GUIDE TO OPERATION OF STEAM RECEIVERS

Occupational Safety and Health Branch
Labour Department

Occupational Safety & Health Council

This guide is prepared by the
Occupational Safety and Health Branch
Labour Department

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This guide is issued free of charge and can be obtained from office of the Boilers and Pressure Vessels Division of the Occupational Safety and Health Branch or downloaded from website of the Labour Department at http://www.labour.gov.hk/eng/public/content.htm. Addresses and telephone numbers of the offices can be found in the website of the Department at http://www.labour.gov.hk/eng/tele/index.htm.

OPERATION OF STEAM RECEIVERS (INCLUDING KIERS)

Labour Department

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FOREWORD

This guide explains briefly the main provisions of the Boilers and Pressure Vessels Ordinance, Chapter 56, as applicable to various types of steam receivers.

Steam receivers are extensively used in industry, particularly textile. Using the equipment by personnel without sufficient knowledge about its operation and maintenance may cause serious accidents. All personnel engaged in the use of such equipment are strongly advised to familiarise themselves with the contents of this guide.

While every care has been taken in the preparation of this guide, the Ordinance itself remains the sole authority for the provisions of the law explained.

On request, the Labour Department will also offer further advice to owners and operators regarding such equipment.

1. GENERAL

The Boilers and Pressure Vessels Ordinance also governs, among other things, the use of steam receivers. Steam receiver means any vessel used for containing steam under pressure greater than atmospheric pressure and covers equipment such as a vessel used to store steam for heating of other materials (i.e. dryers, steam rolls etc.), or for heating of fluid under pressure in a vessel as kiers.

2. REGISTRATION AND EXAMINATION

- The steam receiver must be registered with Boilers and Pressure Vessels Division, Labour Department.
- An appointed examiner must examine the steam receiver and the auxiliary equipment, and the owner shall submit application for registration at least 30 days prior to the steam receiver being put in use.
- The maximum permissible working pressure of the steam receiver must be approved by this Department and be allotted with a Registration Number.
- An appointed examiner must set and seal the safety valve at the approved maximum pressure and issue a Certificate of Fitness.
- Regular periodic examination must be carried out at every 26 months interval by an appointed examiner for the issue of a Certificate of Fitness.
- Operation of a steam receiver without a valid Certificate of Fitness is an offence and the owner may be fined a maximum of HK$50,000 [Level 5 of Schedule 8 to the Criminal Procedure Ordinance, Cap 221] for the contravention of the Ordinance.

3. COMPETENT PERSON

- Incorrect operation of steam receiver and its fittings can cause accidents resulting in injury or loss of life. Therefore, a competent person must be present at all times when the steam receiver is in operation to ensure safety in its operation and to comply with Boilers and Pressure Vessels Ordinance.
- The competent person who operates or supervises the operation of steam receivers must be in possession of a Certificate of Competency awarded by the Boilers and Pressure Vessels Division of Labour Department.

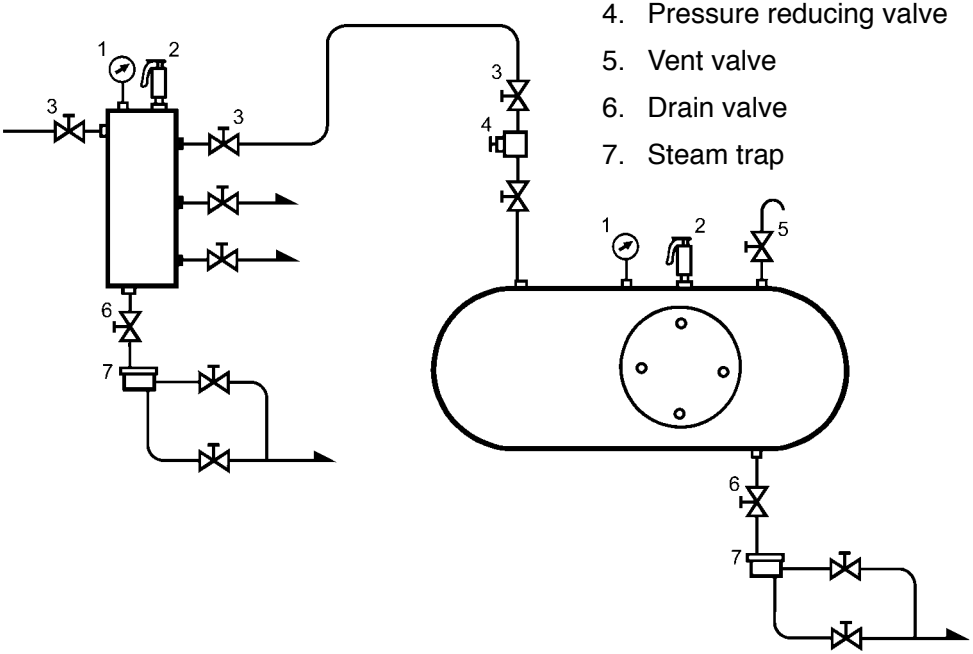
- The competent person who possesses a Certificate of Competency to operate steam receiver is also qualified to operate kiers. He must, therefore, understand the principle and operation of a kier.

4. STEAM RECEIVERS

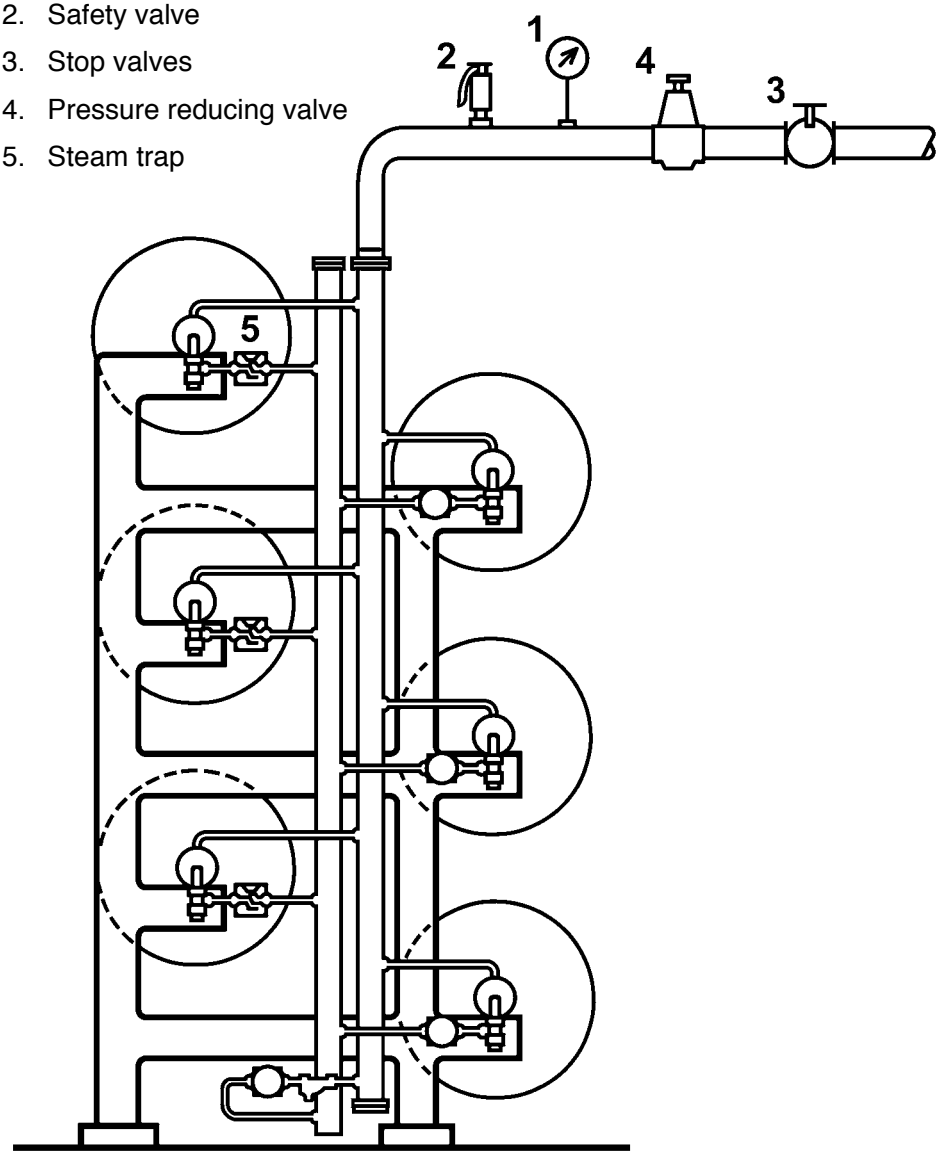
- Different types of steam receivers, such as steam rolls for calendering, or dryers for heating and drying other materials, or kiers for dyeing purposes, or sterilizers used in the preparation of food etc.
- All steam receivers have certain common fittings/mountings, e.g. safety valves, pressure gauges, valves, steam traps etc.
- Some steam receivers may have vent valves, working door/cover etc.
- A thermostatic sensor locking device which is approved by the maker may be fitted for additional safety in operation.

GENERAL ARRANGEMENT OF STEAM RECEIVERS

1. Pressure gauge
2. Safety valve
3. Stop valves (inlet and outlet)
4. Pressure reducing valve
5. Vent valve
6. Drain valve
7. Steam trap



1. Pressure gauge
2. Safety valve
3. Stop valves
4. Pressure reducing valve
5. Steam trap



5. CONE AND FABRIC KIERS

- Cone kiers may be completely flooded or partly filled up with dyeing liquor.
- Compressed air may be used to form an 'air pad' for pressurisation.
- Different types of kiers are used according to the type of material being treated.
- These kiers use high pressure steam to heat up the dyeing liquor.
- All these kiers have certain common mountings, e.g. safety valve, pressure gauge, valves, heating coils, vent and drain etc.

6. PRINCIPLE OF OPERATION FOR KIERS

A. Fabric Dyeing Kiers

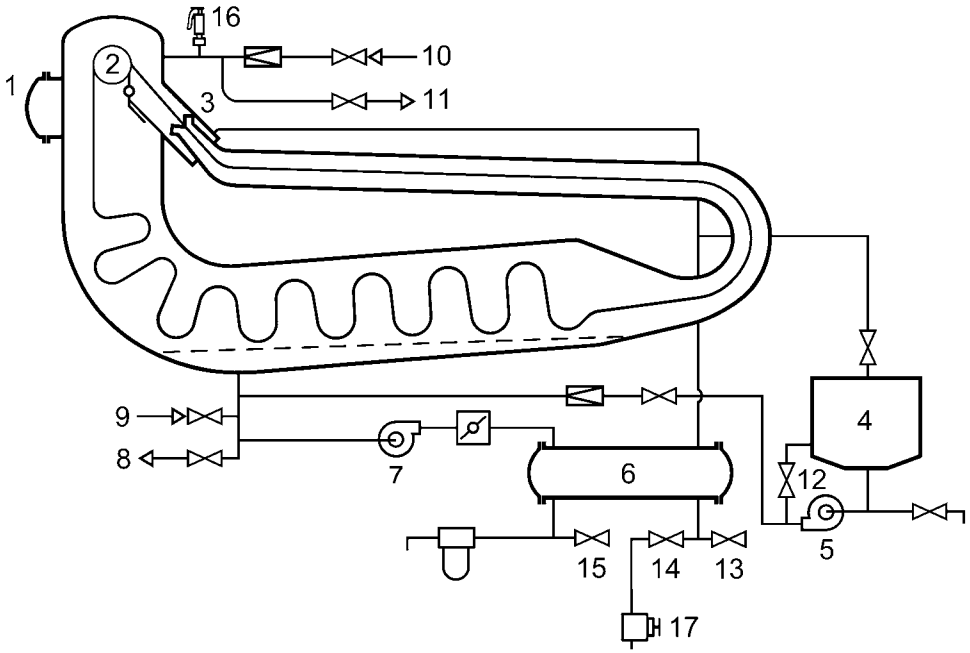
- The fabric to be dyed forms a loop in the vessel and is circulated inside the vessel with the help of liquor circulation and the lifter reel.
- The dye stuff and chemicals are added at the appropriate temperature after the cover is closed.
- The vessel is pressurised by compressed air or by the vapour pressure of steam.
- The temperature and pressure inside the vessel varies for different dyestuff and chemicals used.

B. Cone Dyeing Kiers

- Cone fabric to be dyed is mounted on a carrier.
- The dyeing liquid is mixed in the side tank and circulated through the cones by a circulating pump.
- This type of kier may have three modes of operation, i.e. low/medium/fully flooded mode.
- The first two modes are pressurised by air while the last mode is pressurised by the pump.

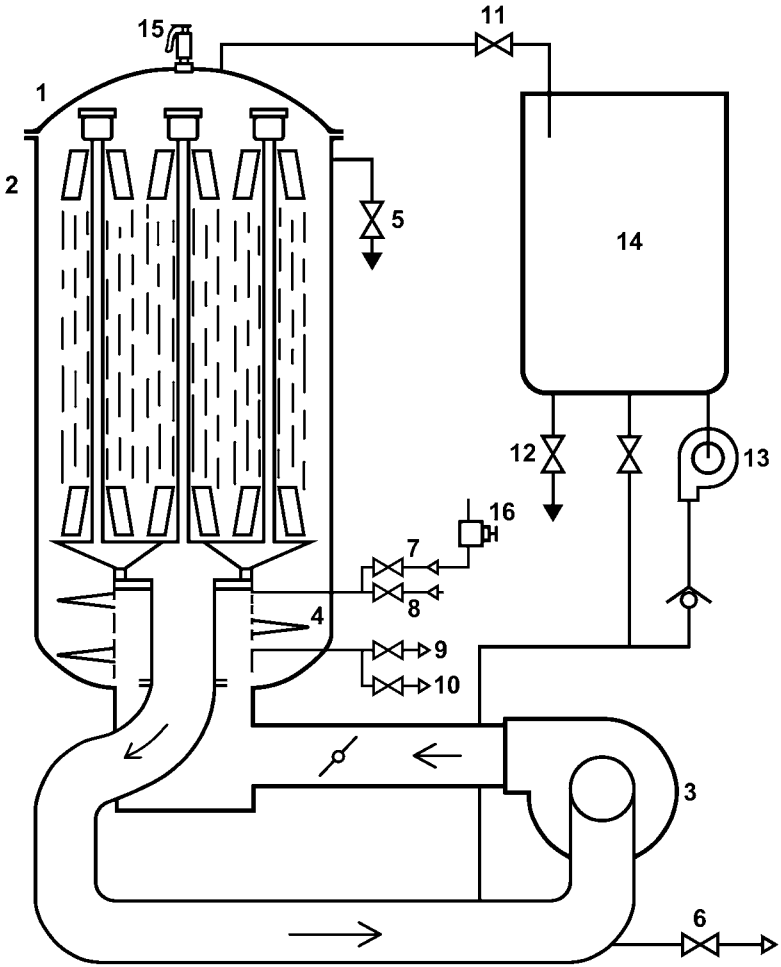
GENERAL ARRANGEMENT OF FABRIC KIER

1. Service door
2. Lifter reel
3. ELPO nozzle
4. Service tank
5. Dyestuff feed pump
6. Filter & heat exchanger
7. Circulation pump
8. Drain valve
9. Water inlet valve
10. Compressed air inlet valve
11. Depressure valve
12. Mixing valve
13. Cooling water outlet valve
14. Steam inlet valve
15. Cooling water inlet valve
16. Safety valve
17. Pressure reducing valve



GENERAL ARRANGEMENT OF CONE KIER

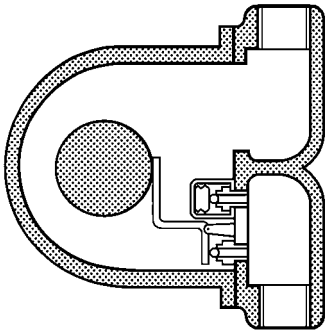
1. Kier cover
2. Dye tank
3. Circulation pump (main pump)
4. Heating coil
5. Overflow valve
6. Drain valve
7. Steam inlet valve
8. Cooling water inlet valve
9. Condensate outlet valve
10. Cooling water outlet valve
11. Lid valve
12. Drain valve
13. Injection pump
14. Service tank
15. Safety valve
16. Pressure reducing valve



7. FITTINGS FOR STEAM RECEIVERS AND KIERS

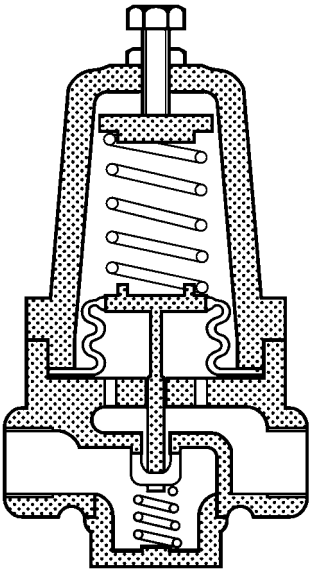
(a) STEAM TRAP —

It is used to drain out the condensate from the steam receiver. As the water level rises, the float in the trap will move up and in turn, connect some leverage to open the valve and drain the water away. When the level falls, the float will come down and the drain valve will be closed.



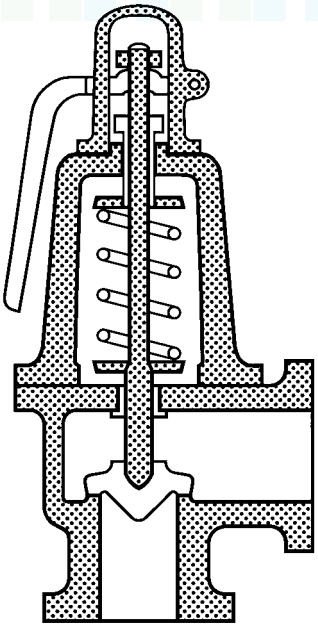
(b) PRESSURE REDUCING VALVE —

It is used to reduce the steam pressure supplied from the boiler. Usually boiler generates steam at a pressure higher than normally required for steam receiver operation. Pressure reducing valve can control and maintain the pressure in the steam receiver. This valve also has a throttling effect which minimise the water droplets in the steam. The bellow in the reducing valve should be checked periodically to ensure the safe operation of the equipment at the receiving end.



(c) SAFETY VALVE —

It prevents the pressure in the vessel from going above a safe working pressure by its automatic opening to release the excess pressure when the set point is reached. This guards against possible explosion from excessive pressure.



8. OPERATING PRECAUTION FOR STEAM RECEIVERS

When steam is supplied to cold steam pipe with condensate, steam condenses as it comes in contact with cold pipe wall or the condensate causing water hammering as illustrated below:

Fig.(A)

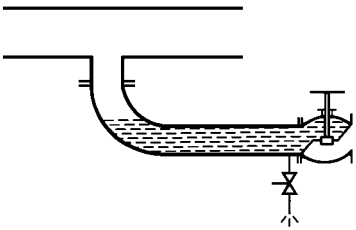


Fig.(B)

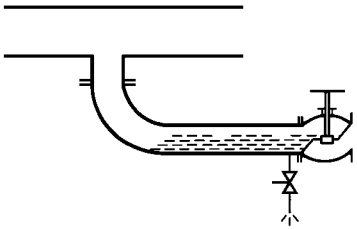


Fig.(C)

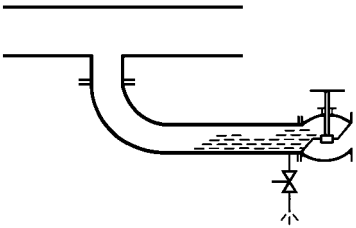


Fig.(D)

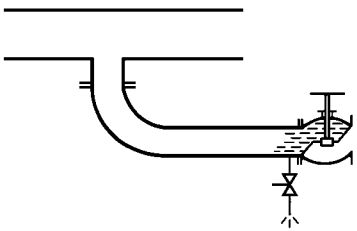


FIG. (A) & (B) Steam is supplying to the pipe which contains condensate with the stop valve closed, and the draining of condensate from the pipe has not been completed. As steam enters the pipe and disturbs the surface of water and causes the formation of waves.

FIG. (C) & (D) When the condensate level falls, the turbulence increases rapidly and breaks the crest of the waves forming bubble-like enclosures containing steam. The pressure causes the bubble to collapse with some noise and force. A surging wave may be big enough to block the pipe. Steam condenses on the other side of the waves creating partial vacuum together with the incoming steam behind the wave forcing the water at high velocity towards the stop valve or other obstruction. This action causes rupture of steam pipe or the valve body.

To prevent water hammer in steam pipe, open the drain valve to drain the condensate completely and crack-open the stop valve to allow warming up the steam pipe. When the steam pipe is warmed up and steam comes out through the drain cock, the drain cock can be closed and the steam stop valve can be opened slowly.

9. POINTS TO BE OBSERVED WHEN PUTTING THE STEAM RECEIVER IN USE

- Periodically check the validity of Certificate of Fitness, to ensure statutory inspections have been carried out at the right time.
- Periodically examine the safety devices, attachments, auxiliary fittings and control equipment to ensure their proper functioning. Defective parts may be the cause of accidents.
- Check all the fittings are properly mounted and there are no leaky joints.
- For bolted covers, the practice of tightening or loosening only a few bolts must be prohibited.
- All swing bolts must be completely free and the cover loosened before swinging the bolts clear.
- Drain the condensate in the steam pipe completely before the steam stop valve is opened slowly to prevent water hammer.
- Check the pressure in steam receiver is not higher than the pre-

determined working pressure to ensure the function of the pressure reducing valve.

- Always ensure that the operating pressure indicated in the pressure gauge should not exceed the red line which indicates the maximum permissible working pressure as specified in the Certificate of Fitness.
- Check the steam trap is functioning properly, and that condensate only is discharged from it.

10. POINTS TO BE OBSERVED WHEN OPENING THE RECEIVER FOR INSPECTION

- The steam receiver should be isolated by closing all its inlet and outlet valves. Drain and vent valves are fully opened to release the pressure or vacuum inside. If drain is connected to a common manifold with other steam receivers or apparatus, then drain valves should be closed after drainage is completed.
- Check pressure gauge is working correctly and indicating zero pressure.
- When no pressure remains inside the receiver, slacken all the nuts and slightly open the cover/inspection door. The nuts must not be swung clear unless no steam comes out from the cover.
- A responsible person must be stationed close by to prevent accidental opening of steam isolating valve or closing the cover when someone is working inside the steam receiver. The steam isolating valve should be locked shut or labelled 'DO NOT OPEN'.
- Appropriate measures to be taken to comply with the Factories and Industrial Undertakings (Confined Spaces) Regulation, Cap. 59AE, Laws of Hong Kong.

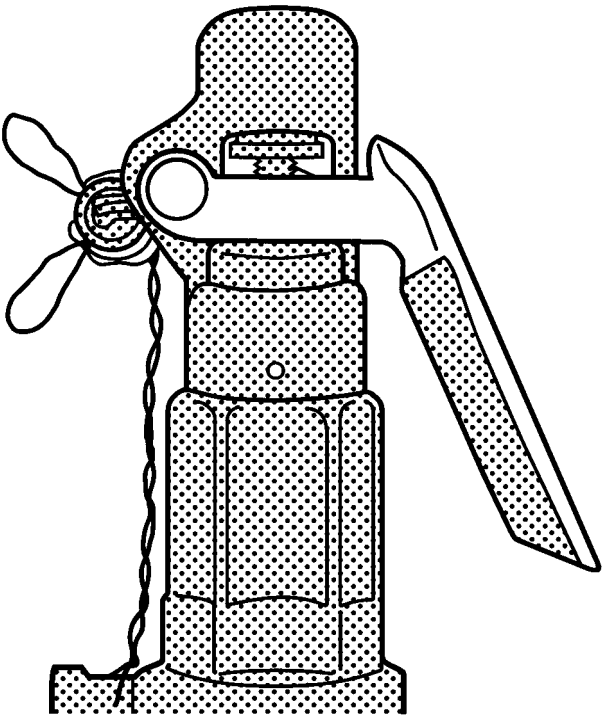
In Addition to the operating precaution for steam receivers, the following points should also be observed when operating kiers:

- The cover should never be opened when pressure still exists inside the shell and its operating temperature is above 80°C. This is especially important in the fully flooded mode of cone dyeing kiers where the pressure inside the shell can be released quickly while the liquid inside the shell is still above boiling point.
- The vent, drain, connection of pressure gauge and level gauge glass are checked for blockage before each dyeing operation.

- Do not by-pass and/or interfere with the function of the interlocking devices.
- After loading the kier and before the door is closed, all foreign matter, spillage, etc., should be cleaned from the locking parts of the door, and the door jointing should be examined to ensure that it is seating properly in its groove.
- Care should be taken to ensure that the locking ring does not bind during rotation. The entire ring may, otherwise, rotate about this fulcrum with the result that the ring does not remain concentric leading to unequal overlap of the locking lug.
- In case of quick closing doors, where locking is by means of a single handle, the use of a piece of steel tubing or other similar arrangements to unduly increase the joint tightness is prohibited.
- In using eye bolts for lifting the cone carrier, the liquid in the shell must be completely drained first. The attendant should prevent the carrier from turning during lifting. Hooks for lifting should be fitted with safety latch.
- In all cases, the manufacturer's recommended method of operation should be strictly followed. Instructions for loading, taking sample and unloading should also be in easy reach of operators, or prescribed procedures, in written orders, are available for observance.
- Concentricity of the rotating ring is maintained by the clearance of the fit. Such clearance should not give way to possible excessive displacement from use of undue force. If the ring has not been rotated to the pre-determined position, the mechanical interlock will prevent the kier from proper functioning and the operator cannot start the process.
- Dyeing chemicals containing chlorine should not be used in stainless steel vessels/kiers without consulting equipment manufacturers.

11. OTHER IMPORTANT POINTS TO BE OBSERVED BY OPERATORS AND OWNERS

- Operators must obtain the relevant certificate of competency before operating any steam receiver.
- Do not tamper with the seal of the safety valve or increase the working pressure beyond the approved maximum working pressure. This endangers the safety, as over-pressure can cause accident and injuries to operator and other persons.
- The cover or locking device should never be forced into position. If there is any unusual resistance to smooth operation, the matter should be reported to the maintenance engineer for immediate investigation.
- Repairing or servicing should only be carried out by qualified engineers approved by the makers and under supervision of appointed examiners.



- In case of accident, owners must ensure the steam receiver and its auxiliaries are shut down immediately and report the accident to the Boilers and Pressure Vessels Authority within 24 hours. The owner can be prosecuted and the maximum fine for this breach of the law is $10,000.

12. ENQUIRIES AND COMPLAINTS

For other enquiries, such as the application for registration, safe operation of steam receivers, approved list of appointed examiners etc., please contact the Boilers and Pressure Vessels Division of the Labour Department through:

Address:	Unit 01-02, 20/F Millennium City 6 392 Kwun Tong Rd Kowloon
Telephone:	3107 3458
Fax:	2517 6853 / 2517 0875
E-mail:	equiry@labour.gov.hk

Information on the services offered by the Labour Department is available on its website at http://www.labour.gov.hk

Information on the services offered by Occupational Safety and Health Council can be obtained through hotline 2739 9000.

If you have any complaints about unsafe workplaces and practices, please call the Labour Department's occupational safety and health complaint hotline on 2542 2172. All complaints will be treated in the strictest confidence.

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