fine:- $10,000

CHAPTER 2

ESSENTIALS OF THERMAL OIL HEATER

GENERAL

2.1 Thermal oil heaters have been involved in serious accidents abroad. The induction of this equipment in Hong Kong is of relatively recent origin and, as such, should be operated with great care. The personnel engaged in operation and maintenance of these heaters should be fully conversant with correct operating procedures and safety devices as given in the makers manual. The essentials of operational and safety information on this equipment is given below.

DESCRIPTION OF THE SYSTEM

2.2 Thermal oil heater is a heat carrier (thermal oil) heating plant comprised of a heater, circulation pump, expansion tank, storage tank, deaerator, piping and a control panel.

2.3 Thermal oil heater is usually of the tube coil type. It can be heated electrically or fired by oil fuel or gas to raise temperature of the thermal oil.

2.4 Thermal oil which circulates through the system is firstly raised to a temperature of about 300 degree C in the heater. The heated fluid is then circulated through the system and the heat energy is transferred to the heat consuming devices. The heat energy of the thermal oil is then utilized for heating purposes. A temperature drop of approximately 40 degree C in the consumers is usually anticipated. After the heat has been absorbed, the thermal oil is returned to the heater by means of a circulating pump.

2.5 An expansion tank is provided in the system to take up expansion of the thermal oil when it is heated. A deaerator is sometimes installed for removing air in the system. A storage tank, having a capacity sufficient to contain all the oil in the system, is also installed. In case of any emergency or repairs, the entire contents in the system can be emptied into this storage tank.

REQUIREMENTS OF HEAT CARRIERS

2.6 The main requirements for an ideal heat carrier are:-

(a) high boiling pint;

(b) low solidification temperature;

(c) good thermal stability;

(d) low viscosity;

(e) good heat transfer properties;

(f) low corrosion tendency;

(g) non toxic and odourless; and

2.7 Commonly used thermal oils have the following significant advantages over water:-

(a) higher boiling point at atmospheric pressure;

(b) low tendency for corrosion or formation of scale;

(c) no need to carry out regular treatment; and

(d) no expansion during solidification.

2.8 The properties of typical heat carrier are:-

Density at 200 ˚C	760 Kg/cm^3
Specific Thermal Capacity	2.4 kJ/kgK
Flash Point	180 ˚C
Ignition Point	370 ˚C
Boiling Point	330 ˚C
Pour Point	-18 ˚C
Coefficient of Thermal Expansion	0.00076/ ˚C

SAFETY VALVE

2.9 Its function is to prevent the thermal oil heater from operating at a pressure exceeding the maximum permissible working pressure.

2.10 It should be connected directly to an independent oil outlet of the thermal oil heater and no valve should be placed in between. The safety valve should be vertically placed.

2.11 An easing gear is usually fitted in order to lift the valve from its seat. When fitted with an easing gear, it should be actuated once a day and the valve should be tested by oil pressure every week.

FLUE GAS TEMPERATURE LIMITER

2.12 It is installed to safeguard against thermal overload of the thermal oil heaters that utilize liquid or gaseous fuel as the heating medium. It also indicates leakage of thermal fluid into the combustion chamber, if any, since the burning of thermal oil will form soot which will foul the heating surface thus producing higher flue gas temperatures.

FLAME DETECTOR

2.13 When flame failure occurs in a thermal oil heater fired by diesel oil fuel or gas, a detector will sense the loss of fire and actuate the cutout device to shut off the fuel supply to the burner in order to avoid any accumulation of flammable gas/vapour inside the furnace.

2.14 Functional tests of the flame detector should be carried out daily, and recorded, by withdrawing the sensor from the socket and covering it to simulate a flame failure. Fuel should be shut off automatically and immediately.

THERMAL OIL HIGH TEMPERATURE CUTOUT ALARM

2.15 It is a temperature switch which is used to safeguard the physical properties of the thermal oil and prevent the thermal oil heater from overheating. Overheating will lead to rapid deterioration of the thermal oil.

2.16 One method of testing this switch is to set the working temperature at a higher level by changing the setting value of the control thermostat. The thermostat set value must be brought back to the normal value after testing.

THERMAL OIL FLOW LIMITER

2.17 It is in a form of differential pressure switch installed at the oil outlet from the heater. If the flow of the heat carrier is interrupted by any blockage found inside the oil pipe or by failure of the circulating pump, the burner will be shut down.

EXPANSION TANK LOW OIL LEVEL CUTOUT

2.18 Any loss of thermal oil due to leakage can be indicated by this device which will cut out the fuel supply to the burner. The leakage is usually found on boiler tubes, shaft seals of circulating pump, pipeline and flanges of the system. If the leakage happens inside the heater furnace, explosion may occur.

THERMAL OIL HEATER CONTROL

2.19 The main parameter for control of a thermal oil heater is the operating temperature. The role of the operating pressure, is not so prominent because any change of pressure will not affect the operating temperature of the system. Furthermore the pressure in the system is basically the discharge pressure of the circulating pump only.

2.20 When the temperature of the heat carrier inside the equipment has attained the upper temperature setting limit, the heat input will be stopped but the circulating pump continues running. When the temperature of the heater carrier has attained the lower temperature setting limit, the burner will again be actuated by the thermostat.

CHAPTER 3

OPERATION AND MAINTENANCE

REQUIREMENTS OF COMPETENT PERSON

3.1 Thermal oil heaters, like other type of boiler, must be operated under direct supervision of a competent person who possesses a relevant Certificate of Competency.

PREPARATION PRIOR TO FLASHING UP A THERMAL OIL HEATER

3.2 The following procedures are to be followed prior to flashing of a thermal oil heater:-

(a) Read and be fully conversant with the detailed operating instruction for the thermal oil heater and its auxiliaries;

(b) Check Certificate of Fitness of the concerned thermal oil heater for the validity date, maximum permissible working pressure and maximum permissible working temperature;

(c) Check the thermal oil heater and its associated equipment to ensure that they are in normal working condition;

(d) Check if the fuel system including fuel oil tank and valves are in order;

(e) Clean all the filters located in fuel oil lines and heat carrier lines;

(f) Check if the oil level at the expansion tank is normal and all the pipelines are free of obstruction;

(g) Check if the electrical system is in order;

(h) Check if the boiler room is clean and well ventilated; and

(i) Check for the availability of fire extinguishing equipment.

PROCEDURE FOR FLASHING UP A THERMAL OIL HEATER FIRED BY OIL OR GAS

3.3 Before the fuel discharged from the burner is ignited, the furnace must be thoroughly purged in order to expel any explosive mixture accumulated inside the furnace. The purging process must be repeated each time the firing sequence is commenced.

3.4 The time required to raise the temperature of a cold thermal oil heater to the required operating temperature should follow the maker's recommendation.

OBSERVATION DURING OPERATION

3.5 The following observations should be made and monitored constantly when operating a thermal oil heater:-

(a) pressure, temperature and flow rate of the heat carrier;

(b) oil level at the expansion tank;

(c) combustion condition inside the furnace (for oil or gas fired units);

(d) noise and water hammer found in the pipeline due to the presence of water in the thermal oil system;

(e) the temperature difference between outlet and inlet of the heater;

(f) any leakage found at pipelines, level gauge, flanges and shaft seals of the circulating pump; and

(g) the running condition of the circulating pump.

OPERATIONAL DATA

3.6 The following readings should be recorded at regular intervals:-

(a) inlet and outlet temperature of thermal oil from heater;

(b) thermal fluid pressure of pump and heater;

(c) flow rate of thermal fluid;

(d) level at expansion tank;

(e) thermal fluid differential pressure between inlet and outlet of strainer;

(f) flue gas temperature; and

(g) coolant outlet temperature of circulating pump.

GENERAL PRECAUTIONS WHEN OPERATING A THERMAL OIL HEATER

3.7 The operator should observe the following precautions when operating a thermal oil heater:-

(a) Do not break the safety valve seal or try to adjust the setting of the safety valve.

(b) Do not try to adjust the setting of the safety devices such as high temperature cutout, fluid low flow cutout, expansion tank low level cutout.

(c) Do not operate the system on overpressure or overtemperature.

(d) No modification shall be made to a thermal oil heater unless prior approval is sought from the maker and the Authority.

(e) All automatic safety devices should be tested periodically as stipulated in the manufacture's instruction to ensure that they are in good working condition at all times.

(f) Thermal oil heaters and their auxiliary equipment should be properly maintained at all times. Major overhauls should be carried out by a reputable engineering firm under the supervision of a Boiler Inspector.

PRECAUTIONS TO BE OBSERVED ON SHUTTING DOWN A THERMAL OIL HEATER

3.8 The operator should observe the following precautions when shutting down a thermal oil heater:-

(a) After switching off the fuel to the burner, the circulating pump must be allowed to operate for a period as recommended by the maker in order to avoid the heat carrier from being overheated by the residual heat energy stored in the furnace or other heat source.

(b) The coolant supplied to the circulating pump, if any, should not be interrupted until the temperature of the pump has been lowered to the extent as stipulated by the manufacturer.

(c) It is also recommended to close the fuel valve and secure the electricity supply to the boiler if the plant is intended to be closed down for a long period.

ROUTINE MAINTENANCE

3.9 In order to maintain the proper functioning of a thermal oil heater, the following points are to be observed:-

(a) Thermal oil samples should be taken from the system preferably in the presence of a Boiler Inspector, and sent for laboratory analysis to confirm its serviceability during initial and each periodic examination. Thermal oil specification and analysis reports should be kept in a secure file for ready reference.

(b) A thermal oil book should be properly maintained by a responsible person indicating the record of any transfers of oil with date.

(c) Thorough examination should be made of the thermal oil heater and its auxiliary equipment and its associated safety devices at regular intervals.

(d) The following safety devices should be tested in the presence of a Boiler Inspector prior to the renewal of Certificate of Fitness:-

(i) safety valve setting;

(ii) thermal oil low flow cutout/alarm;

(iii) maximum permissible temperature cutout/alarm;

(iv) circulation pump/burner interlocks;

(v) thermal oil expansion tank low level cutout/alarm;

(vi) flame failure cutout/alarm; and

(vii) flue gas high temperature cutout/alarm.

COMMON FAULTS IN OPERATING THERMAL OIL HEATER

3.10 ***Overpressure***

Causes:-

(a) blockage in pipeline;

(b) accidental shut off of circuit valves; and

(c) mal-function of circulating pump relief valve.

Remedies:-

(a) check the pipeline and valves; and

(b) check the relief valve.

3.11 ***Thermal oil low flow rate***

Causes:-

(a) dirty filters;

(b) deterioration of pump performance; and

(c) circuit valve accidentally shut off.

Remedies:-

(a) clean filters;

(b) check the pump speed, motor current and pump coolant;

(c) check the circuit valves.

3.12 ***High thermal oil temperature***

Causes:-

(a) malfunction of temperature controller;

(b) low flow rate of heat carrier;

(c) wrong calibration of temperature controller.

Remedies:-

(a) check temperature controller and calibrate it with an accurate thermometer;

(b) check the circulating pump.

3.13 ***Expansion tank low level***

Causes:-

(a) malfunction of level controller; and

(b) leakage in the system.

Remedies:-

(a) check the level controller; and

(b) check for any leakage of the whole system.

3.14 ***Thermal oil heater misfire***

Causes:-

(a) blocked filters an/or water in fuel;

(b) defective fuel pump;

(c) malfunction of burner; and

(d) defective flame detector.

Remedies:-

(a) clean all filters and drain all the water from the system;

(b) check the fuel system and flame detector.

3.15 ***High flue gas temperature***

Causes:-

(a) leakage of heat carrier into the system;

(b) fouling of combustion chamber and uptake;

(c) incorrect air/fuel ratio; and

(d) blockage of air filter.

Remedies:-

(a) clean the furnace and uptake;

(b) adjust the air/fuel ratio;

(c) clean the air filter; and

(d) check for any damage of the coil tube.

3.16 ***Abnormal differential temperature***

Causes:-

It is mainly due to low flow rate.

Remedy:-

Refer to section 3.9.2 of this Chapter on ‘Thermal oil low flow rate’.

3.17 ***Noise and vibration***

Causes:-

(a) gas or air found in the system;

(b) heat carrier deteriorated;

(c) water found in the system.

Remedies:-

(a) check the deaerator and drain water in the expansion tank;

(b) check the air vent;

(c) check the shaft seal of the circulating pump.

3.18 ***Further points to be noted:-***

(a) When the thermal oil heater has been shut down whether due to abnormal condition or not, the circulating pump must be kept running for a period of at least 15 minutes or the time recommended by the maker, whichever is longer. All the defects must be rectified before attempting to re-start the thermal oil heater.

(b) Before any major repair work is carried out on the pressure parts of the thermal oil heater, advice must be sought from a Boiler Inspector or from the Authority.

(c) It is emphasized that the system must not be emptied while the temperature of the heat carrier is still at a high level because a flammable atmosphere will build up within the cavities and pipeline. Any subsequent hotwork will lead to a hazardous situation – risk of explosion.

(d) When the temperature of the thermal oil has been lowered, a particular section of the system can be isolated and drained empty and then thoroughly rinsed in order to prevent formation of an explosive mixtures. Inert gas may also be put into the concerned section during the whole course of hotwork.

CHAPTER 4

SAFETY REQUIREMENTS IN OPERATION AND MAINTENANCE

4.1 Thermal oil heaters must be fitted with an expansion tank of sufficient capacity. The expansion tank should be provided with appropriate level indicator so that its level can easily be read and monitored.

4.2 Thermal oil heaters and their auxiliary equipment are to be located in a boiler house.

4.3 Drip trays must be installed under the components of the installation where leakage is likely to occur, i.e. pump unit, valves, filters etc. These drip trays should be emptied to a sludge tank at regular intervals.

4.4 The inlet and outlet valves of the heaters should be controllable from outside of the compartment where they are situated.

4.5 Flanges are not permitted to be covered by insulation materials.

4.6 Details of physical and chemical properties of the thermal oil should be provided by the oil manufacturer.

4.7 The highest working temperature must not be exceeded during operation.

4.8 Air vents to fuel or thermal oil tanks should be fitted with flame arresters of fine mesh. They must be kept clear, especially from paint, to ensure effective venting.

4.9 Caution tallies, in Chinese and in English, should be displayed in conspicuous locations near the thermal oil heater, reminding the operator to “PURGE COMBUSTION SPACE PRIOR TO LIGHTING UP A BURNER”, and “IF ANY THERMAL OIL LOSS IS OBSERVED FROM THE EXPANSION TANK OR THE SYSTEM, THE BOILER SHOULD BE SHUT DOWN IMMEDIATELY FOR A THOROUGH LEAK CHECK”.

4.10 Thermal oil heaters must be used strictly in accordance with the maker's operational guide in order to avoid deterioration of the thermal oil.

4.11 Used thermal oil should be properly disposed for the sake of environmental protection. Owners should consult the Environmental Protection Department for proper disposal of used thermal oil.

CHAPTER 5

FIRE PRECAUTIONS, FIRE FIGHTING AND EQUIPMENT

FIRE HAZARD

5.1 Liquid fuels evaporate at rates varying with the temperature. The more volatile fuels are those which give off vapour more readily at lower temperatures. With appropriate quantities of air, these vapours can form mixtures which will flash or explode if ignited. If ignition takes place inside a compartment there will be an explosion with destructive results. The destructive ability of vapour mixtures can exceed that of many solid explosives; a cupful of gasoline has the potential explosive power of 2.26 kg (5 lb) of dynamite.

5.2 Fire hazards are more likely in thermal oil heaters than that in other kinds of boiler since thermal oil is also flammable. When the thermal oil is in contact with fire, it fuels the fire.

5.3 Fire causes the thermal oil to undergo 'thermal cracking' whereas molecular chains of the thermal oil break off forming toxic bituminous and gaseous substances. Its flash point lowers as a result of the cracking.

5.4 The working temperature of the thermal oil usually exceeds its flash point and is only marginally below its auto-ignition temperature. Despite the assurance given by the oil suppliers that it is normal for the oil's working temperature to be higher than its flash point and auto-ignition point, the potential hazard in this type of heater should never be ignored.

5.5 When thermal oil leaks out from the system to the atmosphere due to failure of flange joints or tube-coil, the possibility of auto-ignition exists. In the extreme case, an explosion can occur if thermal oil leaks into the combustion chamber of the thermal oil heater or into a poorly ventilated boiler room.

5.6 There are many factors which contribute to the failure of tube-coils e.g. severe scale deposit formed by the combustion gas surrounding the external parts of the coils and poor design giving uneven distribution of heat to the coils. In addition, inherent manufacturing defects and high thermal stress due to a rapid cold start may also cause the tube failure.

PRECAUTIONS

5.7 Precautions relating to the storage of liquid fuel generally aim at achieving:-

(a) The elimination of either liquid or vapour accumulations outside the oil fuel tank or pipe system in use.

(b) The exclusion of all sources of ignition from the neighbourhood of any position where vapour-air mixtures may.

5.8 Air vent pipes to oil fuel tanks should be fitted with flame arresters consisting of double wire gauze of fine mesh. They must be kept clean, especially from paint, to allow them to fulfil their purpose. In the boiler room no oil should be allowed to accumulate in the air boxes, furnace bottoms, or on the boiler room floor. If leakage from the oil fuel system to the boiler room occurs at any time, the oil supply to that part of the system should be shut off immediately. Oil-tight trays should be placed under all fittings from which liquid fuel may spill when the fitting is opened. “Save-alls” should be frequently examined for the presence of oil. A box filled with sand should be kept in a readily accessible place in the boiler room to facilitate the extinguishing of any fire.

5.9 Oily waste can ignite without any external application of heat (such as from a flame or spark), this is called spontaneous ignition. Oil waste should therefore be kept in a metal receptacle partially filled with water to prevent spontaneous ignition. The waste should be disposed of, as soon as possible.

5.10 In general, the best safeguard against fire is a proper attitude towards cleanliness, the disposal of flammable refuse in all its forms, and an intelligent regard for possible danger. Many explosions have occurred when operating boilers merely because of lack of care and knowledge of potential danger.

FIRE FIGHTING

5.11 In case of a fire in the boiler room, the competent boiler operator should:-

(a) Raise the alarm.

(b) Call the fire service.

(c) Restrict the air supply to the boiler room by closing windows and doors.

(d) Shut off the fuel supply to the burners.

(e) Attack the fire using fire extinguishers.

5.12 Oil fires – If water is used in fighting an oil fire, it should be sprayed on the oil using a special spray nozzle. Water has the effect of lowering the temperature of the oil below its fire point, and the fire will therefore go out. However, care should be taken not to allow too much water to accumulate, as oil being lighter than water will float on top of the water, and may cause what started as a small local fire to become a large general one. Foam is a better fire extinguishing agent to use in the case of oil fires and at least one 9-litre (2-gallon) foam extinguisher is normally provided in each boiler room. Foam floats on the surface of the oil and acts as a blanket thereby starving the fire of the oxygen necessary for combustion. Dry sand may be used as a means of confining the oil to a small area, thus preventing the oil from spreading. The oil fuel supply to the burners should be shut off, and for this purpose, a master shut-off valve is usually fitted in the oil fuel supply line and located outside the boiler room.

5.13 Electrical fires – In the case of electrical fires or fires in the close vicinity of electrical appliances, a fire extinguishing medium which is a non-conductor of electricity should be used, otherwise, the fire fighter may experience electric shock. Dry powder extinguishers and carbon dioxide (CO_2) extinguishers are suitable for use on electrical fires. All fuses, switches, etc. that can isolate the affected section from the source of electrical supply should be withdrawn or opened.

FIRE FIGHTING EQUIPMENT

5.14 Some commonly encountered types of portable fire extinguishers used in combating oil and electrical fires are described in the following paragraphs.

FOAM EXTINGUISHERS

5.15 Usually consist of two parts, an inner container and an outer casing. The outer casing is of lead-coated steel. The inner container is made of copper. The foam making contents are a solution of aluminium sulphate in the inner container and bicarbonate of soda in the outer container. The extinguisher is operated by merely turning it upside down. Other similar models may have double sealing valves which are released by a T-handle or lever before the extinguisher is inverted.

5.16 Foam is emitted to a distance of from 6m (20ft) to 9.1m (30ft), and once started the extinguisher will empty and eject about 90 litres (20 gallons) of foam. The foam should be directed to fall upon the fire-if need be, by deflecting it from another surface.

5.17 Foam extinguishers are suitable for oil fires. They should not be used in fires involving electrical equipment as electric shock, which could prove fatal, might be experienced.

DRY POWDER EXTINGUISHERS

5.18 These extinguishers are suitable for oil fires as well as electrical fires. The extinguisher medium is finely processed bicarbonate of soda (dry powder), pressurized by CO_2 at a pressure of 21 kg/cm^2 (300 psi). The dry powder is a non-conductor of electricity, is non-corrosive, non-abrasive, and non-poisonous. The CO_2 pressure charge may be checked by means of a flush-fitting pressure gauge fitted to the extinguisher body.

5.19 To operate the extinguisher, pull out the safety clip and strike the knob on top of the extinguisher. This causes a stainless steel piercer shaped cloud of powder to be discharged, 7.62 m (25 ft) long, 1.82 m (6 ft) wide and 1.21 m (4 ft) deep. The duration of discharge is about 28 seconds and the discharge may be prolonged by interrupting the flow with the lever provided at the hose end.

CARBON DIOXIDE EXTINGUISHERS

5.20 The charge of CO_2 is controlled by a valve and lever so that part of the charge may be conserved if not fully used. Usually, the extinguisher contains 2.26 kg (5 lb) of CO_2 and the pressure inside the extinguisher body under normal temperature conditions is about 59.77 kg/cm^2 (850 psi). The period of discharge is about 8 seconds. Being sealed with a domed nickel diaphragm which requires piercing with the striker to discharge the contents, the extinguisher is virtually leak-proof. As carbon dioxide is a non-conductor of electricity these extinguishers may be used on fires involving electrical appliances.

COLOUR CODING - EXTINGUISHERS

5.21 For the sake of easy distinguishing the type of fire extinguisher a colour coding system is adopted by the Fire Services Department in accordance with British Standard BS5423. The fire extinguishers used in Hong Kong should have the colour on their bodies as follows:-

Type	Colour
Water	Red
Foam	Cream
Carbon Dioxide (CO_2)	Black
Dry Powder	Blue

UPTAKE FIRE

5.22 Soot and unburnt carbon can deposit on the walls of the boiler uptake (chimney). They form, in effect, another fuel and can catch fire in the uptake. Although uptake fires do not often occur, they can be very difficult to extinguish and the hazard builds up quietly and usually undetected. The fire is caused by smouldering of the deposits accumulated in the uptake. It usually occurs during boiler shutdown or under light load condition. There is evidence that under normal loads the flue gas "cools" the soot and the carbon deposits so that a smouldering fire does not occur. In the absence of flue gas or if the flue gas flow is insufficient to cool the deposits, they can catch fire.

5.23 When an uptake fire occurs, it results in very high exhaust temperatures and excessive thick black smoke, mixed with sparks, coming out of the uptake. The boiler must be shut down immediately and the blower switched off or the damper closed to stop any air supply to the uptake. The fire service must be called. If the uptake is common for several boilers, all the boilers must be shut down. The key point is to stop the boiler air supply. No attempt should be made to extinguish the fire by water unless the water supply is plentiful. A steam fire may result if the water supply is not plentiful. The fire should be allowed to die out. The fire must be contained by restricting and removing any combustibles in the near vicinity.

5.24 To prevent an uptake fire, the operator must clean the uptake periodically to eliminate accumulation of soot and unburnt carbon. He should also exercise care in the daily operation of the boiler and maintain the correct air/fuel ratio to ensure complete combustion of fuel and minimize production of soot or unburnt carbon.

PROVISION OF FIRE EXTINGUISHERS

5.25 The owner must provide one set each of the following types of fire extinguishers near the entrance to the boiler room:-

(a) at least one 9-litre (2-gallon) foam extinguisher for oil fire; and

(b) at least one powder extinguisher or carbon dioxide extinguisher for electrical fire.

FIRE DRILL

5.26 The boiler operators and the workers working nearest to the boiler room and a supervisor should conduct fire drills at least once every 3 months. The drills should include:-

(a) the identification of the type of fire;

(b) the identification of the type of extinguishers to be used; and

(c) any other procedures to be followed.

5.27 A written procedure in case of fire should be posted outside the entrance to the boiler room.

5.28 A record book of fire drills with the dates, names and signatures of persons participating in the fire drill should be kept in the boiler room for inspection.

CHAPTER 6

ACCIDENTS AND DEFECTS

GENERAL

6.1 It is the responsibility of the owner of a thermal oil heater to report to the Authority when:-

(a) an accident occurs in or to the thermal oil heater or its auxiliary equipment; or

(b) he is aware of any defect in the thermal oil heater or in its auxiliary equipment that is likely to cause danger to life or damage to property.

6.2 The owner must forthwith stop the use and operation of the thermal oil heater and shall, as soon as practicable and in any event within 24 hours, notify the Authority of the accident or defect, as the case may be, and, where applicable, shall, at the same time, send to the Authority the latest Certificate of Fitness issued in respect of the thermal oil heater.

6.3 Every such notice shall include the following particulars:-

(a) the address or place at which the thermal oil heater is installed;

(b) a general description of the thermal oil heater;

(c) the purpose for which the thermal oil heater is or was used;

(d) where applicable, the name and address of the Thermal oil heater Inspector who issued the latest Certificate of Fitness in respect of the thermal oil heater;

(e) in the case of an accident in or to a thermal oil heater:-

(i) the number of persons killed or injured, if any;

(ii) details of the part thereof that failed and the extent of failure generally, if known; and

(iii) the pressure and the thermal oil temperature at which the same was being operated at the time of the accident; and

(f) in the case of a defect in a thermal oil heater, details of the nature of the defect.

N.B. It must be pointed out here that a safety valve with its seal broken, whatever is the cause, is considered a defect. Although such a defect does not create immediate danger, the owner must immediately arrange a Boiler Inspector to examine and re-seal the safety valve.

The following are examples of the types of equipment which the holders of different Certificates of Competency may operate:-

CERTIFICATE OF COMPETENCY		TYPE OF BOILER/STEAM RECEIVER FOR WHICH THE CERTIFICATE IS VALID	
A)	All Classes (I to VI)	i)	All Boilers (including automatically controlled with superheaters) and
		ii)	Steam Receivers
B)	Class I	i)	All Water-tube Boilers (including automatically controlled with superheaters) and
		ii)	Steam Receivers
C)	Class I(A)	i)	Water-tube Boilers (including automatically controlled but without superheaters) and
		ii)	Steam Receivers
D)	Class I(B)	i)	Manually Controlled Water-tube Boilers (without superheaters) and
		ii)	Steam Receivers
E)	Class II	i)	All Fire-tube Boiler (including automatically controlled) and
		ii)	Steam Receivers
F)	Class II(A)	i)	Automatic Fire-tube Boilers and
		ii)	Steam Receivers
G)	Class II(B)	i)	Manually Controlled Fire-tube Boilers and
		ii)	Steam Receivers

H)	Class III	i)	All Electrically Heated Boilers (including automatically controlled) and
		ii)	Steam Receivers
I)	Class III(A)	i)	Manually Controlled Electrically Heated Boilers
J)	Class IV	i)	Sterilizing and Vulcanizing Boilers
K)	Class V	i)	Special Purpose Boiler as specified
L)	Class VI	i)	Steam Receivers

Certificates of Competency issued before the year 1981 namely, the B & S certificates, shall remain valid for the type of equipment as specified in the certificate. Any person who has any query about such certificates should consult the Pressure Equipment Division.

BASIC KNOWLEDGE OF COMBUSTION

Liquid fuel (e.g. diesel oil) and gaseous fuel are hydrocarbon fuels containing molecules made up of carbon and hydrogen atoms. Hydrocarbon molecules can be written as C_mH_n, where m and n are integer variables indicating the number of carbon atoms and hydrocarbon atoms building up the molecule respectively. Both carbon atoms and hydrogen atoms can react with oxygen chemically under high temperature. This chemical process is more commonly known as burning or combustion. Some impurities exist in the fuel and also undergo chemical changes during combustion. Harmful products may be produced depending on the type of impurities e.g. sulphur can form acidic oxide. However, impurities usually occupy a very minor part in the fuel. Careful operation can minimize or even eliminate the effect of harmful impurity products.

Hydrocarbon molecules combine with oxygen at high temperature to form carbon dioxide and water. At the same time a large amount of heat is generated. Part of this heat energy is in turn used to maintain the high temperature favourable for the combustion (chemical process) of the fuel, while most of this heat is extracted for use. In our subject of discussion, the heat is used to raise temperature of the thermal oil. Chemical Equation:-

$$C_mH_n + (m+n/4)O_2 = mCO_2 + (n/2)H_2O + HEAT$$

Air contains about 20% by volume of oxygen. It is a cheap and convenient source of oxygen for combustion. From the chemical equation, it can be seen that a certain minimum amount of oxygen, or air, is required for a particular hydrocarbon fuel to burn completely. Insufficient air supply causes poor combustion producing sooty smoke, less heat, carbon monoxide, etc. Taking into consideration air/fuel mixing efficiency and to ensure complete combustion, excess air is required. For most thermal oil heaters, 20-50% excess air is usually arranged. Excessive air will, however, lower the efficiency of the boiler, cause flame instability and create undesirably high flue gas temperatures. The correct amount of air depends on the fuel as m and n vary with the type or supply of fuel. The operator

should consult the fuel supplier and the burner appliance maker for the optimal air/fuel ratio. The operator should adjust the air blower damper mechanism as necessary to establish an optimal flame. An optimal flame is a stable flame (i.e. the shape of the flame is stable) with a near colourless exhaust.

The burner injects gas or atomizes oil fuel which mixes with the air from the blower. Turbulence produced by the air draught thoroughly mixes the fuel particles and air producing plenty of reacting contact surfaces between the hydrocarbon molecules and oxygen molecules. If a flame exits, the heat will cause the chemical process described above to occur and sustain the flame. If there is no flame but an ignition spark is produced, the high temperature spark (2000˚C or above) starts the combustion process and creates a flame. The combustion process is self-sustaining and the flame continue as long as there is fuel and sufficient air being supplied and mixed at the correct ratio.

Diesel oil vaporizes even at room temperature. The vapour is similar, in its effect, to gaseous fuel and is combustible. After a flame has been extinguished or a boiler has been shut down, residual diesel oil vaporizes and mixes with the air inside the furnace. This mixture is flammable and extremely dangerous. If any hot material is present it may set off a very rapid combustion with a large amount of heat released in an extremely short time or, more exactly, an explosion can occur. A spark for ignition purpose would be hot enough to cause such an explosion. This can happen if the operator tries to ignite a flame inside the furnace to start the boiler without knowing that there is an explosive mixture present. The spark can ignite the explosive mixture before igniting the fuel/air mixture to make the flame. A similar phenomenon applies in the case of gaseous fuel. The operator must take every precaution to eliminate accumulation of the explosive mixture. The rule is to purge the furnace every time before attempting to ignite a flame and to purge the furnace after extinguishing a flame. Never try to ignite a flame using the heat of the furnace. Under such circumstance, a large amount of fuel is injected into the furnace giving a very good opportunity for an explosive mixture to build up and to explode subsequently.

During ignition, the jet of fine fuel particles as atomized by the burner at high pressure or injected through gas nozzle mixes with air. This is a flammable mixture but got ignited and burnt before accumulating to large. However, if it fails to ignite a flame after several sparking, a considerable volume of flammable mixture, which is explosive, may have created. The operator should not insist on attempting to ignite a flame. He should shut off the fuel supply, purge the furnace thoroughly to remove any explosive mixture which might have been created. He should check and eliminate any fault in the burning system. Most automatic combustion control fitted for automatic thermal oil heaters will carry out the above practice, except examining the system, automatically. Nevertheless, the operator should make himself aware of the consequence and should never be complacent. In case of failure of automatic device, the system shall be changed over to manual control where the operator has to exercise the above practice.

ALWAYS PURGE THE FURNACE BEFORE MAKING A FLAME!

BASIC KNOWLEDGE OF ELECTRICITY

Electric Circuit – a network of paths designed for electric current to carry out a specified function.

Circuit Breaker – one form of switch providing ON/OFF function and automatic tripping of the electric circuit in the event of short circuit or circuit overload. The point at which the breaker trips depends on the rating of the circuit. The breaker can be reset to operate again after the fault has been cleared.

Fuse – a conductor, usually in the form of a wire or a cartridge, of low melting point material placed in the electrical supply circuit and forms part of the circuit. It serves to protect the electric circuit from short circuiting or overloading. It melts to interrupt the electricity supply because the excess current produces a large amount of heat. Unlike the circuit breaker, it must be replaced with a new unit after blowing.

Earth Line – a conductor or wire which electrically connects the boiler metal casing with the earth terminal provided by the electricity supply company. This line plays a very vital role in the prevention of electric shock.

Electric Shock – this is a phenomenon whereby the human body has become a path for electric current. The human body may suffer burns and heart difficulties which can result in death.

When an electric wire of high potential becomes loose or exposed and is in contact with the metal casing of the boiler, the casing will also be at a high potential relative to the earth. If the earth line is also defective, the casing will be maintained at a high potential. There may not be any indication of the high potential but when a person is in contact with the casing and he is also in contact with the earth, an electric path for current is established through the human body. Potential differences above 50V, A.C. or D.C., are able to drive electric current through the body. This is what is termed an electric shock. Alternating current has a more serious effect in that it can cause the victim to become paralysed while still holding firmly onto the faulty electric part. The normal mains supply in Hong Kong is nominally 200V A.C. which is well above the threshold voltage of 50V. However, it should be noted that, depending on the physical conditions of a person, potential difference less than this threshold voltage has been known to cause serious injuries.

IMPORTANT NOTE:- Never try to repair any fault electric circuit. The repair should be carried out by a registered electrical worker only.

Quoted References on Statutory Provisions

Paragraph of the Code	Section(s)/ Regulation(s)	Ordinance/ Regulation
1.2	4(3) & 66(1)	Boilers and Pressure Vessels Ordinance, Cap 56
1.3	13	Ordinance, Cap 56
1.4	15	Ordinance, Cap 56
1.5	16	Ordinance, Cap 56
1.7	6(1)	Ordinance, Cap 56
1.9	49(7)	Ordinance, Cap 56
1.10	49(7) & 67	Ordinance, Cap 56
1.11	22(1) & 27(1)	Ordinance, Cap 56
1.12	33(6), 49(1) & 62(a)	Ordinance, Cap 56
1.13	49(1)	Ordinance, Cap 56
1.14	32(1)	Ordinance, Cap 56
1.15	32(2) & (3)	Ordinance, Cap 56
1.16	17(1)	Ordinance, Cap 56
1.17	25 & 26	Ordinance, Cap 56
1.18	17(2)	Ordinance, Cap 56
1.19	2, 26(1)	Ordinance, Cap 56
1.20	63	Ordinance, Cap 56
1.21	15A/50(1)	Ordinance, Cap 56
	22/51(1)	Ordinance, Cap 56
	49(1)/49(8)	Ordinance, Cap 56
	49(6)/49(10)	Ordinance, Cap 56
	49(7)/49(8)	Ordinance, Cap 56
	55	Ordinance, Cap 56
	56	Ordinance, Cap 56
	Reg 4(1)(a)/Reg 17(1)	Boilers and Pressure Vessels Regulations, Cap 56
3.1	49(7)	Ordinance, Cap 56
3.7(f)	22(1)	Ordinance, Cap 56

Paragraph of the Code	Section(s)/ Regulation(s)	Ordinance/ Regulation
4.3	Reg 9	Regulations, Cap 56
6.1	63(1)	Ordinance, Cap 56
6.2	63(1)	Ordinance, Cap 56
6.3	63(2)	Ordinance, Cap 56
Appendix I	Form 4	Boilers and Pressure Vessels (Forms) Order, Cap 56

Please refer to the relevant Ordinance or Regulations for full details of the statutory provisions referred to in this Code.

Code of Practice for Thermal Oil Heaters
1994 Edition (English Version)

Amendment No.1

Item	Clause	Correction
1.	Introduction, paragraph III after 5th line	Insert ' (In the interpretation of the Ordinance, a thermal oil heater is also considered as a boiler.'
2.	Chapter 1, page 3 paragraph 1.4 2nd line & 8th line	Insert 'The Boiler Inspector shall determine the maximum permissible working pressure for the equipment and state that in the documents accompanying the application of registration' after the word 'registration'. Insert 'at owner's expenses' before 'for collecting'.
3.	Chapter 1, page 7 paragraph 1.21 Section 22	Replace 'pressure vessel' with 'a boiler or a pressure vessel and its auxiliary equipment'.
4.	Chapter 2, page 9 paragraph 2.1 6th line	Delete the words 'essentials of operational and safety information on' and replace with 'essential devices for operation and safety of'
5.	Chapter 2, page 9 insert a new paragraph para 2.1A	Insert the following as a new paragraph after para 2.1:— '2.1A All record books or oil reports required by this code should be kept by a responsible person for as long as practicable for reference, otherwise be kept for a continuous period of the recent 3 years or since registration and put to use.'
6.	Chapter 3, page 18 insert new paragraphs 3.9(e) and 3.9(f)	Insert the following new paragraphs after para 3.9(d):— '3.9(e) All maintenance and general repairs carried out on a thermal oil heater should be recorded. These record books should be kept by a responsible person for as long as practicable for reference, otherwise be kept for a continuous period of the recent 3 years or since registration and put to use.'

Item	Clause/page	Correction
		'3.9(f) All modifications, extensive repairs and repairs involved with pressure parts other than those involved with part replacement, carried out on a fossil-fuel boiler should be recorded and reported. These record books and reports should be kept by a responsible person for as long as practicable since the equipment was registered and put to use.'
7.	Chapter 3 page 22 paragraph 3.16 5th line	Delete the word '3.9.2' and replace with '3.11'
8.	Chapter 4 page 24 paragraph 4.2 1st line	Insert 'usually' after the word 'are'.
9.	Chapter 5 page 30 paragraph 5.18 2nd line and end of paragraph	Insert '(13.62 kg or 30 lbs contents)' after 'medium'. Insert at end of paragraph 'There is also another type of dry powder extinguisher using compressed gas as expellant in a gas cartridge form.'
10.	Chapter 5, page 30 paragraph 5.19 insert after 2nd line	Insert 'to perforate a metal seal and release the contents. A horizontal fan' after 2nd line.
11.	Chapter 5, page 31 paragraph 5.23 at end of last line	Insert a sentence at end of paragraph '(A steam fire cannot occur in a thermal oil heater, however, a thermal oil heater oil fire would be as severe as a steam fire.)'
12.	Chapter 5, page 32 paragraph 5.25(b) 1st line	Insert 'dry' after the word 'one'.
13.	Appendix II, page 37 2nd paragraph, 4/5th line	Replace 'fuel. While' with 'fuel, while'
14.	Appendix II, page 37 2nd paragraph, 5th line	Replace 'discussion, the heat' with 'discussion on thermal oil heaters, bulk of the heat generated'.

Code of Practice for Thermal Oil Heaters
1994 Edition (English Version)

Amendment No.2

Item	Clause/page	Correction
1.	In "Contents' insert below Appendix III	Insert 'Appendix IV Quoted References on Statutory Provisions'
2.	Insert after page 41, new Appendix IV	Insert new Appendix IV (page 42 & 43)
3.	In 'Introduction' insert at the end of paragraph 1	Insert 'Some of these provisions, and some other relevant statutory provisions, are highlighted or summarised in this Code of Practice (see Appendix IV). The statutory provisions referred to in this Code are provisions in force on 15 November 1994.'
4.	In 'Introduction' insert at the end of paragraph IV	Insert 'However, failure to observe statutory provisions, including the provisions of the Boilers and Pressure Vessels Ordinance, may be an offence under the relevant Ordinance or Regulations.'
5.	Chapter 1 paragraph 1.2(d)	Delete the sentence in paragraph 1.2(d) and replace with 'to make such examination and inquiry as may be necessary.'
6.	Chapter 1, paragraph 1.19	Delete last sentence in paragraph 1.19 and replace with 'Extensive repairs means any repairs that affect or may affect the structure of the boiler and includes alterations or welding repairs to the pressure parts of the boiler or its controls and safety devices.'
7.	Chapter 1, paragraph 1.21, Section 22	Replace '$20,000' with '$25,000'
8.	Chapter 1 paragraph 1.21, Sect. 49(1) & 49(7)	Replace '$30,000' with '$50,000'
9.	Amendment No.1 item 6, para 3.9(f)	Replace 'fossil-fuel boiler' with 'thermal oil heater'

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