

SECTION 12—HYDRAULIC LIFTS

12.1 HYDRAULIC LIFTS

Hydraulic lifts shall comply with the foregoing rules except where instructions to the contrary are given in this rule.

For the purpose of this rule the following definitions shall apply.

“Design Pressure” means the relief valve opening pressure.

“Working Pressure” (normal operating pressure) shall be not more than 80 percent of design pressure.

12.2 DESIGN

(a) Rams

Rams shall have smooth cylindrical external surfaces and, if hollow, should be of approximately uniform thickness.

Grey cast iron or other brittle material shall not be used for rams or connecting links.

Grey cast iron, where used in other parts of the ram assembly, shall have a safety factor of not less than 10.

Direct acting rams shall be attached to the car platform with fastenings of sufficient strength to support the weight of the ram with a safety factor of not less than 4.

Rams shall not be subjected to bending stresses or eccentric loading. Eccentric loading shall be taken by the car frame and guiding shoes.

Ram heads shall be positively guided.

Rams shall be provided with solid metal stops at the limit of stroke, or with other means to prevent the ram from travelling beyond the limits of the cylinder.

Stops shall be so designed and constructed as to stop the ram from maximum speed at maximum operating pressure in the out direction without damaging the hydraulic system.

Rams shall be so constructed that a normal working stress of 1/5 ultimate or 2/3 yield strength or 0.2 percent proof stress is not exceeded.

The maximum load of a ram should be based on the maximum pressure obtainable from the supply and calculated for the condition of a fully extended ram.

The maximum load shall not exceed that obtained by the following formula:

$$P_e = \frac{4.085 EI}{L^2 \times 10^2}$$

Where P_e = maximum load, (kilograms), (N)

E = modulus of elasticity, (MPa),

I = moment of inertia of ram, (cm⁴),

L = maximum exposed length of ram, (metres). (m)

(b) Cylinders

(i) Grey cast iron (or other brittle material) if used in the cylinder assembly, shall have a factor of safety of not less than ten (10).

- (ii) Cylinders shall be designed and constructed in accordance with the following formula:

$$t = \frac{pd}{2S} + C$$

Where: t = minimum thickness of wall in millimetres,

p = design pressure in MPa,

d = internal diameter in millimetres,

S = design stress in MPa (82.5 MPa for mild steel and 1/5 the ultimate or 2/3 yield strength or 0.2 percent proof stress for other metals).

C = corrosion allowance, which shall be:

(A) 4 mm where the cylinder is of steel and installed so that it is not available for inspection;

(B) 2 mm where the cylinder is of steel and installed so that it is available for inspection;

(C) 9 mm where the cylinder is of cast iron and installed so that it is not available for inspection;

(D) 5 mm where the cylinder is of cast iron and installed so that it is available for inspection;

(E) 2 mm where the cylinder is of non-ferrous material.

- (iii) Clearance shall be provided at the bottom of the cylinder so that the bottom of the plunger will not strike the bottom head of the cylinder when the car is resting on its fully compressed buffer.

- (iv) Cylinders, valves and pipes shall be so arranged that they can be completely vented with efficient air cocks.

- (v) Cylinders, pipes and valves using water based fluid and exposed to the action of frost shall be protected against freezing of their contents.

- (vi) Effective measures shall be taken to prevent the siphoning of fluid from cylinders.

- (vii) Means shall be provided to collect drainage from the cylinder gland.

(c) *Cylinder and Ram Heads*

Heads of cylinders and heads of rams subject to fluid pressure shall be designed and constructed in accordance with one of the following applicable formulae:

- (i) Flat Unreinforced Heads

$$t = d \sqrt{\frac{P}{4S}} + C$$

- (ii) Dished Seamless Heads, Concave to Pressure

$$t = \frac{pr}{1.2S} + C$$

Where: t = minimum thickness of head in millimetres.

d = diameter of head between supporting edges in millimetres.

p = design pressure in MPa.

S = design stress in MPa. (82.5 MPa for mild steel and 1/5 the ultimate or 2/3 yield strength or 0.2 percent proof stress for other metals).

r = radius to which head is dished, measured on concave side in millimetres (not greater than d).

C = corrosion allowance, which shall be:

(A) 4 mm where the head is of steel and installed so that it is not available for inspection;

(B) 2 mm where the head is of steel and installed so that it is available for inspection;

(C) 9 mm where the head is of cast iron and installed so that it is not available for inspection.

(D) 5 mm where the head is of cast iron and installed so that it is available for inspection.

(E) 2 mm where the head is of non-ferrous material.

(iii) Dished Seamless Heads, Convex to Pressure:

Dished seamless heads, convex to pressure, shall have a maximum allowable working pressure not more than sixty (60) percent of that for heads of the same dimensions with pressure on the concave side.

(iv) Reinforced Heads:

Reinforced heads shall be designed and constructed so that the maximum stress at rated capacity shall not exceed 82.5 MPa for mild steel and 1/5 the ultimate or 2/3 yield strength or 0.2 percent proof stress for other metals.

(v) Heads Subjected to Mechanical Loads in Addition to Fluid Pressure Loads:

Pressure heads subjected to mechanical loads in addition to fluid pressure loads shall be so designed and constructed that the combined stresses will not exceed the limits specified in subparagraphs (i)-(iv) of this subrule.

(d) *Pumps*

Each pump or group of pumps shall be equipped with a relief valve complying with the requirements of rule 12.8. The following information shall be permanently displayed on each hydraulic pump and/or motor:

(i) manufacturer's name; and

(ii) manufacturer's part, model and/or serial number.

If this information is not readily visible duplicate information shall be provided adjacent to the pump or motor where it can be easily read.

The original nameplate shall not be removed from the pump motor.

The direction of rotation of each pump shall be clearly indicated on the pump where it can be readily seen.

All pumps shall be clearly marked to indicate inlet and outlet, related to a specified direction of rotation.

(e) *Components*

All pipes, fittings, etc., shall be designed to withstand a static pressure equal to twice the design pressure without permanent deformation.

(f) *Pipes and Pipe Supports*

Piping shall be so supported that undue stresses are eliminated at joints, bends and fittings, particularly at any section of the system subject to vibration. Cross-sectional areas of piping shall be sufficient to prevent cavitation and starvation and not to induce turbulence or temperature rise.

(g) *Oil Storage Tanks (atmospheric and discharge type)*

All tanks shall have sufficient capacity to provide for an adequate oil reserve to prevent the entrance of air or other gas into the system.

They shall be of rigid construction so as to prevent distortion due to the weight of oil and shall be so designed and constructed that when completely filled a factor of safety of at least 4, based on the ultimate strength of the material, is obtained.

All sides of the tank shall be fully visible for examination and protected by a substance unaffected by the working fluid.

Tanks and feed pipe connections shall be of fluid-tight construction.

Means for checking the fluid level shall be provided and the minimum permissible fluid level shall be clearly indicated. Such means shall be accessible without the removal of any cover or other parts of the equipment.

A removable cover for the tank, as well as a suitable vent to atmosphere, fitted with a breather, shall be provided.

The system shall incorporate a continuous full flow removable oil filter.

The tank shall be of adequate depth to permit settling of the fluid.

Means for draining the tank shall be provided.

12.3 SAFETY GEAR

All indirectly operated roped hydraulic lifts shall be provided with safety gear and overspeed governors as per rules 11.2 and 11.1 respectively.

Direct acting hydraulic lifts shall not be provided with safety gear.

12.4 RAM STOPS

Hydraulic lifts shall be so constructed or reeved that the cars are prevented, by means of permanent stops on the cylinders, from exceeding the runby.

12.5 SUSPENSION

The minimum number of ropes or chains for the car and counterweight of hydraulic lifts shall be two.

12.6 HOISTING MACHINERY

(a) General

All openings in hydraulic equipment should be sealed prior to despatch.

Adequate precautions shall be taken to prevent corrosion during transit.

Hydraulic equipment and piping shall be accessible and shall be mounted in a position that will not interfere with equipment adjustment or maintenance. All pressure and volume controls shall be so constructed that they are not adjustable outside the safe working range of the system which they form part.

(b) Emergency lowering

Provision shall be made on hydraulic lifts for the emergency lowering of the car by manual operation. Any such device must automatically reset when hand pressure is removed.

The seating of any valve used for such a purpose shall be maintained by the pressure within the lifting cylinder. Springs or weights shall be used only to assist initial movement of valve mechanism to the seated position.

A prominent notice shall be displayed stating that hand lowering shall be undertaken only by experienced persons and only after the driving motor has been disconnected from the electrical supply.

12.7 ANTI-CREEP DEVICE

NOTE: An anti-creep device is a device used to limit automatically a change in car level caused by leakage in the hydraulic system.

All hydraulic lifts, other than service lifts, shall be provided with an anti-creep device conforming to the following requirements:

- (a) It shall automatically limit the car movement within 75 mm of the landing from any point within the interlocked zone irrespective of the hoistway door or doors.

The device will operate only in the landing level interlocked zone.

- (b) For electro-hydraulic lifts it shall be required to operate the car in the "up" direction only.

- (c) For maintained pressure hydraulic lifts it shall be required to operate the car in both directions.

The operation may depend on the availability of the electrical power supply provided that:

- (i) the disconnect switch is kept in the closed position at all times except during maintenance, repairs and inspection; and
- (ii) the electrical protective devices shall not cause the electrical power to be removed from the anti-creep mechanism except when such a device operates in consequence of driving motor failure.

12.8 CHECK, RELIEF AND OTHER AUXILIARY VALVES

A check valve shall be provided and shall be so installed that it will hold the lift car with the contract load at any point when the pump stops or the mains pressure drops below the minimum operating pressure.

Check, relief and other auxiliary valves shall be designed to withstand a static pressure equal to twice the design pressure without permanent deformation.

The relief valves shall be located between the pumps and the check valve and shall be of such a type and so installed in a by-pass connection that the valve cannot be shut off from the hydraulic pump. The return from the valve shall be passed directly to the tank and not to the suction side of the pump.

The relief valve shall be pre-set to open at a pressure not greater than 125% of the working pressure of the pump.

The size of the relief valve and by-pass shall be sufficient to pass the maximum rated capacity of the pumps without raising the pressure more than 20% above that at which the valve opens. Two or more relief valves may be used to obtain the required capacity.

Relief valves having exposed pressure adjustments shall have their means of adjustment sealed.

12.9 CONTROL VALVES

The main control valves shall be so constructed that they will remain closed to the supply when pressure is shut off.

Valve spindles or plungers shall be positively restrained against their being forced from the valve casing.

Electrically controlled valves shall be so designed and installed that they fail to safety in the event of power failure.

Every hydraulic lift shall be controlled by a stop valve and a non-return valve. The non-return valve shall be placed as close as possible to the machine control valve.

Control valves shall be constructed as to effectively seal the circulating pipe to the machine in the event of control failure.

12.10 HYDRAULIC TESTS

Hydraulic tests of twice the design pressure shall be carried out on all parts subject to pressure on completion of assembly.

SECTION 13—SERVICE LIFTS

13.1 COMPLIANCE

Service lifts shall comply with the foregoing rules except where instructions to the contrary are given in the rules that follow.

13.2 CONTRACT LOAD

The machine, supporting structure, car and all parts and equipment of a lift shall be designed and constructed to safely carry a contract load of not less than 220 kilograms per square metre based on the car floor area.

A load plate bearing the contract load in kilogrammes shall be fitted at each landing in a conspicuous position.

Refer to NZBC F8 Signs.

13.3 WINDING MACHINE

13.3.1 Position

The winding machine, together with its control mechanism and ancillary equipment, may be placed in the area of the liftwell above the limits of the car travel provided suitable access is provided.

Note: No lift machine shall be hung from the overhead supporting beams.

13.3.2 Lifting Beam

A beam for lift machine parts need not be provided.

13.4 CLEARANCES

13.4.1 Car Bottom Clearance

The car bottom clearance shall be such that when the car rests on completely compressed buffers the distance between the underside of the car (guide shoes or rollers, safety gear, toe guards and other equipment round the perimeter of the car excluded) and the bottom of the pit shall be at least 150 mm.

13.4.2 Car Top Clearance For Lifts With Counterweights

The car top clearance for lifts with counterweights shall be not less than the sum of the following dimensions:

- the bottom counterweight runby.
- 1.5 times the stroke of the counterweight buffer.
- 75 mm ^{plus} above the projection of any part of the car or its equipment above the car roof.

13.4.3 Car Top Clearance For Lifts Without Counterweights

Car top clearance for lifts without counterweights shall be not less than either of the following:

- 0.5 metres ~~from the car top.~~ plus car top runby
- the projection of any part of the car or its equipment above the car plus 150 mm. plus car top runby.

13.4.4 Counterweight Top Clearance

Counterweight top clearance shall not be less than the sum of the following dimensions:

- (a) the bottom car runby.
- (b) 1.5 times the stroke of the car buffer.
- (c) 150 mm.

13.5 BUFFERS

Buffers of service lifts may be of rubber or timber for lift speeds up to the maximum permitted by these rules.

13.6 ENCLOSURE DOORS

Enclosure doors shall have a maximum height of 1.25 m and need not be fitted with vision panels.

13.7 ROPES

A single rope may be used for the cars and counterweights of service lifts. The rope factor of safety based on maximum static load for car and counterweight ropes shall be not less than 10. The minimum diameter of ropes shall be 6 mm.

13.8 DRUMS, SHEAVES AND PULLEYS

The diameter of drums, sheaves or pulleys shall be not less than 30 times the rope diameter.

13.9 LIFT CAR SERVICES

Lift cars need not be provided with either normal or emergency lighting, nor opening for ventilation purposes.

13.10 CAR ENTRANCES

Provided there is only one car entrance, gates or doors need not be fitted to the car. Where there are two entrances, they should both be provided with means of preventing goods projecting outside the car.

Where car gates or doors are fitted electrical interlocks need not be provided.

13.11 EMERGENCY SIGNALS AND ALARMS

Emergency signalling devices and alarms need not be fitted.

13.12 ENCLOSURE DOORS

Where enclosure doors are more than 0.75 m above floor level mechanical door locks need not be fitted.

13.13 EMERGENCY STOP

An emergency stop button need not be provided.

13.14 FINAL TERMINAL STOPPING DEVICE

Final terminal stopping devices need not be fitted.

13.15 SAFETY GEAR

The fitting of safety gears to cars and counterweights is not required.

13.16 GOVERNOR

Speed governors are not required.

Rule 13.4.5 Clearances and safety for maintenance personnel:

Clearances at the top and the bottom of the car need not be provided for service lifts.

Provision shall be made to prevent trapping of maintenance personnel under the lift car. This shall be provided by a manually positioned prop, or other equally effective device, capable of holding the lift car with its contract load, in a raised position.

