GENERAL STANDARD

FOR

ELECTRIC AND HYDRAULIC ELEVATORS

FIRST EDITION

JUNE 2004

This standard specification is reviewed and updated by the relevant technical committee on Oct. 2013. The approved modifications are included in the present issue of IPS.

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS is based on internationally acceptable standards and includes selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS:

Throughout this Standard the following definitions shall apply.

COMPANY:

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER:

Means the “Company” where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract documents.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR:

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR:

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

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0. INTRODUCTION

This Standard gives the amendment and supplement to American Society of Mechanical Engineers Standard ASME A17.1-2010/CSA B44-10 "Safety Code for Elevators and Escalators". For ease of reference, the clause (or paragraph) numbering of ASME A17.1 has been used throughout this Standard. Clauses in ASME A17.1 not mentioned remain unaltered. For the purpose of this Standard the following definitions shall hold:

Sub.: The ASME Std.; clause is deleted and replaced by a new clause.

Del.: The ASME Std.; clause is deleted without any replacement.

Add.: A new clause with a new number is added.

Mod.: Part of the ASME Std.; clause is modified and/or a new statement or comment is added to that clause.

Note 1: This is a revised version of the standard specification for Electric and Hydraulic Elevators, which is issued as revision (1). Revision (0) of the said standard specification with IPS-M-GM-370 (0) No. is withdrawn.

Note 2:

This standard specification is reviewed and updated by the relevant technical committee on Oct. 2013. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 398 on Oct. 2013. These modifications are included in the present issue of IPS.

PART 1

GENERAL

SECTION 1.1 SCOPE

1.1.1 Equipment covered by this code **(Mod.)**

This Standard contains the minimum requirements relating to the elements of design, construction, selection, installation, operation, inspection, testing, maintenance, alteration and repair of electric and hydraulic passenger and good elevators for use in refinery services, chemical plants, gas plants, petrochemical plants and building administer.

Compliance by the elevator manufacturer with the provisions of this Standard does not relieve him of responsibility of furnishing elevator and accessories of proper design, mechanically suited to meet guarantees at specified service conditions.

No deviations or exceptions from this Standard shall be permitted without the written prior approval of the Purchaser.

Intended deviations shall be separately listed by the Vendor and supported by reasons thereof for Purchaser's consideration. **(Mod.)**

1.4. REFERENCES **(Add.)**

Throughout this Standard the following dated and undated standards / codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date, shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

A17.1-2010 "Safety Code for Elevators and Escalators"

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-GN-100 "Engineering Standard for Units"

IPS-I-GN-335 "Periodic Inspection & Testing of Elevators" **(Add.)**

1.5. UNITS **(Add.)**

The International System (SI) of Units, dimension and rating in accordance with IPS-E-GN-100 shall be used, Unless otherwise specified. **(Add.)**

PART 2

ELECTRIC ELEVATORS

SECTION 2.1 - CONSTRUCTION OF HOISTWAYS AND HOISTWAY ENCLOSURES

2.1.1 Hoistway enclosure

2.1.1.1 Fire-resistive construction

2.1.1.1.3 The only permissible openings are:

a) Openings for landing doors.

b) Openings for inspection and emergency doors to the well and inspection traps.

c) Vent openings for escape of gases and smoke in the event of fire.

d) Ventilation openings.

e) Permanent openings between the well and the machine or pulley rooms. **(Mod.)**

2.1.1.5 Strength of enclosure

The structure of the well shall be able to support at least the loads which may be applied by the machine, by the guides at the moment of safety gear operation, or in the case of off-centering of the load in the car, by the action of the buffers, or those which may be applied by the anti-rebound device.

In the case of elevators without car doors, the wall facing the car entrances shall possess mechanical strength such that when a force of 300 N is applied at right angles to the wall at any point on either face, being evenly distributed over an area of 5 cm^2 in round or square section, they shall:

a) resist without permanent deformation;

b) resist without elastic deformation greater than 10 mm. **(Mod.)**

SECTION 2.30 GUIDANCE TO CONTRACTING PARTIES (Add.)

2.30.1 Exchange of Information (Add.)

If the projected installation is one of the arrangements described in 2.32.1, the following guidance will enable the preliminary scheme for the installation to be established.

These should be finally settled at the earliest possible stage by detailed investigation, with the purchaser's representative reaching agreement with the lift contractor, where necessary, before an order is finalized. This will enable a check to be made and information to be exchanged on such essential matters as:

a) the number, capacity, speed and disposition of the lifts necessary to give adequate lift service in the projected building;

b) the special requirements of local authorities and other requirements set out in the planning permit;

c) relevant statutory regulations;

d) the provision of safe and convenient access to the machine room;

e) the loads that the lift will impose on the building structure, the holes to be left in the machine room floor and the cut-outs for wall boxes for push-buttons and signals;

f) the necessity for and type of isolation to minimize the transmission of vibration and noise to other parts of the building;

g) machine room heating and ventilation;

h) the need for the builder to maintain accuracy of building in relation to dimensions and vertical alignment (see 2.31.2);

i) the time required for preparation and approval of relevant details and drawings for the manufacture and the installation of the lift equipment;

j) the requirements for fixing guide brackets to the building structure;

k) the time at which electric power will be required before completion of the lift contract;

l) the requirements for electrical supply, feeders, associated switchgear, etc.;

m) the requirements for scaffolding in the well and protection of the well prior to and during installation and testing of equipment. **(Add.)**

2.30.2 Elevator Enquiry or Invitation to Tender (Add.)

2.30.2.1 General (Add.)

The enquiry documents should be kept to the essential minimum and should be strictly confined to material relevant to the elevator work and to the particular project concerned.

The following (a) to (n) is an example of the basic data needed by the elevator contractor for each elevator; this list is not exhaustive:

a) Customer's identification of elevator.

b) Installation arrangement (see Section 2.31).

c) Rated load and speed (see Section 2.31).

d) Lift travel and floor-to-floor heights.

e) Location and designation of levels served.

f) Installation arrangement of multiple lift installation.

g) Electricity supply (voltage, etc.).

h) Power system and duty cycle (see 2.32.2.2, 2.32.2.3 and 3.30.2).

i) Control system and indicators (see 2.32.2.4, 2.32.3.5).

j) Additional items (see 2.30.2.2).

k) Finishes (see 2.30.2.3).

l) Inclusions and exclusions (see 2.30.2.4).

m) Site programme (see 2.30.2.5).

n) Capacity and availability of craneage facilities. **(Add.)**

2.30.2.2 Additional items (Add.)

The enquiry should specify any additional items, such as dismantling of existing lift, vision panels, forced ventilation, landing architrave, telephone, level of fire resistance, special controls (see 2.32.2.5 and 3.30.2.4).

Lifts to be installed in adverse conditions, such as chemical works; lifts used with power trucks; and lifts used in vandalprone situations and similar specialized applications require individual consideration according to the circumstances. **(Add.)**

2.30.2.3 Finishes (Add.)

Finishes should be specified at the enquiry stage or an allowance should be taken into account in the initial costing.

Finishes to be considered may include:

a) lift car enclosure;

b) lift car ceiling;

c) lift car floor;

d) lift car light fitting;

e) lift car trims;

f) lift car and landing doors;

g) landing architraves;

h) push-button and indicator fittings in lift car and at landings. **(Add.)**

2.30.2.4 Inclusions and exclusions (Add.)

A number of peripheral items are associated with a lift installation, of which some should always be provided by the building contractor and some are best included by the lift contractor. The requirements vary to some extent with the type of installation. It is important that the limits of responsibility are clearly understood, and the enquiry documents should be specified in this respect.

The lift contractor will normally supply such items as:

a) guide brackets;

b) buffers and metal stools for the buffers (where applicable);

c) pit screen for counterweight;

d) machine and pulley subframes (in cast iron or fabricated steel);

e) sound and vibration isolation for the machine, where this is required;

f) sill support member (with toe guard and/or facias) for all except good lifts;

g) interlocks for access, inspection and emergency doors;

h) power supply for emergency lighting and alarm signals;

i) electrical wiring and cables for the lift itself, terminating in the main switch in the machine room furnished by the purchaser;

j) alarm push-button and bell or other intercommunication system (which may be limited to that part of the system contained within the well);

k) lifting tackle and small electric tools for use during the actual installation;

l) services of erection staff to install and wire;

m) services of testing engineer, and provision of the necessary instruments and test weights; The lift contractor does not normally:

1) carry out builders work, such as forming the lift well, pit and machine room or building in wall inserts;

2) cut away and make good;

3) form the machine room floor, including any reinforcement necessary for load bearing;

4) supply or fix lifting beams in machine room;

5) supply or fix structural steelwork for machine and buffer supports;

6) provide safe and adequate access to the machine room and lift well;

7) supply or fix steel surrounds for vertical bi-parting sliding doors;

8) supply or fix still support members (with toe guards) for general purpose goods lifts;

9) carry out any necessary tanking, lining or reinforcement of the pit;

10) supply or fix dividing beams for multiple wells and inter-well screens,

11) supply or fix access doors to machine room, pit and pulley room, emergency doors and inspection doors and their locks;

12) supply or fix temporary guarding of openings;

13) provide temporary protection (over and above the additional protective skin) of finished lift equipment on loadings, and if necessary in the car;

14) supply or fix scaffolding, planks and ladders;

15) off-load and store in a protected area the lift materials and equipment that he has delivered;

16) paint site steelwork supplied by other parties;

17) supply or install any electrical wiring external to the well and machine;

18) supply or install working lights, temporary and permanent electricity supplies, etc. (see 2.30.3.7 and 2.32.3.3);

19) provide a three-phase electrical supply for a mobile plat-form or hoist fitted in well, if required;

20) provide messrooms, sanitary accommodation and welfare facilities for his personnel;

21) bore the hole and provide the liner for the jack on hydraulic lifts;

22) provide craneage facilities;

23) supply and fix permanent access ladders, steps and guard rails.

For more detailed discussion of the requirements for site preparation and work by other trades, reference should be made to 2.30.4 and other clause, such as 2.32.3.

The provision of architraves, or finish surround to doors, should be the subject of agreement between the lift contractor and the customer. **(Add.)**

2.30.2.5 Inserts **(Add.)**

According to the construction methods adopted, inserts for attaching equipment may be required. The primary responsibility for the supply of inserts should be with the builder and where possible the type of insert specified should be in agreement with the lift contractor. Due allowance should be made in the builder's bill of quantities. **(Add.)**

2.30.2.6 Site programme **(Add.)**

The enquiry should indicate as accurately as possible the contract programme as it affects the lift maker, in particular the target date for lift completion, the date when the lift site will be prepared and the availability of a crane. **(Add.)**

2.30.3 Acceptance of Tender and Subsequent Procedure **(Add.)**

2.30.3.1 General **(Add.)**

The procedure indicated in 2.30.3.2 to 2.30.3.7 particularly relates to the most usual case, where the lift maker is a subcontractor. **(Add.)**

2.30.3.2 Order **(Add.)**

The main contractor is instructed to place an order with the selected lift maker. If alternative schemes have been offered, the order should clearly indicate which has been accepted. **(Add.)**

2.30.3.3 Programme **(Add.)**

As noted in 2.30.2.6 the programme should have been indicated as accurately as possible at the times of enquiry.

At the time of order, the programme for manufacture and installation of the lift should be agreed. The programme should cover each lift separately, including dates such as:

a) the order date;

b) the date when the lift site will be ready;

c) the date for provision of lift electricity supplies;

d) the lift completion date.

The period between order and delivery of materials falls into two stages; first the finalizing of details and secondly the actual production of the equipment, which depends on the first stage. Within the first stage, other dates may need to be considered, such as when:

1) all relevant building information will be available;

2) builders drawings prepared by the lift contractor will be available;

3) the layout drawings will be approved;

4) the finishes will be finally accepted;

Information relevant to programming the site work can be found in 2.30.3.4. **(Add.)**

2.30.3.4 Drawings **(Add.)**

After the order has been placed the lift contractor should supply drawings showing builders work required and the point loadings. To enable these to be prepared, the purchaser's representative should furnish the relevant detail building drawings. **(Add.)**

2.30.3.5 Approval of drawings **(Add.)**

The purchaser's representative should give written approval of the drawings referred to in 2.30.3.4 submitted by the lift contractor (after modification if necessary and within the limitations of the information provided), and at the same time ask for such additional copies (normally up to five of each drawing) required for distribution to other parties concerned. **(Add.)**

2.30.3.6 Selection of finishes **(Add.)**

Where the contract provides for the purchaser's choice of architrave styling, decorative features, finishes, colors, etc., the decisions should be communicated by the purchaser's representative as early as possible and preferably not later than the time of approving the drawings. Decision delays can adversely affect the completion of the contract. **(Add.)**

2.30.3.7 Electricity supplies to lift **(Add.)**

Whilst a temporary electricity supply may be provided (See 2.32.3.3), final testing and setting up should be carried out with the permanent supply connected. For this reason, the timely provision of the permanent supplies is important, and if not available when required, it may necessitate additional work. **(Add.)**

2.30.4 Co-Ordination of Site Work (Add.)

2.30.4.1 Preparatory work on site (Add.)

It is customary for the lift contractor to make periodic visits to the site before his starting date to check progress on the lift well construction and discuss relevant matters with the building contractor.

The lift contractor should assure himself that all building work has been carried out in accordance with his requirements. Immediately before the time for lift installation to commence, the lift contractor should check that site conditions are fit to permit installation to proceed. The building work which should be completed before lift installation starts includes that listed in (a) to (i) below:

a) Pit to be dry and watertight, including tanking if necessary, and clear of rubbish.

b) Well complete and watertight and equipped with well lighting (permanent if possible).

c) Machine room complete and watertight, with full lighting, cleared of rubbish, dustproofed and with access secure against unauthorized entry, including temporary warning notice and lock, with key available exclusively to authorized personnel.

Note: In certain system buildings and buildings of over 10 floors, it may be necessary, by prior agreement, to start erection before the top portion of the lift well has been constructed, in which case the general contractor should temporarily deck out and waterproof.

d) Preparation for lift fixings in pit, lift well and machine room complete. If built-in wall inserts are used, these should be placed accurately and slots thoroughly cleaned out.

e) Steel work items (e.g. lift well trimmers and machine beams) finally grouted or otherwise fixed in position after checking for correct position by the lift contractor.

f) Scaffolding in position, as agreed with the lift contractor; lift well, etc., properly fenced and guarded in accordance with current statutory regulations.

g) Entrance preparations completed, including preparations for door frames, push button boxes and indicators. In many cases progress can be facilitated by omitting the front walls of the lift well until the lift car, doors, etc., are installed.

h) Datum-line (in elevation) established at each floor to enable the lift constructor to set metal sills and frames in relation to finished floor levels.

i) Plan dimensions in accordance with clause 2.31.2. **(Add.)**

2.30.4.2 Delivery of material (Add.)

The lift contractor should advise the building contractor when equipment is ready for dispatch, so that the latter can make arrangement on site to receive and unload with appropriate hoisting tackle, slings and supports, as near as possible to the lift well. **(Add.)**

2.30.4.3 Storage (Add.)

Adequate provision should be made by the building contractor for storing, protecting and preserving against loss, deterioration or damage, all material on the site.

Note: Attention is drawn to the adverse effect of damp conditions on electrical equipment and on steel wire ropes. (Add.)

2.30.4.4 Site meeting (Add.)

For the successful progress of the work, full cooperation between all parties is essential, and on large sites it will be found that regular meeting of such parties are beneficial.

Programmes for the constructional work in that part of the building containing the lift should be made in consultation between all parties concerned. **(Add.)**

2.30.4.5 Services of other trades (Add.)

The lift contractor will require the services of joiners, bricklayers and other trades as the work proceeds, and it is essential that the lift contractor should give due notice to the building contractor of the demands to be made on other trades, so that he can plan accordingly. **(Add.)**

2.30.4.6 Scaffolding, fencing, etc. (Add.)

Scaffolding, timbers, rollers and similar plant required for the unloading and installation of the lift and also for the proper guarding and close fencing of the lift well should be provided, erected and maintained by the building contractor.

The lift well should not be used as a means of disposal for rubbish from the upper floors. Such practice is dangerous. The lift well and machine room should be handed over to the lift contractor complete, and no other trades should be allowed work in them during the whole time of installation of the lift, except by arrangement with the lift contractor. **(Add.)**

2.30.4.7 System building sites (Add.)

If the building programme allows insufficient time for lift installation in conventional fashion after the well is completely built, special procedures are needed. This applies particularly to industrialized multi-storey buildings. Methods differ in detail. In most cases, however, the building contractor’s crane is used to lower and position pre-assembled batches of lift equipment into the progressively rising top of the lift well. The building contractor should provide a suitable portable cover for the completed portion of the lift well in order to protect the lift erectors working below against the weather and falling objects. When the top of the well has been reached, it is normal practice to cap it immediately with a precast load-bearing floor slab on to which is lowered the pre-assembled machine room equipment. It then remains for the building contractor to complete and weatherproof the machine room as swiftly as possible. On all such projects as these the closest cooperation between the building contractor and the lift contractor is essential. **(Add.)**

2.30.4.8 Connecting to power supply (Add.)

The lift contractor should give prior warning to the building contractor of the date the power supply to the lift is required, so that suitable arrangements for connection can be made (see 2.32.3.3 and 2.32.3.4). **(Add.)**

SECTION 2.31 INSTALLATION ARRANGEMENTS AND DIMENSIONS (Add.)

2.31.1 General (Add.)

The rated speed and dimensions of the lift arrangements related to the rated load shall be as specified in and given in the following tables:

Light passenger, electric traction lifts	Table 2.31.2.1
Light passenger, hydraulic lifts	Table 2.31.2.2
General purpose passenger	Table 2.31.3
Bed/passenger	Table 2.31.4
General purpose goods	Table 2.31.5

It is important to make early planning for the access route into and through the building for introducing large or heavy components, e.g. hydraulic jack, pre-assembled car, and lift machine. If, owing to building restrictions, hydraulic jacks cannot be accommodated in single length, special arrangements may be necessary and the lift contractor should be consulted.

Note: Guidance on the selection of appropriate lifts is given in Section 2.32..

2.31.2 Dimensional Tolerance (Add.)

2.31.2.1 Lift well dimensions (Add.)

Owing to lifts having to move vertically through a building and the lift car and landing door equipment having to interconnect, the plumbness of the well and the alignment of the landing openings are of paramount importance. However, plan dimensions of lift wells given by the lift contractor represent minimum clear plumb sizes whatever type of construction is used.

The purchaser’s representative, in conjunction with the builder, should ensure that adequate tolerances are included in the building design so that plumb dimensions specified by the lift contractor are obtained in the finished work.

Dimensions in excess of these specified minimum plumb dimensions for lift wells and openings (but not less) can be accommodated by the lift contractor up to certain maximum values, i.e., those given in Table 2.31.1 (see 2.31.2.3), beyond which changes in design may be necessary involving additional expense or work by the builder. The purchaser’s representative should take these factors into account when specifying the lift well structural dimensions on the basis of the constructional tolerance appropriate to the building technique.

Where architratives are to be supplied by the lift contractor, it is particularly important to ensure there is true alignment with the, landing along the front line of the well. This sill line should serve as the datum-line for the well dimensions. **(Add.)**

2.31.2.2 Common well (Add.)

When several lifts utilize a common well, the inner plan dimensions shall be as follows:

a) the total width of the common well shall be equal to the sum of the individual well widths plus the sum of the boundary widths between the wells, each boundary width being at least 200 mm;

b) the depth of the constituent parts of the common well shall be the same as those laid down for the individual lifts;

c) the pit depth shall be that specified for the fastest lift in the group;

d) the minimum height above the highest level served shall be that specified for the fastest lift in the group. **(Add.)**

2.31.2.3 Structural limits of accuracy for lift wells at any level (Add.)

Fig. 2.31.1 illustrates the structural limits of accuracy pertaining to single and multiple well arrangements.

If the net well dimensions Ww and Wd and the nominal structural entrance opening dimensions C and D are defined by plumb lines, it is essential that the actual wall should not encroach upon the space bounded by those dimensions.

Dimension K in Fig. 2.31.1, which is the limit of accuracy of dimensions Ww and Wd should not exceed the value given in Table 2.31.1 according to well height.

TABLE 2.31.1

LIMITS OF ACCURACY OF WELL PLUMB DIMENSIONS	
WELL HEIGHT	**LIMIT OF ACCURACY K**
m	mm
30	25
>30 ≤60	35
>60 ≤90	50

In the case of multiple wells, dimension K is not applicable to the space between the plumb wells. See 2.31.2.2 for this space.

When architraves are to be supplied by the lift contractor, dimension L in Fig. 2.31.1, which is the limit of accuracy of dimensions C and D, pit depth Ph and headroom Sh, should not exceed 25 mm. The distance from plumb well to the outer face of the front wall, dimension M in Fig. 2.31.1 should not vary to an extent greater than can be accommodated by the subsequent front wall finish, the architraves being set accurately plumb.

When the entrance linings are supplied by the building contractor, corresponding provision should be made for the finished openings to be accurately plumb one above the other for the full travel of the lift and to design size. **(Add.)**

2.31.2.4 Special requirements (Add.)

When the counterweight is provided with a safety gear, either of the plan dimensions of the well (Ww and Wd) shall be increased as necessary. **(Add.)**

Note: The lift manufacturer should be consulted for details.

2.31.2.5 Floor to floor distance (Add.)

The minimum distance between two successive landings, to permit the accommodation of landing doors, shall be as given in Table 2.31.2. **(Add.)**

TABLE 2.31.2 - MINIMUM FLOOR TO FLOOR DISTANCES(Add.)

CLEAR ENTRANCE HEIGHT, Eh	DIRECTION OF DOOR OPENING	FLOOR TO FLOOR DISTANCE
mm 2000 2100 2300	Horizontally	mm 2450 2550 2750
2300 2500	Vertically	3700 4000

2.31.2.6 Landing area (Add.)

The depth of the landing shall be as given in Table 2.31.6.

This depth shall be maintained over at least the width of the well or the sum of the well widths.

Note: **The above landing area does not take account of any additional space required for the through traffic of persons not using the lifts (see Fig. 2.32.1). (Add.)**

2.31.2.7 Landing door openings (Add.)

It is essential that finished landing openings should be accurate to design size and vertically aligned one above the other for the full travel of the lift. In constructing the structural openings in concrete walls to lift wells it is often not possible to achieve a degree of accuracy vertically that will allow doors and frames to be inserted in the openings without some form of masking or packing to overcome inaccuracies. Provisions should therefore be made in design by increasing the nominal height from design finished floor level and width of openings to each jamb and head.

In addition, the alignment of the landing face of the front wall of the lift well is of importance when architraves of fixed dimensions are called for, and in this case the alignment of the landing face from floor to floor should not vary to a greater extent than can be accommodated by the subsequent front wall finish, the architraves being set accurately plumb. Where architraves are to be supplied by the lift contractor in conjunction with multiple wells, lateral alignment is especially important and necessary for visual acceptance.

To facilitate accurate alignment of landing sills, it is common practice to provide at each landing an independent threshold, the position of which can be adjusted. To prevent water draining into the well from cleaning or sprinkler operation, a slight fall away from the lift entrance is recommended.

(Add.)

2.31.3 Machine Room Dimensions for Electric Traction Lifts, Other than Residential and Similar Lifts (Add.)

2.31.3.1 Individual lifts (Add.)

The dimensions of the machine room shall be as given in Tables 2.31.2.1, 2.31.2.2 & 2.31.3 through 2.31.5. **(Add.)**

2.31.3.2 Multiple lifts (Add.)

The area and plan dimensions of the common machine room shall be as given in Table 2.31.7.

The minimum height of the common machine room shall be equal to the height of the machine room having the greatest individual requirement. **(Add.)**

2.31.4 Machine Room Dimensions for Hydraulic Lifts **(Add.)**

2.31.4.1 Individual lifts **(Add.)**

The dimensions of the machine room shall be as given in Table 2.31.2.2. **(Add.)**

2.31.4.2 Twin lifts **(Add.)**

Note: It is preferable that a common machine room should be provided.

2.31.4.2.1 Floor area **(Add.)**

The minimum floor area of a common machine room shall be as follows

a) lifts having identical rated loads: equal to the sum of the minimum areas for individual lifts placed behind the well;

b) lifts having dissimilar rated loads: equal to the sum of the minimum areas for individual lifts placed behind the well, plus the difference between the well areas of the two lifts.

(Add.)

2.31.4.2.2 Height **(Add.)**

The height of the machine room shall be as given in Table 2.31.2.2. **(Add.)**

2.31.5 Location of Machine Room **(Add.)**

2.31.5.1 Electric traction lifts **(Add.)**

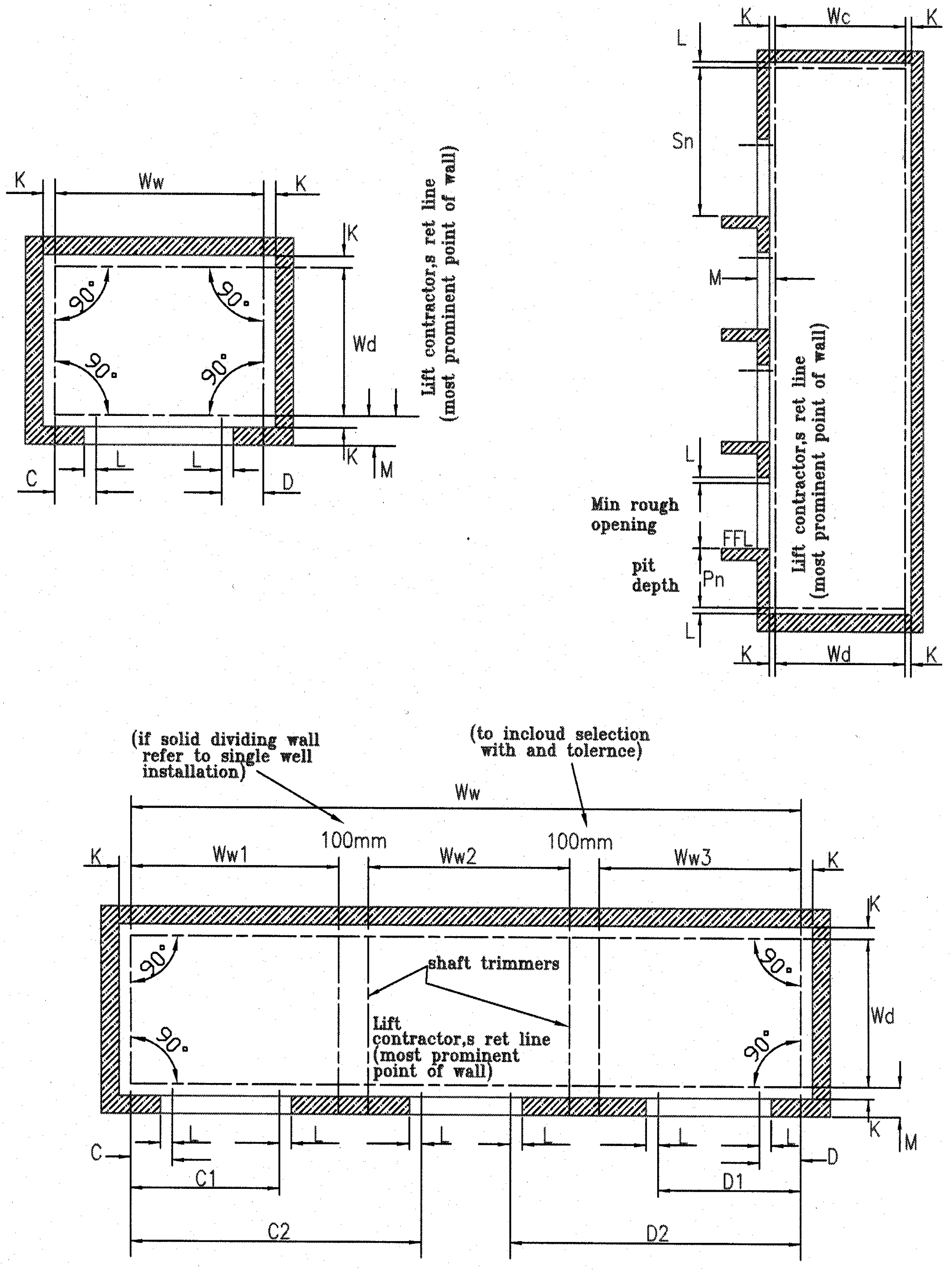
The area of the machine room shall be located directly above the well (or common well) and landings.

Note: Any necessary extension to achieve this minimum machine room area should be made by increasing the overall width. **(Add.)**

2.31.5.2 Hydraulic lifts **(Add.)**

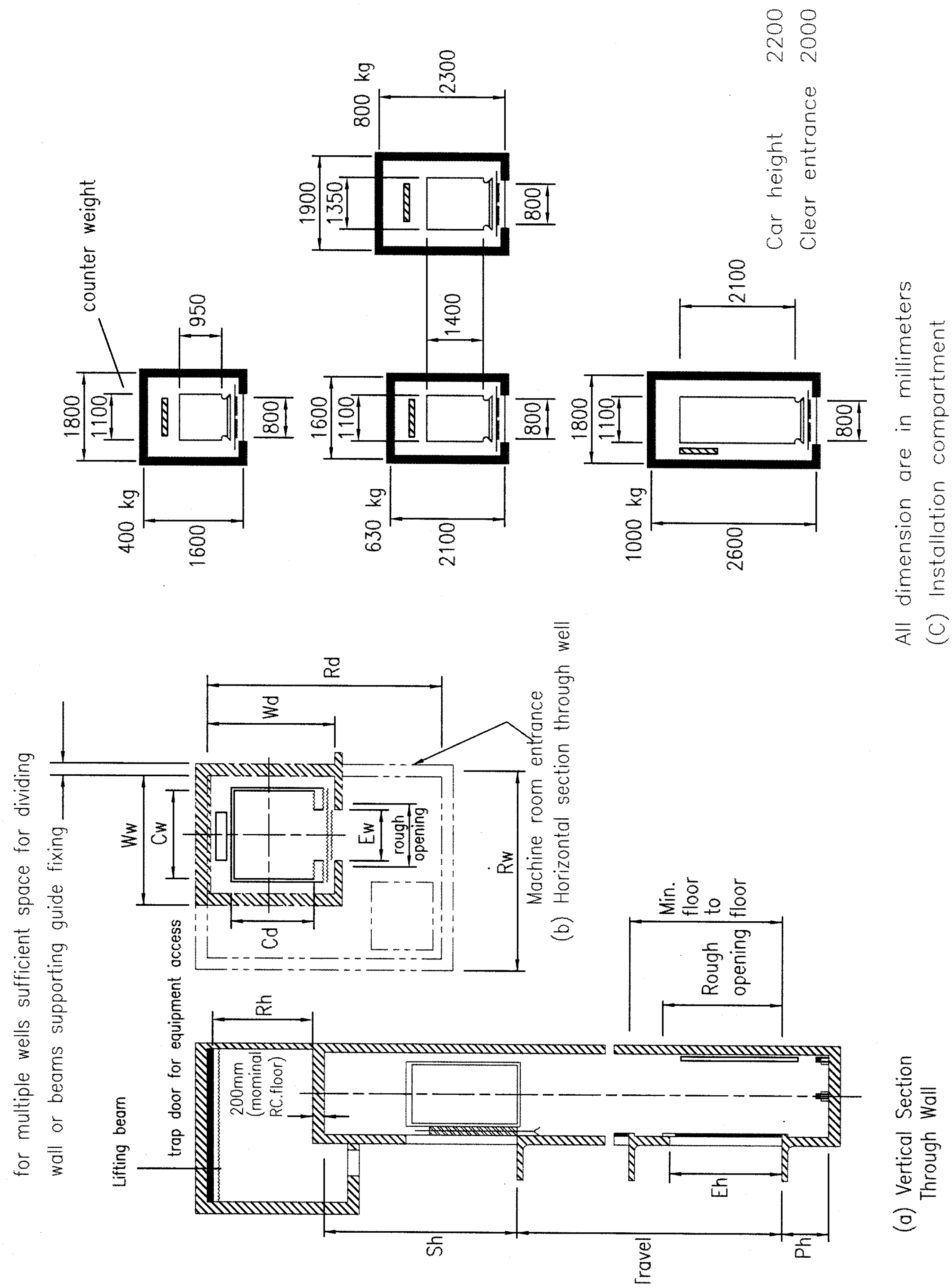
The machine room shall be located adjacent to the lift well at the lowest level served.

Note: If this is not practicable, the machine room may be remote from the lift well at a location which is not greater than 10 m from the well. **(Add.)**



Note: See 2.31.2.3 for explanation of symbols.

STRUCTURAL LIMITS OF ACCURACY
Fig. 2.31.1 (Add.)



LAYOUT OF LIGHT TRAFFIC ELECTRIC TRACTION LIFT INSTALLATIONS

Fig. 2.31.2.1 (Add.)

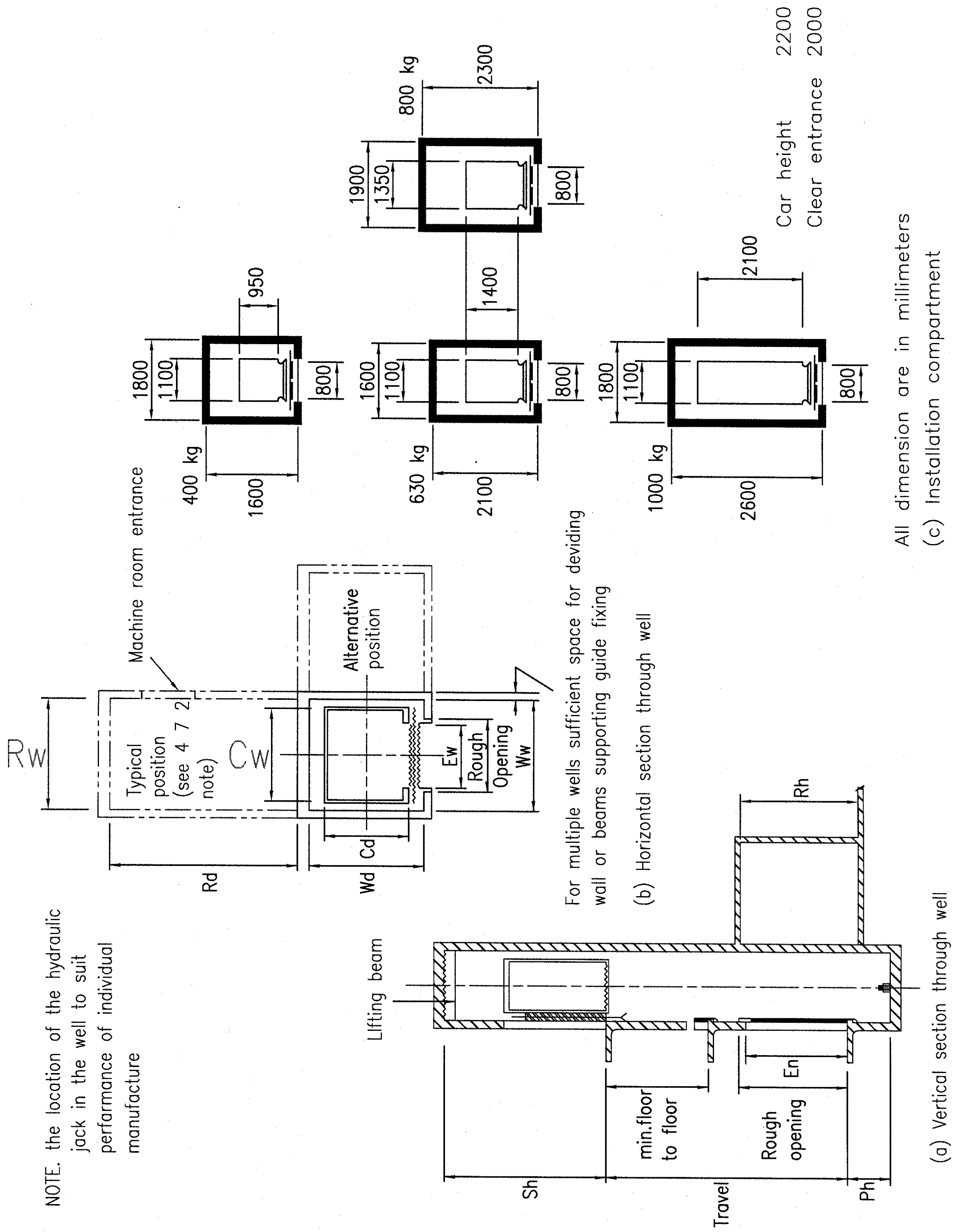
TABLE 2.31.2.1 - DIMENSIONS FOR LIGHT TRAFFIC ELECTRIC TRACTION LIFT INSTALLATIONS (Add.)

Typical applications. For the carriage of passengers in hotels, small offices, etc. residential health care buildings and residential buildings
Entrances. Power operated, two panel center opening, sliding doors.
Standard speeds (see note 1). These speeds are as follows:
(a) single speed V = 0.50 m/s
(b) two speed V = 0.63 m/s and 1.00 m/s
(c) variable speed V = 1.00 m/s and 1.60 m/s

Rated load	Max. no. of Passengers	Rated speed	Car internal sizes			Well min. dimensions		Clear entrance		Pit depth	Head room	Machine room min. dimension (see note 2)			
			Width	Depth	Height	Width	Depth	Width	Height			Area	Width	Depth	Height
Q		V	C_w	C_d	C_h	W_w	W_d	E_w	E_h	P_h	S_h	R_a	R_w	R_d	R_h
kg		m/s	mm	mm	mm	mm	mm	mm	mm	mm	mm	m^2	mm	mm	mm
400	5	0.50 0.63	1100	950	2200	1800	1600	800	2000	1400	3900	7.5	2200	3200	2300
		1.00								1500	4000				
630	8	0.50 0.63	1100	1400	2200	1800	2100	800	2000	1400	4000	15	2500	3700	2600
		1.00								1700					
		1.60									4200				
800	10	0.50 0.63	1350	1400	2200	1900	2300	800	2000	1500	4000	15	2500	3700	2600
		1.00								1700					
		1.60									4200				
1000	13	1.50 1.63	1100	2100	2200	1800	2600	800	2000	1500	4000	15	2500	4200	2600
		1.00								1700					
		1.60									4200			4200	2700

NOTE 1. The dimensions specified in this table are also valid for rated speeds lower than those stated.
NOTE 2. Select dimensions for R_w and R_d

(a) which are equal to or greater than those specified, and
(b) whose product produces an area which is equal to or greater than that specified for R_a.



LAYOUT OF LIGHT TRAFFIC HYDRAULIC LIFT INSTALLATIONS

Fig. 2.31.2.2 (Add.)

TABLE 2.31.2.2 - DIMENSIONS FOR LIGHT TRAFFIC HYDRAULIC LIFT(Add.)

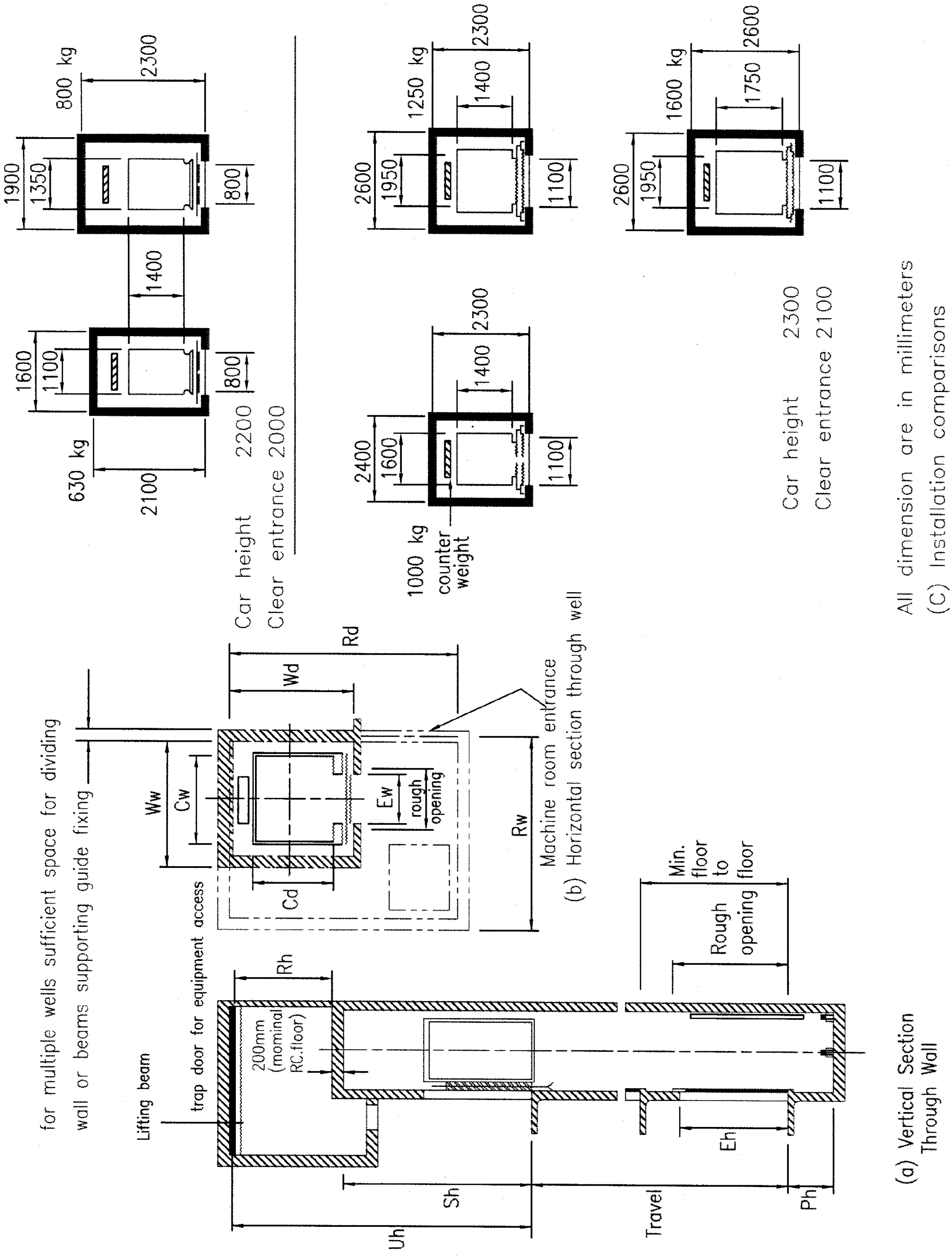
Typical applications. For the carriage of passengers in hotels, small offices, etc. residential health care buildings and residential buildings
Entrances. Power operated, two panel center opening, sliding doors.
Standard speeds (see note 1). These speeds are as follows:

v ≤ 0.5 m/s, 0.63 m/s and 1.00 m/s

Rated load	Max. no. of passengers	Rated speed	Car internal sizes			Well min. dimensions		Clear entrance		Pit depth	Head room	Machine room min. dimension (see note 2)			
			Width	Depth	Height	Width	Depth	Width	Height			Area	Width	Depth	Height
Q		V	C_w	C_d	C_h	W_w	W_d	E_w	E_h	P_h	S_h	R_a	R_w	R_d	R_h
kg		m/s	mm	mm	mm	mm	mm	mm	mm	mm	mm	m²	mm	mm	mm
400	5	0.50 0.63	1100	950	2200	1800	1600	800	2000	1400	3900	3.6	1800	2000	2300
		1.00								1500	4000				
630	8	0.50 0.63	1100	1400	2200	1800	2100	800	2000	1400	4000	3.6	1800	2000	2300
		1.00								1700					
800	10	0.50 0.63	1350	1400	2200	1900	2300	800	2000	1500	4000	3.8	1900	2000	2300
		1.00								1700					
1000	13	1.50 1.63	1100	2100	2200	1800	2600	800	2000	1500	4000	3.6	1800	2000	2300
		1.00								1700					

NOTE 1. The dimensions specified in this table are also valid for rated speeds lower than those stated.
NOTE 2. Select dimensions for R_w and R_d

(a) which are equal to or greater than those specified, and
(b) whose product produces an area which is equal to or greater than that specified for R_a.



LAYOUT OF GENERAL PURPOSE PASSENGER TRAFFIC ELECTRIC TRACTION LIFT INSTALLATIONS

Fig. 2.31.3 (Add.)

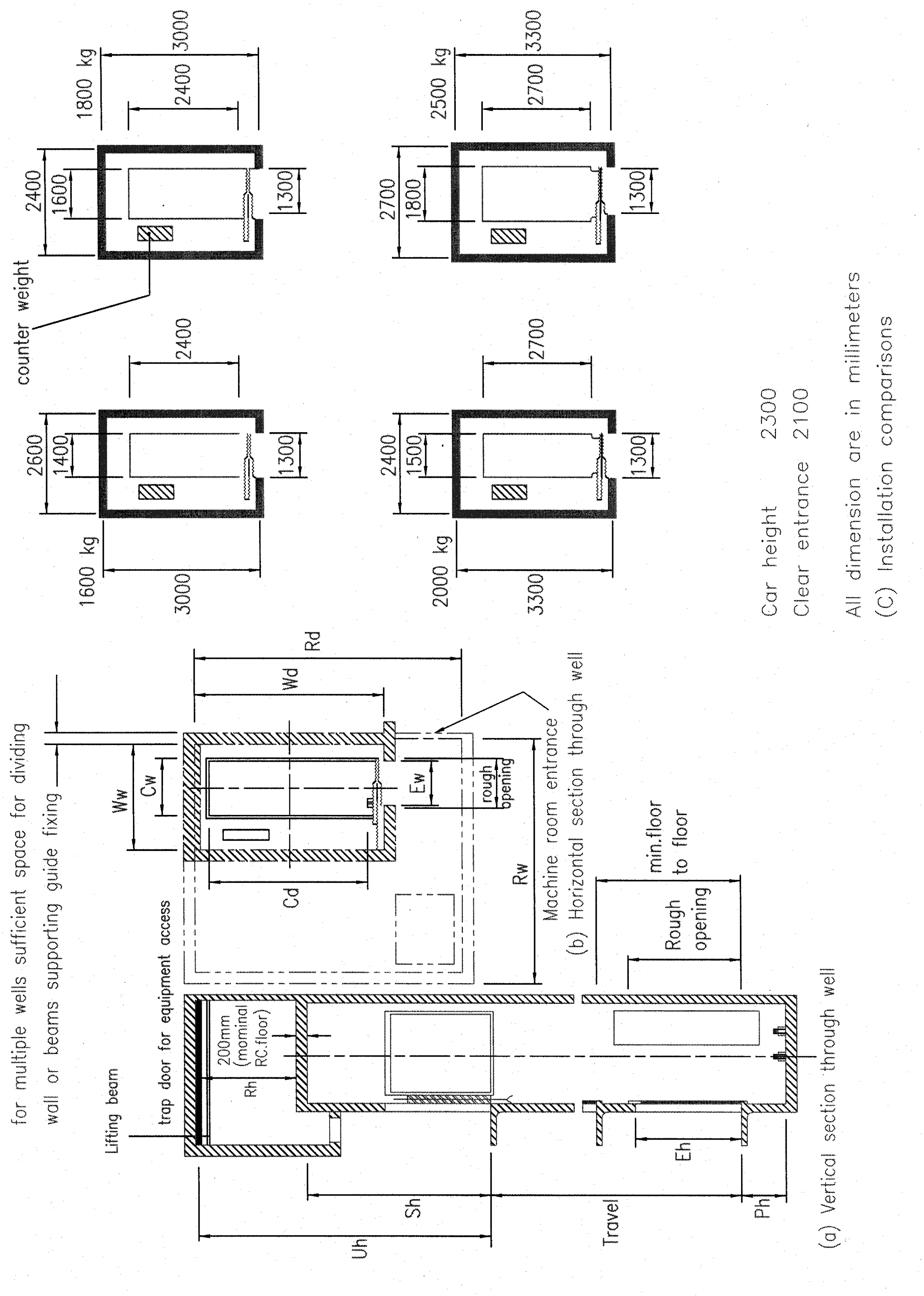
TABLE 2.31.3 - DIMENSIONS FOR GENERAL PURPOSE PASSENGER TRAFFIC ELECTRIC TRACTION LIFT INSTALLATIONS (Add.)

Typical applications. For the carriage of passengers in hotels, offices, buildings, hot8ls etc.
Entrances. Power operated, two panel center opening, sliding doors.
Standard speeds (see note 1). These speeds are as follows:
(a) two speed V = 1.00 m/s
(b) variable speed V = 100 m/s and 1.60 m/s

Rated load	Max. no. of passengers	Rated speed	Car internal sizes			Well min. dimensions		Clear entrance		Pit depth	Head room	Machine room min. dimension (see note 2)			
			Width	Depth	Height	Width	Depth	Width	Height			Area	Width	Depth	Height
Q		V	C_w	C_d	C_h	W_w	W_d	E_w	E_h	P_h	S_h	R_a	R_w	R_d	R_h
kg		m/s	mm	mm	mm	mm	mm	mm	mm	mm	mm	m^2	mm	mm	mm
630	8	1.00	1100	1400	2200	1800	2100	800	2000	1700	4000	15	2500	3700	2600
		1.60									4200				
800	10	1.00	1350	1400	2200	1900	2300	800	2000	1700	4000	15	2500	3700	2600
		1.60									4200				
1000	13	1.00	1600	1400	2300	2400	2300	1100	2100	1800	4200	20	3200	4900	2700
		1.60													
1250	16	1.00	1950	1400	2300	2600	2300	1100	2100	1900	4400	22	3200	4900	2700
		1.60													
1600	21	1.00	1950	1750	2300	2600	2600	1100	2100	1900	4400	25	3200	5500	2800
		1.60													

NOTE 1. The dimensions specified in this table are also valid for rated speeds lower than those stated.
NOTE 2. Select dimensions for R_w and R_d

(a) which are equal to or greater than those specified, and
(b) whose product produces an area which is equal to or greater than that specified for R_a.



LAYOUT OF BED/PASSENGER ELECTRIC TRACTION LIFT INSTALLATIONS

Fig. 2.31.4 (Add.)

TABLE 2.31.4 - DIMENSIONS FOR BED/PASSENGER ELECTRIC TRACTION (Add.)

Typical applications. For the carriage of beds and passengers in hospitals, nursing homes, residential homes and similar institutions.

Entrances. Power operated, two panel side opening, sliding doors.

Standard speeds (see note 1). These speeds are as follows:

- **(a) two speed V = 0.50 m/s and 0.63 m/s**
- **(b) variable speed V = 1.00 m/s and 1.60 m/s**
- **(c) gearless variable speed V = 2.50 m/s**

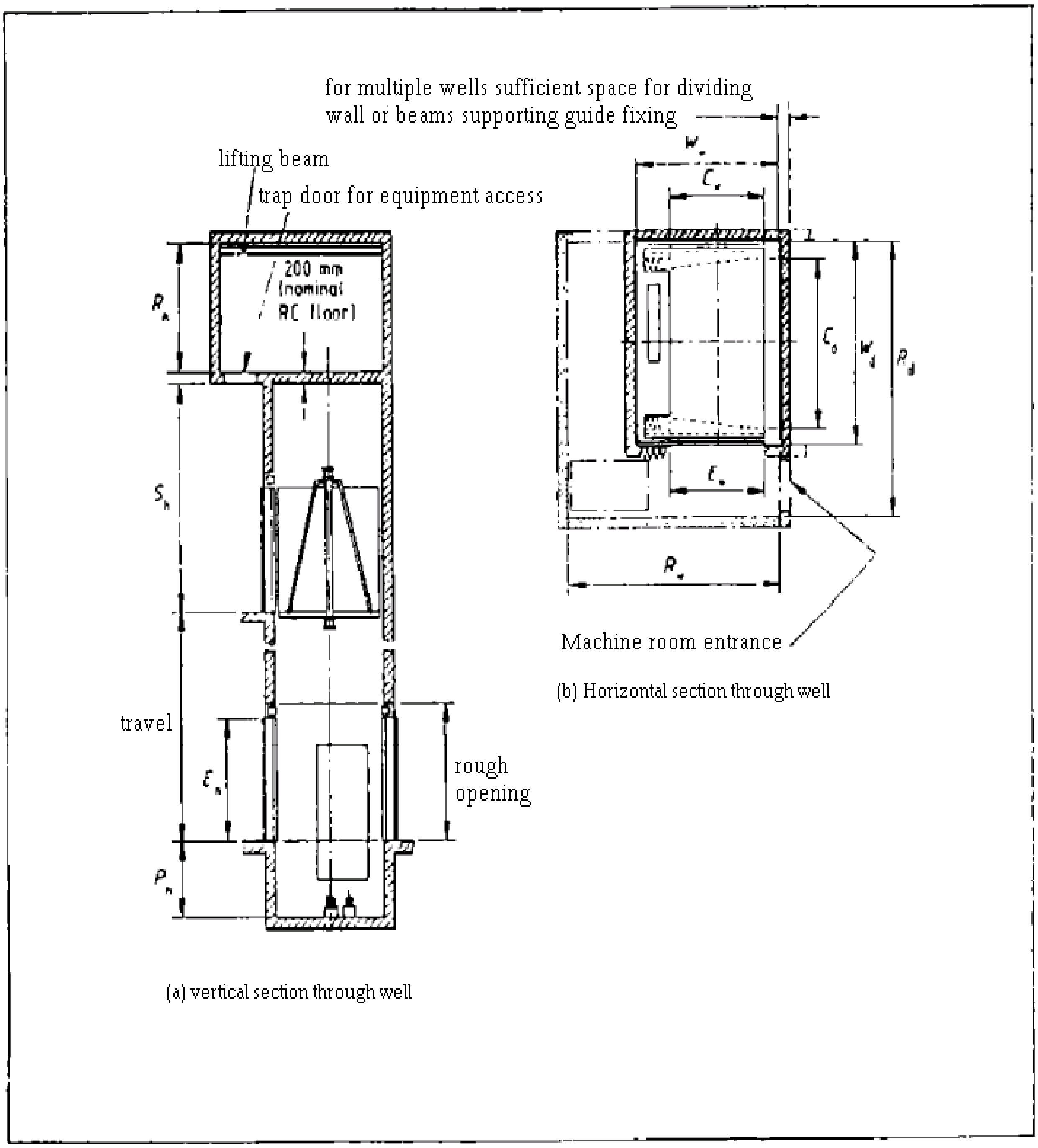
Rated load	Max. no. of passengers	Rated speed	Car internal sizes			Well min. dimensions		Clear entrance		Pit depth	Head Room	Overall Headroom	Machine room min. dimension (see note 2)			
			Width	Depth	Height	Width	Depth	Width	Height				Area	Width	Depth	Height
Q		V	C_w	C_d	C_h	W_w	W_d	E_w	E_h	P_h	S_h	U_h	R_a	R_w	R_d	R_h
kg		m/s	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	m²	mm	mm	mm
1600	21	0.50 0.63 1.00	1400	2400	2300	2400	3000	1300	2100	1700	4600	---	25	3200	5500	2800
		1.60								1900						
		2.50								3200						---
1800	24	0.60 0.63 1.00	1600	2400	2300	2400	3000	1300	2100	1700	4600	---	27	3200	5800	2900
		1.60								1900						
		2.50								3200	---	9700				---
2000	26	0.60 0.63 1.00	1500	2700	2300	2400	3300	1300	2100	1700	4600	---	27	3200	5800	2900
		1.60								1900						
		2.50								3200	---	9700				---
2500	33	0.60 0.63	1800	2700	2300	2700	3300	1300	2100	1800	4600	---	29	3500	5800	2900
		1.00								1900						
		1.60								2100						

NOTE 1. The dimensions specified in this table are also valid for rated speeds lower than those stated.

NOTE 2. Select dimensions for R_w and R_d

(a) which are equal to or greater than those specified, and

(b) whose product produces an area which is equal to or greater than that specified for R_a.



LAYOUT OF GENERAL PURPOSE GOODS ELECTRIC TRACTION LIFT INSTALLATIONS

Fig. 2.31.5 (Add.)

TABLE 2.31.5 - DIMENSIONS FOR GENERAL PURPOSE GOODS ELECTRIC TRACTION LIFT INSTALLATIONS (Add.)

Typical applications. For the carriage of goods and passengers in factories, industrial plants, warehouses etc.
Entrances. Collapsible sliding shutter doors on landing and car.
Standard speeds (see note 1). These speeds are as follows:

Rated load in kg (Q)	500	1000	1500	2000	3000
Single speed in m/s (V)	0.50	0.25	0.25	0.25	---
Two speed in m/s (V)	0.50 0.63 1.00	0.50 0.63 1.00	0.50 0.63 1.00	0.50 0.63 ---	0.25 0.50 0.63
Variable speed in m/s (V)	---	---	1.00	1.00	0.63

Rated load	Max. no. of passengers	Rated speed	Car internal sizes			Well min. dimensions		Clear entrance		Pit depth	Head room	Machine room min. dimension (see note 2)			
			Width	Depth	Height	Width	Depth	Width	Height			Area	Width	Depth	Height
Q		V	C_w	C_d	C_h	W_w	W_d	E_w	E_h	P_h	S_h	R_a	R_w	R_d	R_h
kg		m/s	mm	mm	mm	mm	mm	mm	mm	mm	mm	M^2	mm	mm	mm
500	6	0.50	1100	1200	2000	1800	1500	1100	2000	1400	3800	9	3700	3700	2400
		0.63 1.00								1500					
1000	13	0.25 0.50 0.63 1.00	1400	1800	2000	2000	2100	1400	2000	1500	3800	10	2100	4300	2400
1500	20	0.25	1700	2000	2300	2500	2300	1700	2300	1500	4000	14	2500	4500	2700
		0.50								1700	4100				
		0.63 1.00								1800	4200				
2000	26	0.25	1700	2500	2300	2500	2800	1700	2300	1500	4100	16	2500	5100	2900
		0.50								1700	4300				
		0.63 1.00								1800	4500				
2000	26	0.25	2000	2100	2300	2800	2400	2000	2300	1500	4200	17	2800	4700	2900
		0.50								1700	4400				
		0.63 1.00								1800	4500				
3000	40	0.25	2000	3000	2300	3000	3300	2000	2300	1500	4200	23	3000	5600	2900
		0.50								1700	4400				
		0.63								1800	4500				
3000	40	0.25	2500	2400	2300	3500	2700	2500	2300	1500	4200	24	3500	5000	2900
		0.50								1700	4400				
		0.63								1800	4500				

NOTE 1. The dimensions specified in this table are also valid for rated speeds lower than those stated.
NOTE 2. Dimension Cd gives the nominal internal depth of the car with the shutter doors in the closed position. When cosid erring clear internal depth of the car it is essential that allowance be made for the bunching of shuttered doors.
NOTE 3. The well depth W_d should be increased by 200 mm when entrances are provided at front and rear of car.
NOTE 4. Select dimensions for R_w and R_d

(a) which are equal to or greater than those specified, and
(b) whose product produces an area which is equal to or greater than that specified for R_a.

TABLE 2.31.6 - LANDING DEPTH (Add.)

TYPE OF LIFT	INSTALLATION	LANDING DEPTH
Non-residential, excluding bed/passenger	Individual	$\geq$ 1.5 × dimension C_d
	Multiple, side by side	Either $\geq$ 2400 mm, or $\geq$ 1.5 × the greatest C_d of the group,whichever is the greater
	Multiple, face to face	$\geq$ the sum of the greatest dimension C_d of the facing lifts and not greater than 4500 mm
Bed/passenger	Individual	$\geq$ 1.5 × dimension C_d
	Multiple, side by side	$\geq$ 1.5 × the greatest dimension C_d of the group
	Multiple, face to face	$\geq$ the sum of the greatest dimension C_d of the facing lifts

TABLE 2.31.7 - MINIMUM DIMENSION OF COMMON MACHINE ROOM FOR MULTIPLE ELECTRIC TRACTION LIFTS, OTHER THAN RESIDENTIAL AND OCCASIONAL PASSENGER TRAFFIC (Add.)

DIMENSION	ARRANGEMENT	
	Side by Side *	Face to Face *
Floor area	$R_a + 0.9\, R_a\, (N - 1)$	$R_a + 0.9\, R_a\, (N - 1)$
Width	$R_W + (N - 1)\,(W_W + 200)$	$R_W + \frac{(N-1)\,(W_W + 200)}{2}$
Dept.	R_d	$2W_d$ + distance between wells

*** N is the total number of lifts. In the case of an odd number of facing lifts, N is rounded up to the next even number.**

SECTION 2.32 SELECTION AND INSTALLATION OF ELECTRIC LIFTS FOR PASSENGER AND GOODS (Add.)

2.32.1 Preliminary Design (Add.)

2.32.1.1 Lift speed in relation to travel (Add.)

For major buildings and for groups of lifts there is no simple relationship between the rated speed and building height. The number and size of the lifts and the requisite handling capacity all have to be taken into account, as described in 2.32.1.2 to 2.32.1.5.

However, for broad guidance, and particularly in relation to single lifts, reference should be made to Table 2.32.1 the recommended travel limits being based upon current general practice. Goods lifts, for instance, can operate generally at lower speeds than general purpose lifts over the same travel, principally because traffic conditions are less demanding and more time is required for loading and unloading of goods. Also the leveling accuracy of goods lifts may be an important additional requirement.

In addition the functional use of the building may finally determine the choice of speed. This is particularly the case, where lifts may be zoned for local and express service or local, intermediate and express, with some lifts bypassig a number of floors in order to better serve a particular zone.

(Add.)

2.32.1.2 Number of lifts and capacity for passenger service (Add.)

The number of passenger lifts and their capacities, i.e. load and rated speed, required for a given building depend on the characteristics of the building. The most important of these are:

a) the number of floors to be served by the lift;

b) the pitch of the floors;

c) the population of each floor to be served;

d) the maximum peak demand, which may be unidirectional, as in up or down peak periods, or a two-way traffic movement.

It should be appreciated that all calculations on the traffic handling capabilities of lifts are dependent on a number of factors that vary according to the design of lift and the assumptions made on passenger actions.

It follows therefore that the result of such calculations can only be put to limited use of a comparative nature. For instance, they can with advantage be used to compare the capabilities of lifts in a group with different loads and speeds provided the same set of factors are used for all cases. On the other hand, they cannot be used to compare the capabilities of different makes of lift used for a given group of lifts.

Different authorities and manufacturers differ somewhat in their methods of calculation owing to the variations in lift performance, especially with regard to rates of acceleration and deceleration and door operation times, which form the components of performance time. Therefore the calculations made by different organizations will not necessarily agree. **(Add.)**

2.32.1.3 Preliminary lift planning (Add.)

2.32.1.3.1 General (Add.)

Methods of calculating the traffic handling capabilities of lifts were first devised for office buildings.

In due course detail modifications were devised to suit other applications without altering the basic principles. The application to office buildings is still the most frequently used.

The following general method may therefore be used as general guidance on preliminary lift planning for offices:

A lift installation for office buildings in normally designed to populate the building at a given rate and the three main factors to be considered are:

a) population or the number of people who require lift service;

b) handling capacity or the maximum flow rate required by these people;

c) interval or the quality of service required. **(Add.)**

2.32.1.3.2 Population (Add.)

The first thing to establish from the eventual occupier is the total building population and, whether this is likely to increase in the future.

If a definite population figure is unobtainable, an assessment should be made from the net area and probable population density. Average population density can vary from about one person per 4 m² to one person per 20 m². It is essential therefore that some indication of the probable population density should be obtained from the building owner. If no indication is possible (a speculative development for example) population in the region of 10 m² per person for general office buildings should be assumed. **(Add.)**

TABLE 2.32.1 - RECOMMENDED LIFT TRAVEL IN RELATION TO RATED SPEED (Add.)

REFERENCE IN SECTION 10			RECOMMENDED UPPER LIMIT OF LIFT TRAVEL FOR STATED TYPICAL APPLICATION				
Class of Lift Arrangement	Rated Speed	Table and Figure	Residential Buildings	Small Offices, Hotels, etc.	Large Offices and Hotels, etc.	Hospitals, Nursing Homes, Residential Homes, etc.	Factories, Wershouses, Shops, etc.
Light Passenger	m/s 0.50 and 0.63 1.00 1.60	10.2	m 12 20 35	m 10 20 30	m — — —	m — — —	m — — —
General Purpose Passenger	1.00 1.60	10.3	— —	20 30	20 30	— —	— —
Bed/Passenger	0.50 and 0.63 1.00 1.60	10.4	— — —	— — —	— — —	12 25 40	— — —
General Purpose Goods	0.25 0.50 and 0.63 1.00	10.5	— — —	— — —	— — —	— — —	8 15 25

2.32.1.3.3 Handling capacity (Add.)

Having established the population requiring lift service, it is necessary to determine the flow rate at which people will enter the building and require transportation to higher floors. This will vary according to:

a) the type of building occupation;

b) the location of railway stations and bus stops;

c) whether the building is in the heart of the city or in the suburbs;

d) the starting and finishing habits of the building population, i.e. unified or staggered working.

This flow rate is usually expressed as the percentage of the total population requiring lift service during a 5 min period, and this is known as the handling capacity of the installation. It may vary between 10% and 25%. If no information is available on the flow rate to be expected, 12% may be assumed for speculative buildings or buildings where staggered starting times will be practiced, and 17% for buildings where unified starting times will exist. **(Add.)**

2.32.1.3.4 Interval (Add.)

The interval is expressed in seconds and represents the round trip time of one car divided by the number of cars interconnected in the common group system and provides a criterion for measuring the quality of service. The average waiting time may therefore be expressed theoretically as half this interval, but in practice it is probably nearer three-quarters of the interval.

For office buildings, the interval may be specified as not exceeding, for example, 30 s. For comparison purposes, intervals of 30 s and under are considered to be excellent, 45 s is satisfactory for diversified office buildings and 60 s and over is poor In blocks of flats, intervals might increase to as much as 90 s to 100 s and can still be considered satisfactory.

Although interval has little meaning during the morning peak, it is the theoretical criterion of measurement by which the quality of service is measured. Whilst actual passenger waiting time is the real measure, there is no ready means of calculation. The reference values given above are measurements of quality. The interval during the inter-peak period, particularly during lunch periods, when intensive two-way demands exist, will result in a passenger waiting time approximately 50 % greater than during the morning peak. **(Add.)**

2.32.1.3.5 Performance data and calculations (Add.)

The number and sizes of lifts finally selected should provide a performance capable of dealing with the anticipated flow rate. Tables 2.32.2 and 2.32.3 provide average performance figures for various sizes and rated speeds of lifts based on car sizes and entrances in accordance with Section 2.31, with average floor heights of 3.3 m and all lifts serving all floors. An interconnected collective control system is also assumed with an automatic highest call reversal feature.

From these tables, several combinations consisting of a different number of lifts of varying loads and speeds, all providing the transportation capacity required, may be selected.

For the purposes of these performance data tables, a building that has 10 floors above ground with a total travel of 33 m would be designated as 11 floor building.

The calculations would be the same if the floor pitches were 4.5 m between ground and first, and between first and second, with 3 m pitch for the remainder, provided the total number of stops was 11 and the total travel remained at approximately 33 m.

These calculations cover only groups of lifts serving all floors. Where buildings consist of more than 18 floors, high rise and low rise groups of lifts may be more economic; in these instances specialist advice should be sought.

The selected combinations, however, will show different intervals, and a final selection should be made according to the quality of service required.

Tables 2.32.2 and 2.32.3 do not make allowance for serving basement floors. It is becoming more common for car parks to be located in a basement, and lift service may be required at this floor at the same time as peak ground floor traffic is experienced. Where a single basement condition exists, calculations may be made as described above, ignoring the basement, but the handling capacity of each combination is reduced on average by 20%, and the interval is increased by approximately 20%.

To ensure the performance figures given in Tables 2.32.2 and 2.32.3 it is essential that groups of lifts should be planned for efficient passenger movement; Fig. 2.32.1 shows the recommended grouping (see also 2.32.1.5).

From the various group combinations satisfying the transportation capacity requirement selected, one of these combinations may then be chosen that provides the required quality of service by the interval criterion.

TABLE 2.32.2 - PASSENGER LIFTS PERFORMANCE DATA FOR SIX TO NINE FLOORS SERVED (Add.)

No. of Floors*	No. of Cars	Rated Speed	8 Passengers 630 kg		10Passengers 800 kg		13 Passengers 1000 kg		16 Passengers 1250 kg		21 Passengers 1600 kg	
			Interval	Handling capacity (Persons)	Interval	Handling capacity (Persons)	Interval	Handling capacity (Persons)	Interval	Handling capacity (Persons)	Interval	Handling capacity (Persons)
		m/s	s		s		s		s		s	
6	2	1.0	38	50	---	---	---	---	---	---	---	---
	2	1.6	32	61	36	69	39	79	42	89	47	103
	3	1.0	25	75	---	---	---	---	---	---	---	---
	3	1.6	21	91	24	103	26	120	28	135	32	157
7	2	1.6	35	55	39	61	43	71	46	80	---	---
	3	1.6	---	---	---	---	25	107	31	122	35	140
8	2	1.6	37	51	42	55	46	64	---	---	---	---
	3	1.6	---	---	---	---	31	97	35	111	38	132
9	3	1.6	---	---	---	---	33	93	36	105	40	123
	2	2.5	---	---	---	---	46	66	48	75	---	---
	3	2.5	---	---	---	---	30	100	33	114	38	132

*** Based on 3.3 m floor-to-floor heights and lifts serving all floors (including main floor but excluding basements). Cars and entrances are as specified in Section 2.31.**

Example 1

It is required to design a lift installation in an office building located in the suburbs of a provincial town. It has eight floors above ground each with 3.3 m pitch (floor-to-floor distance) and 925 m² in net rentable area.

The building will be let to a number of tenants whose starting and leaving times are unlikely to coincide. The population above the ground is given as 740. In the event of the population not being given, it should be estimated on the basis of, say, 10 m² per person.

Estimated population above ground:

$$925 \times \frac{8}{10} = 740$$

Since the flow rate is not given it should be assumed as 12%.

Required handling capacity per 5 min to satisfy 12% flow rate:

$$740 \times \frac{12}{100} = 89 \text{ persons per 5 min.}$$

The travel of the lift is number of floors above ground × floor pitch:

$8 \times 3.3 = 26.4$ m

From Table 2.32.1 the rated speed required for 26.4 m travel for lifts in offices is 1.6 m/s.

TABLE 2.32.3 - PASSENGER LIFTS PERFORMANCE DATA FOR 10 TO 18 FLOOR SERVED (ADD.)

No OF FLOORS*	No OF CARS	RATED SPEED	13 PASSENGERS 1000 kg		16 PASSENGERS 1250 kg		21 PASSENGERS 1600 kg	
			INTERVAL	HANDLING CAPACITY (PERSONS)	INTERVAL	HANDLING CAPACITY (PERSONS)	INTERVAL	HANDLING CAPACITY (PERSONS)
		m/s	S		S		S	
10	3	1.6	35	86	38	97	44	113
	3	2.5	32	98	34	106	40	124
	4	2.5	24	126	26	141	29	116
11	3	1.6	37	83	40	91	---	---
	3	2.5	34	92	36	100	43	118
	4	2.5	25	123	27	132	32	157
12	3	2.5	35	88	38	95	44	112
	4	2.5	26	117	29	126	33	149
	3	3.5	---	---	37	98	43	115
	4	3.5	---	---	27	130	32	152
13	3	2.5	36	84	40	91	46	106
	4	2.5	27	113	30	121	34	142
	4	3.5	---	---	29	125	34	145
	5	3.5	---	---	23	156	27	182
14	3	2.5	38	81	41	87	---	---
	4	2.5	28	109	31	116	36	135
	4	3.5	---	---	30	120	35	140
	5	3.5	---	---	24	151	28	175
15	4	2.5	29	105	32	112	37	130
	4	3.5	---	---	31	116	36	135
	5	3.5	---	---	25	146	29	168
	6	3.5	---	---	---	---	24	202
16	4	2.5	30	102	33	108	39	125
	4	3.5	---	---	32	113	38	130
	5	3.5	---	---	26	141	30	163
	6	3.5	---	---	---	---	25	195
17	4	2.5	31	99	35	105	40	123
	4	3.5	---	---	33	110	39	127
	5	3.5	---	---	26	137	31	157
	6	3.5	---	---	---	---	26	189
18	4	3.5	---	---	34	107	40	124
	5	3.5	---	---	27	134	32	153
	6	3.5	---	---	---	---	27	184

*** Based on 3.3 m floor-to floor heights and lifts serving all floors (including main floor but excluding basements). Cars and entrances are as specified in Section 2.31.**

The performance data given in Table 2.32.2 cover this example of a lift service to ground and eight floors above, i.e. nine floors. From this table it is seen that handling capacity of 93 persons per 5 min can be given by three 13 passenger cars. This is satisfactory as it complies with the above requirement and also gives an interval of 33 s. **(Add.)**

2.32.1.4 Quality service for office buildings (Add.)

For office buildings it may also be taken, for very general guidance, on quality of service only, that the following number of lifts are required, interconnected in one group:

a) For excellent quality of service: one lift required for every three floors.

b) For average quality of service: one lift required for every four floors.

c) For below average quality of service: one lift required for every five floors.

This is reflected in the average performance data given in Tables 2.32.2 and 2.32.3, which assume that all lifts are available for service. **(Add.)**

2.32.1.5 Grouping of passenger lifts **(Add.)**

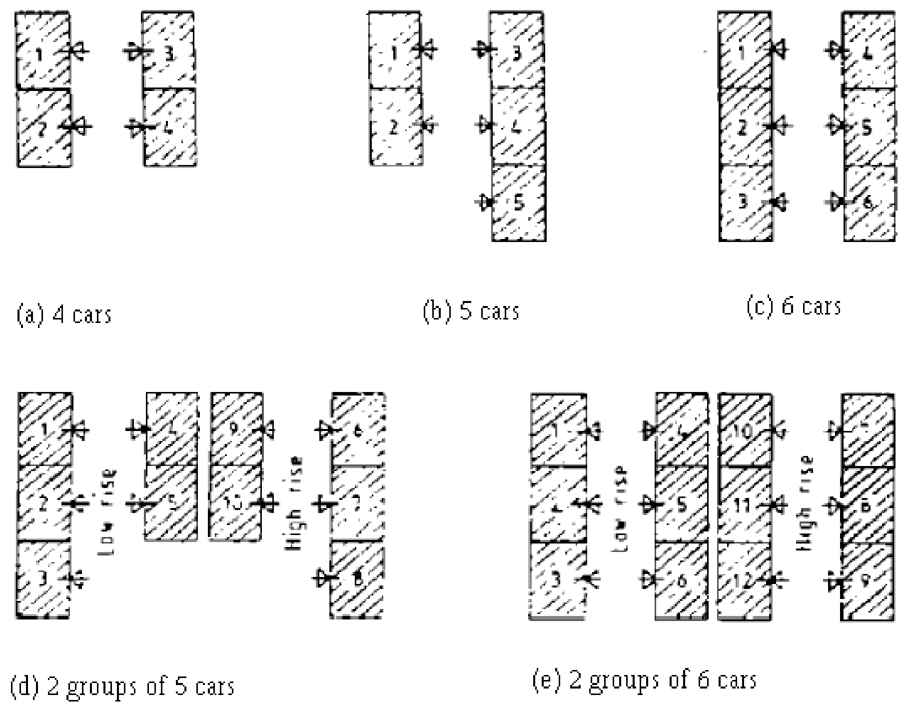
When a building requires a number of passenger lifts, it is almost certain that the vertical transport system will operate at a much greater degree of efficiency if all the lifts are located together. There is no greater fallacy in the location of lifts than the thought that by spreading the lifts throughout the building, potential passenger's time is saved.

It is true that some passengers walking time is saved but this is more than offset by the increase in the average waiting time for lift service. Furthermore, passengers tend to be far more impatient when standing still and doing nothing waiting for a lift to respond to their call for service, than they are actively engaged in walking to the lift lobby. Examples of recommended groupings are given in Fig. 2.32.1.

It is important that the carrying capacity of each lift in a group of lifts should be carefully considered, and normally a lift having a capacity of not less than 1000 kg should be installed except under very special circumstances. The minimum landing depth specified in Section 2.31 should be adhered to.

Note: Car capacities of eight or ten persons may be appropriate when the number of floors does not exceed eight.

In large buildings where groups of passenger lifts are provided, consideration should be given to providing a separate service facility in the form of one or more separate service facility in the form of one or more separate passenger/goods lifts which may also serve as fire-fighting lifts. **(Add.)**



GROUPING OF LIFTS
Fig. 2.32.1

2.32.1.6 Quiet operation (Add.)

No lift installation can be noiseless or silent in operation, and the intensity of noise will depend on particular circumstances. The location of lifts should be such as to cause minimum disturbance.

Dwelling spaces and especially bedrooms should not be sited adjacent to machine rooms.

Beams and structural members associated with the lift installation should not penetrate into such areas. Similar considerations will apply to office buildings and other quiet areas.

The purchaser's representative should consult the lift contractor and obtain his agreement in regard to the steps to be taken in the design of the building and the equipment to ensure compliance with any noise level requirements. Particular attention should be paid to the provision of the necessary degree of isolation of lift equipment from the building structure and the lift interior, and the provision of the necessary acoustic insulation cover within the lift and within the living areas surrounding the lift to attenuate airborne vibrations.

Whilst most acoustic specialists are aware of the quality of isolation necessary to meet specific requirements, it is strongly recommended that the purchaser's representative checks the operation of the lift contractor's equipment in as near similar conditions as possible to ensure satisfaction. It has frequently been found that identical lift equipment, about which noise complaints have been justified, has been perfectly satisfactory under a different building structural design.

No lift specification should include a requirement that the lift is to operate silently to the satisfaction of the purchaser's representative.

If the purchaser's representative requires the main contractor to ensure that the lift operates to the customer's specific acoustic requirements, such a request should be the subject of joint consultation between all parties concerned and should not be passed on as if it were solely the responsibility of the lift contractor.

2.32.1.7 Location of machine rooms (Add.)

It will be noted that all lifts complying with Section 2.31 have the machine room immediately over the lift well, and this arrangement should be used whenever possible without restricting the headroom, Sh, required for normal safety precautions.

Alternative machine positions should only be considered when there are special reasons justifying the additional cost, such as headroom restrictions imposed by the planning authority for lifts serving the top floor. This may result in well dimensions in excess of those specified in Section 2.31.

The specific position, type and anticipated loading of lifting supports will be detailed on the drawings prepared by the lift contractor, taking account of equipment access, changes of level in the machine room and final equipment location.

Unless the design is in accordance with Section 2.31 the contour of the lift machine room should not be finalized until the purchaser's representative, in conjunction with the lift contractor, is satisfied that it would meet the needs of the lift that is ultimately to be accommodated. **(Add.)**

2.32.2 Power and Control Systems (Add.)

2.32.2.1 General (Add.)

Lifts are increasingly being controlled by solid state devices in the form of either microprocessors or discrete component configurations. Solid state switching may be used for logic and/or motor control.

To ensure that failure or malfunction does not jeopardize the safe operation of the lift, solid state switching should not replace safety contacts.

All controllers, whether associated with fire-fighting lifts or not, should be unaffected by extraneous signals. Microprocessor controllers may include sophistications that are not easily achievable with relay controllers. **(Add.)**

2.32.2.2 Features associated with power systems (Add.)

2.32.2.2.1 Electrical controlgear and switching devices (Add.)

Control equipment for lift power systems is characterized by its high duty cycle and its high rupturing capacity. It should not be assumed that general purpose switchgear with nominal industrial rating is suitable for use in lifts, except possibly for the starting of motor generator sets.

(Add.)

2.32.2.2.2 Flameproof equipment in hazardous areas (Add.)

Owing to the complications involved in the use of flameproof equipment, the power and the control systems should be as simple as possible. Wherever possible, the machine room should be located in non hazardous areas so that normal equipment can be used. **(Add.)**

2.32.2.2.3 Leveling accuracy (Add.)

The leveling tolerances quoted in 2.32.2.3 are those that can be reasonably expected between no load and full load in either direction.

Where greater leveling accuracy is required, careful examination should be made to see whether such increased precision is justified or practical. Advice should also be obtained, as additional apparatus and cost may be involved, and in some cases the recommendations may not be practicable. **(Add.)**

2.32.2.2.4 Re-leveling (Add.)

Re-leveling should be used when it is otherwise impossible to achieve the required leveling tolerances, or on long travel lifts to maintain the required leveling tolerances during loading and unloading. **(Add.)**

2.32.2.2.5 Leveling with variable speed (Add.)

A variable speed system is one using continuous regulation that minimizes speed differences due to load variations. Therefore the actual leveling speed is of less importance than the general refinement of the lift speed pattern. In fact no leveling speed as such may be identifiable. **(Add.)**

2.32.2.3 Power system application (Add.)

2.32.2.3.1 General (Add.)

Guidance on the application of power systems for lifts is given in Table 2.32.4 and data on performance are given in 2.32.2.3.2 to 2.32.2.3.5. **(Add.)**

2.32.2.3.2 Lifts with single-speed a.c. motors (Add.)

The practical limit to a single-speed a.c. lift is a compromise between stopping comfort and leveling accuracy throughout the loading range.

This type of lift stops from full rated speed by means of mechanical braking and, according to severity of braking, can achieve a leveling accuracy of ±25 mm to ±40 mm at a rated speed of 0.5 m/s.

This speed and performance is generally acceptable for a simple economical lift, and therefore, for general use, 0.5 m/s is the recommended rated speed.

Single-speed a.c. lifts running at 0.25 m/s are suitable for use in low rise residential homes for the aged and infirm. For handling truck loads in goods lifts, greater accuracy of leveling is necessary, and therefore the rated speed should not exceed 0.25 m/s.

The lift rating in terms of starts per hour is 90. **(Add.)**

2.32.2.3.3 Lifts with two-speed a.c. motors (Add.)

The two-speed a.c. motors are generally of the pole-change brushless induction type with two well-defined running speeds, high and low. The speed ratio is usually 3:1 or 4:1 and sometimes 6:1. For an acceptable leveling accuracy of ±20 mm, the lower speed should not exceed 0.33 m/s, and should preferably be less. If the leveling speed is in the region of 0.1 m/s, a leveling accuracy of ±10 mm can normally be achieved.

Passenger comfort depends on the pattern of acceleration and deceleration. With this type of motor and simple control the standard maximum rated speed for general duty is 1.0 m/s. The lower rated speeds specified in Section 2.31 are adequate for many purposes.

The lift rating in terms of starts per hour is 120 at a rated speed of 0.63 m/s and 150 at a rated speed of 1.0 m/s.

2.32.2.3.4 Lifts with variable speed a.c. or d.c. motors (Add.)

For lifts where rated speeds higher than 1.0 m/s are required, or where superior performance in comfort, speed pattern or leveling accuracy is called for, then a motor and control system is needed that can closely regulate the lift running speed from start to stop under varying load conditions.

This is achieved in a number of ways with either a.c. or d.c. motors, in some cases using solid state device elements for supply or control purposes.

For a geared lift machine the standard maximum rated speed is 1.6 m/s and the appropriate leveling accuracy is ±10 mm. The lower rated speeds specified in Section 2.31 are adequate for many purposes.

The lift rating in terms of starts per hour is normally 180. Variable speed control systems are also suitable for bed lifts or large capacity goods lifts at the lower rated speeds, where accurate leveling is essential. In some such cases, however, the lift rating may be reduced.

TABLE 2.32.4 - POWER SYSTEMS AND RELATED STANDARD SPEEDS* (Add.)

APPLICATION	STANDARD RATED SPEED m/s ♣						
	≤ 0.25	>0.25 ≤ 0.50	>0.50 ≤ 0.63	>0.63 ≤ 1.0	>1.0 ≤ 1.6	>1.6 ≤ 2.5	>2.5 ≤ 3.5
Light Passenger		1x	2x	2x or V	V		
General Purpose Passenger				2x or V	V		
Bed/Passenger		2x	2x	V	V	G	
General Purpose Goods	1x or 2x	1x or 2x	2x or V	2x or V			

*** Summarized from Section 2.31 to which reference should be made for greater detail.**

♣ In this table, the following abbreviations are used:

1x denotes single speed;

2x denotes two speed;

V denotes variable speed;

G denotes gearless. **(Add.)**

2.32.2.3.5 Gearless variable speed lifts **(Add.)**

A change from a geared machine, described in 2.32.2.3.2 to 2.32.2.3.4 to a gearless machine becomes technically and economically justified at a rated speed of about 2.5 m/s, and this is the lowest standard rated speed for gearless machines. The motor control systems associated with these are considerably more sophisticated than those used for the geared lifts, and individual manufacturers should be consulted in relation to the performance of equipment in this range. **(Add.)**

2.32.2.4 Description of control systems **(Add.)**

2.32.2.4.1 Types of control systems **(Add.)**

The three basic types of control systems used on lift installations are:

a) non-collective control (see 2.32.2.4.2);

b) collective control (see 2.32.2.4.3);

c) group supervisory control (see 2.32.2.4.4).

Permutations of these control systems are possible for use in special installations. The lift contractor should be consulted if such installations are required. **(Add.)**

2.32.2.4.2 Non-Collective control **(Add.)**

Non-collective control is the simplest type of automatic control whereby the car answers a landing call only if it is available, i.e. the car at rest and the landing door closed, and is able to carry the passengers to their destination. Simple timing devices give passengers priority to register their car calls and leave the car without haste.

This type of control is particularly suitable for small residential buildings with light passenger traffic serving up to four floors and for goods lifts. **(Add.)**

2.32.2.4.3 Collective control **(Add.)**

2.32.2.4.3.1 General **(Add.)**

Collective control is a generic term for those methods of automatic operation by which calls made by pressing pushbuttons in the car and at lift landings are registered and answered by the car stopping in floor sequence at each lift landing for which calls have been registered, irrespective of the order in which the calls have been made and until all calls have had attention. Collective control of any form is usually not suitable for goods lifts.

The most common basic types of collective controls are described in 2.32.2.4.3.2to 2.32.2.4.3.5. **(Add.)**

2.32.2.4.3.2 None-Selective **(Add.)**

A non-selective control has a single push-button at each landing. It is not recommended, as the direction in which it is described to travel cannot be registered by the intending passenger. **(Add.)**

2.32.2.4.3.3 Down collective **(Add.)**

With a down collective control landing calls can be registered whether or not the car is available. The calls are registered by pressing the call push-button provided on each landing. If the car is free or descending, it will answer the landing call from the highest landing and then the other calls in succession as it approaches the main floor. Calls registered from the car will be retained at any time and answered in a logical sequence according to the direction of travel.

A down collective control can be used when there is normally no passenger traffic between floors (i.e. passengers make use of the lift from the main floor to a required floor, or vice versa) and where is no level to be served below the main floor. It can be used with a single lift or group collective lifts (see 2.32.2.4.3.4).

When one or more levels below the main floor level require to be served, the control is so arranged that the lift operates as down collective for the levels above the main floor and up collective for the levels below the main floor. **(Add.)**

2.32.2.4.3.4 Full collective **(Add.)**

A full collective control requires two call push-buttons on each intermediate landing, one for ascent and one for descent so that the passenger can indicate the direction in which he wishes to travel (one single push-button at the terminal landings).

Both landing and car calls registered are answered in logical sequence according to the direction of travel of the car.

A full collective control system is installed when interfloor traffic is expected during upward and downward travel. It can be used with a single lift or in group collective lifts (see 2.32.2.4.3.5). **(Add.)**

2.32.2.4.3.5 Group collective **(Add.)**

Groups of two or three cars are frequently interconnected and collectively controlled. One push-button station is required at each landing and the call system is common to all lifts in the group.

If, for architectural balance, as in the case of a three-car group, extra push-button stations are required, these should be specified. Each landing call is automatically allocated to the best placed car. The control is designed to space the cars and to give an even service. When a car reaches the highest floor to which there is a call, its direction of travel can be reversed when it next starts. One or more cars will return to a designated floor. Automatic bypassing of landing calls when a car is fully loaded is an essential feature. Any car under inspection or taken out of service would be isolated from the group whilst the other cars would continue to provide service to all floors.

When three-car groups serve seven or eight floors and over, some form of automatic supervisory control (as described in 2.32.2.4.4 is generally necessary in the interests of efficiency. **(Add.)**

2.32.2.4.4 Group supervisory control **(Add.)**

A group of passenger lifts serving a heavy traffic demand requires a supervisory system to coordinate the operation of individual lifts that are all on collective control and are interconnected. The very nature of intensive service calls for a sophisticated automatic supervisory control system so as to match the speed and capacity of these lifts. The supervisory system regulates the dispatching of individual cars and provides service to all floors as different traffic conditions arise, minimizing such unproductive factors as idle cars, uneven service and excessive waiting time. The system will respond automatically to traffic conditions such as up and down peaks, balanced or light traffic, and provides other specialized features.

If desired, a master station can be provide in the lift lobby that gives, by indicators, visual information regarding the pattern under which the system is operating. There are other facilities, such as the removal of any lift from service.

Since development in this field is continuing, lift contractors should be consulted as to the details of the systems available, especially of the indicators needed for the proper working of their individual systems. **(Add.)**

2.32.2.5 Features of control systems (Add.)

Note: When any preferential service is operative for a particular lift it will jeopardize normal service provided by that lift or group of lifts. (Add.)

2.32.2.5.1 Car preference service (Add.)

Sometimes it is necessary to give a special personal service or a house service. When this service is required and for whatever purpose, it should be specified as car preference service. The transfer from normal passenger control to car preference service is by a key-operated switch in the car. The operation is then from the car only and the doors remain open until a car call is registered for a floor destination. In the case of a single lift this means that landing calls cannot be registered. The removal of the key when the special operation is completed restores the control to normal service.

(Add.)

2.32.2.5.2 Independent service (Add.)

Sometimes it is necessary to give a special service where one lift in a group is required to operate separately in a full collective manner. When this service is required it should be referred to as independent service. The transfer from normal passenger control to independent service is by a key operated switch. The operation is then from an independent set of landing control stations that particular car responding in a full collective manner. **(Add.)**

2.32.2.5.3 Hospital service **(Add.)**

Lift for carrying beds and stretchers require a car preference switch so that an attendant can have complete control of the car when required. This requirement should be specified as car preference and it will function as described in 2.32.2.5.1.

Otherwise such lifts can have the same control systems as for normal passenger lifts, the choice depending on the number of floors served, the service required and the number of lifts. **(Add.)**

2.32.2.5.4 Priority service **(Add.)**

There are many forms of control giving special service for individuals, but they should always be avoided. They range from keyoperated switches at preferred landings to the complete segregation of one out of a group of lifts. It is obvious that any preferential treatment of this nature can seriously jeopardize the efficiency of the service as a whole.

When a group of, say, three lifts is installed to meet the anticipated traffic requirements, and then, when the building is occupied, one lift is detached permanently for a priority service, the traffic handling can be reduced by a half rather than a third. **(Add.)**

2.32.2.5.5 Manually operated doors (without closers) (Add.)

A door open alarm should be provided to draw attention to a car or landing door that has been left open. **(Add.)**

2.32.2.5.6 Automatic power operated doors (Add.)

For passenger operation, when the car arrives at a landing the doors will automatically open and then close after a time interval.

This time interval can be overruled by the operation of a car push-button or door close button. An open door pushbutton is provided in the car to reverse closing motion of the doors or hold them open. **(Add.)**

2.32.2.5.7 Controlled power operated doors (Add.)

When there are conditions that particularly affect the safety of passengers or damage to vehicles or trucks, the closing of the doors should only be made by the continuous pressure of push-buttons in the car or on landings. A door open alarm should be provided to draw attention to a car or landing door that has been left open. **(Add.)**

2.32.2.5.8 Vision panels (Add.)

The following practice should be adopted for vision panels in doors:

a) For lifts with manually operated car and landing doors, vision panels should be provided in all doors.

b) For lifts with power operated car doors and manually operated landing doors, vision panels should be provided in the landing doors only.

c) For lifts with automatically operated car and landing doors, vision panels need not be provided.

d) When vision panels are provided they should comply with 2.14.2.5, ASME A17.1-2000.

Not withstanding (b) and (c), there may be exceptional circumstances when it is considered necessary to provide vision panels. **(Add.)**

2.32.2.5.9 Push-Buttons and indicators (Add.)

It is most important that the purpose of every push-button and indicator should be clearly understood by all passengers. **(Add.)**

2.32.3 Electrical Installation (Add.)

2.32.3.1 Main supply (Add.)

The lift contractor should declare, on a schedule, values of full load current, starting current and its duration, maximum permissible voltage drop and other details to enable the electrical contractor to determine the size of the mains isolating switch. Where an installation has more than one lift supplied from a common feeder, a diversity factor may be applied to the cable size. Examples are given in Table 2.32.5.

TABLE 2.32.5 - EXAMPLES OF DIVERSITY FACTORS (Add.)

NUMBER OF LIFTS	DIVERSITY FACTOR
1	1.0
2	1.0
3	0.9
4	0.8

Note: Where the number of lifts is greater than four the lift contractor should be consulted.

It is important that mains isolating switches at the intake point and in the machine room (which are provided by the electrical contractor) should be the correct type and rating and accept high rupture capability (HRC) fuses.

The lift contractor should also declare the size and type of fuses to be fitted in the mains isolation switch in the machine room. In order that the lift contractor may specify these fuses correctly, the electrical contractor should state the prospective short circuit current at the inlet to the machine room.

It is permissible for the supply cable to the mains isolating switches for the lift installation and lift lighting circuits to be routed through the lift well.

The electrical installation up to the inlet terminal of the machine room isolating switches is not part of the lift installation.

Overcurrent protection for individual lift machines and switching control circuits should be provided by the lift contractor, either on the lift controller or by a circuit breaker, but the following points (a), (b) and (c), not within the supply of the contractor, should be noted.

a) The lift circuit from the intake room should be separate from other building services. In addition:

1) where a lift within a group is designated as a fire fighting lift;

2) where the installation consists of a single lift, and its supply is fused both in the lift machine room and at the inlet distribution board, the cable size and fuse ratings on the supply side of the machine room mains isolating switch should take account of the fact that overload current protection is provided by the lift contractor within the lift installation;

3) on groups of interconnected lifts, a separate circuit is required for the supervisory control system in order that any individual lift may be shut down without isolating the supervisory control for the remainder;

4) each and every lift in an installation should have its own individual fused mains isolating switch that is lockable in the off position;

5) no form of no volt trip mechanism should be included anywhere in a lift power supply.

b) The supply to the car lighting should be from a circuit separate from the lift power supply or taken from a point on the supply side of the mains isolating switch and controlled by a fused switch in the machine room. For multiple lifts with a common machine room, a separate fused switch should be provided for the lighting supply to each lift car.

c) The supply to the machine room and pulley room lighting and the socket outlets and to the well lighting should be taken from a circuit totally separate from the lift supply. **(Add.)**

2.32.3.2 Machine room, well and pit **(Add.)**

The circuits for the lighting and power supplies in the machine room, well and pit, whilst associated with the lift installation, do not constitute part of the lift installation specifies certain requirements that should be complied with, in particular the following.

a) Machine room (and all other rooms containing lift equipment):

1) lighting is required giving a level of illumination of at least 200 lx at floor level;

2) a lighting switch is required adjacent to every entrance to the room;

3) in every room containing lift equipment at least one 16 A socket outlet is required.

b) Lift well:

Lift well lighting is required and should be controlled by a switch within the machine room.

Two-way switching may be used in association with an additional switch in the well.

c) Pit, at least one 16 A socket outlet is required. **(Add.)**

2.32.3.3 Temporary supply **(Add.)**

A temporary electricity supply will be required by the lift contractor during installation in the machine room and inside the lift well in association with both lighting and socket outlets for power tools. These should be located in the well at intervals not greater than 7 m. The temporary supply should be 220 V a.c., center tapped to earth.

The lift contractor may also require a three-phase supply to operate a materials handling hoist. The capacity of this supply, if required, should be specified by the lift contractor.

The permanent electricity supply to the lift should be connected in sufficient to time to permit the running adjustments and tests that are necessary before lift completion can be carried out. If there will be a delay in connection of the main supply, a temporary supply of the same characteristics as the permanent supply should be provided to operate the lifts. Where stand-by supply operation is required (see 2.32.3.3), the stand-by supply should be made available during lift testing at a time to be agreed between the lift contractor and the client, in order to fully test the stand-by supply operation as a whole. **(Add.)**

2.32.3.4 Stand-By supplies **(Add.)**

Where it is required that the lift installation is to be supplied from a stand-by generator/battery during interruptions to the normal power supply, the level of performance of the lifts or reduction in lift service should be agreed between the lift contractor and the client.

The lift contractor should then specify the capacity of power supply required to give this performance and, in particular, the level of regenerated energy that the lift installation may be expected to give, and the stand-by supply to absorb, during such periods. Where appropriate, the lift contractor should specify the amount of harmonic distortion to be expected in the lift supply circuits in relation to both voltage and current.

Unless there is no break stand-by supply generator/battery of sufficient capacity to drive the lift system with the same performance as the permanent power supply, there should be a break of adequate duration after failure or restoration of the main supply so that the lift control system can re-set and enter or leave its stand-by supply mode. The actual duration of this break should be agreed between the lift contractor and the client.

A signal, in a form to be agreed between the lift contractor and the client, should be provided to indicate whether the supply is from the permanent supply or from the stand-by generator/battery.

Where there is insufficient capacity in the stand-by supply to operate the lift system as a whole, requiring certain lifts to be shut down during emergency periods of stand-by supply, those lifts which are to be taken out of service should initially return to a nominated floor to release passengers, if necessary in sequence or at a reduced speed.

Where there are several lifts or groups of lifts with separate machine rooms, the lift contractor should specify the number and sizes of electrical conductors required to run between machine rooms for stand-by supply mode control purposes. In addition, any special requirements with regard to segregation should be specified by the lift contractor.

Where there are remote indicators associated with the lift system giving, for example, information concerning lift position, due regard be given to the power supply requirements of these and whether this is to be derived from the stand-by supply. **(Add.)**

2.32.3.5 Communications (Add.)

Where the lift installation, including its external indicators and emergency communications, requires external data and/or signal/communication links, the number, sizes and types of these should be specified by the lift contractor.

Where special links, e.g. fiber optic data links, are required, the lift contractor should also specify the required terminations.

The positioning of external indicators and alarm bells should be specified by the client in his enquiry. **(Add.)**

2.32.3.6 Terminations (Add.)

All wiring and cables, other than those recommended in 2.32.3.1 and 2.32.3.2, of whatever types, that run outside the lift machine room, well and pit but are associated with the lift installation, should be installed by the electrical contractor to the specification of the lift contractor. The lift contractor should provide a schedule of all such cables/wiring with appropriate instructions as to any special precautions required in respect of terminations, limit on length of run, screening and/or segregation.

Unless otherwise agreed between the lift contractor and the electrical contractor, such wiring should be terminated in appropriate terminal boxes within the lift machine room or lift well.

The position of such boxes may be shown on installation drawings, but should be finally agreed with the lift contractor's site representative. The markings of terminals within such terminal boxes should be specified by the lift contractor. **(Add.)**

2.32.3.7 Markings (Add.)

All switches, controls and terminal boxes associated with the lift installation should be clearly and indelibly marked with their function and the equipment and/or lift to which they relate. All switches should also have their off position clearly and indelibly marked and should be of a type such that the on or off condition is clear and unambiguous **(Add.)**

2.32.3.8 Telephones (Add.)

When a telephone is to be provided in the lift car, the lift contractor should fit the cabinet in the lift car and provide wiring from the car to a terminal box adjacent to the lift well. Where a telephone is to be connected to an outgoing switchboard, an approved type of instrument should both be provided and fitted by a specialist contractor. The type of telephone should be specified in the enquiry. **(Add.)**

2.32.4 Conditions for Optimum Practice (Add.)

2.32.4.1 Application of suspension ropes (Add.)

2.32.4.1.1 General (Add.)

Satisfactory performance and service of lift rope suspension systems depend upon a number of interdependent factors, a relatively small variation in one may cause a disproportionate effect by other factors.

The recommendations given in 2.32.4.1.2 to 2.32.4.1.8 are based on experience that has been shown to produce systems with good performance. **(Add.)**

2.32.4.1.2 Factor of safety (Add.)

The factors of safety of the suspension wire ropes shall be as those specified in Section 2.20, ASME A17.1-2000.

2.32.4.1.3 Sheave diameter/rope diameter (Add.)

Clause 2.24.2.2 ASME A17.1-2000 specifies a ratio of sheave diameter to rope diameter of not less than 40: 1; in some cases it may be advantageous to increase this ratio in order to extend rope life. **(Add.)**

2.32.4.1.4 Number of pulleys (Add.)

As a rope passes over a pulley, flexing takes place, which induces wear and fatigue in the rope. Although the amount of wear will depend upon unit pressure on the groove and the profile of the groove, the more pulleys introduced into a roping system, the greater will be the wear. **(Add.)**

2.32.4.1.5 Multiplying pulleys (Add.)

If multiplying pulleys are used to extend the application of machines in relation to speed and load, the increased rope wear may often be outweighed by the economies thus achieved. **(Add.)**

2.32.4.1.6 Reverse bends (Add.)

Where multiplying pulleys or machine room at side or below lift well configurations is employed, the ropes will bend in differing planes. This will not have a serious detrimental effect on those parts of the rope most affected provided the minimum diameter of the pulleys are increased by at least 10% when the rope speed over such pulleys is greater than 0.5 m/s. **(Add.)**

2.32.4.1.7 Fleet angle (Add.)

When a rope leads on to or off a pulley in a plane that is not coincident with the radial plane of the pulley, the angle between these two pulleys/sheaves is fixed, the fleet angle of the ropes in relation to the grooves should not exceed 4° either side of the groove axis. Where the distance between the two points varies as the car travels, on the basis of rope life, the fleet angle should not exceed 1.4° when the car or counterweight is on a compressed buffer. **(Add.)**

2.32.4.1.8 Machine layouts (Add.)

The machine room should be located directly above the well. A machine room at the side of, or below, the lift well will introduce more pulleys and hence more flexing with the resulting shorter life of the ropes and should only be considered if it is not possible to arrange for the machine to be above the well. **(Add.)**

2.32.4.2 Application of compensation (Add.)

Compensation is sometimes used to minimize the out-of-balance rope tension on the driving sheave with the car at any position in the lift well due to the mass of suspension ropes and traveling cables.

This mass relationship should be minimized for long travel lifts as the traction between suspension ropes and driving sheave may be adversely influenced.

Rope compensation may be used for any travel, but it is usually only necessary for travels over 30 m.

For rated speeds of 2.5 m/s and above, steel wire rope should be hung between car and counterweight, and should pass round an idler tension pulley in the lift pit.

For rated speeds above 3.5 m/s, an anti-rebound arrangement of idler tension pulley should be used to prevent the counterweight jumping with engagement of the car safety gear. **(Add.)**

2.32.4.3 Securing of non-rotating shafts (Add.)

Where pulleys with sleeve journals rotate upon fixed axles, the axles should be restrained from all movement, for example to prevent the seizure of a pulley bearing causing the shaft to rotate in its supports.

A plain parallel shaft should not be restrained by set screws alone nor should a keep plate locating on a short tangential groove be used.

2.32.4.4 Application of worm geared machines (Add.)

Conditions peculiar to worm gearing for lifts, such as the relatively high torques during acceleration and retardation, varying load duty and frequent reversal of direction of rotation, militate against readily expressed ratings.

Owing to the heavy loads supported by lift gears, there is a safety aspect in the design which has to be related to the level of design stresses permitted. However, it has to be recognized that experience of lift gears under known service conditions is a most valuable and reliable basis for design.

Satisfactory performance and service life of lift gears depends upon a number of factors. The standard products of gear manufacturers are not generally satisfactory for lift applications. Good lift practice requires a careful choice of ratios between the effective pitch circle diameter of the worm wheel and the diameter of the traction sheave, accurate control of the tooth form and surface finish and control of the backlash between the worm and worm wheel teeth.

The anticipated duty cycle of a lift drive should be made known by the purchaser's representative when inviting tenders and the suitability of the gear offered should be discussed with the proposed manufacturer. **(Add.)**

2.32.4.5 Lift entrance operation (Add.)

2.32.4.5.1 General (Add.)

The type of door, and the operation of the doors, play a major part in the service provided by a lift and should receive careful consideration. **(Add.)**

2.32.4.5.2 Passenger traffic (Add.)

The passenger lifts specified in Section 2.31 embody fully power operated doors, Which contribute to efficient operation by simultaneous movement of car and landing doors; the door are set in motion as soon as the lift arrives level at the floor. As an aid to efficient operation, pre-opening of the doors as the car approaches a landing and is within the unlocking zone is usually incorporated on lifts with variable speed drive. It is normal practice for the doors to close automatically to ensure that the lift is always ready to respond to other calls. **(Add.)**

2.32.4.5.3 Goods traffic **(Add.)**

Most types of goods traffic require relatively longer loading and unloading times and manual doors are frequently used for economy and simplicity.

Power operation can be applied, especially for large entrances, to give automatic opening; the doors then always open to the full width of the car, reducing the risk of damage. For many types of goods traffic, it is preferable for the closing, though powered, to be controlled by continuous pressure push-button, rather than being automatically initiated.

For heavy duty goods lifts, power operated vertically sliding door panels are preferable; these can be made extremely robust and are suitable for very large entrances. **(Add.)**

2.32.4.6 Painting of lift equipment at works and on site **(Add.)**

Lift equipment will normally receive a protective coat of paint at works before dispatch to site. Further painting of lift equipment will be necessary, and is normally in the form of a finishing coat and can take place on site.

Alternatively, the further painting of the equipment may be carried out at works as a finishing coat with re-touching after site erection as may be necessary.

Any additional painting required owing to site conditions during erection and/or final operating conditions in the premises is subject to negotiation between the lift maker and the purchaser. Decorative finishes are a subject for separate negotiation. **(Add.)**

2.32.4.7 Special environments **(Add.)**

Lift equipment complying with Parts 1, 2, 3 is suitable for use inside normal residential, commercial and industrial buildings but where unusual environments are likely to be encountered, e.g. observation lifts the advice of the lift contractor should be sought at the earliest possible stage to enable the most economic satisfactory solution to be found. Special mechanical protection and/or electrical enclosures may be necessary, as well as compliance with statutory or other regulations and with the purchaser's particular requirements, which should be fully considered at the time of enquiry.

Examples of situations that necessitate special consideration are:

a) exposure to weather, e.g. car parks;

b) low temperature, e.g. cold stores;

c) high temperatures, e.g. boiler plant;

d) hosing-down, e.g. for hygiene or decontamination;

e) corrosive atmosphere, e.g. chemical works;

f) dusty atmospheres, e.g. boiler plant, flour mills;

g) explosive atmospheres, e.g. gas plant;

h) vandal prone installations;

i) extreme variations in humidity. **(Add.)**

2.32.4.8 Heating and ventilation of machine rooms **(Add.)**

All machine rooms should be provided with adequate ventilation to dissipate the heat generated by the lift equipment. For most single and double installations in a temperate climate, a high and low louvred convection ventilation arrangement may be adequate. For groups of three or more lifts in one machine room, increased ventilation is necessary and forced ventilation may be required, the design of which should prevent local hot spots. The lift contractor should be consulted but, for general guidance, for passenger lifts, the heat output of complete equipment is as follows:

a) Geared machines

Operating at the rated starts per hour (See 2.32.2.3), the heat loss of complete equipment, in watts, is approximately:

1.3 × rated load (in kg) × rated speed (in m/s).

b) Gearless machines

It is essential that the lift contractor should be consulted. Generally, the heat output will be at least equal to that for geared machines, but will depend considerably on the duty cycle and the power control system used.

c) Multiple machines

For multiple machines in one room, each with large heat outputs, building designers should take into account the possible need for standby heating and ventilating equipment and, if the building has an integrated heating and ventilating system, make suitable arrangements to cope with lift operations when other building services are shut down, e.g. at weekends.

Generally, goods lifts operate at a lower rating in terms of starts and heat output.

The provision of suitable ventilation to maintain machine room temperature under 40°C maximum is not only necessary for reasonable working conditions for maintenance personnel, but also to ensure stability of lift operations.

Should the lift machine room be located where temperatures could drop below 5°C, heating should be provided to avoid frost and condensation and to maintain stability of operation.

Ventilation louvers should be designed and sited to prevent rain, snow and birds entering the machine room. **(Add.)**

2.32.4.9 Lighting and treatment of walls, floors, etc. **(Add.)**

2.32.4.9.1 All machine rooms and pulley rooms should be considered as plant space, and it is essential that conditions should be provided to permit reliable operation of electrical control equipment and rotating machinery and also be conductive to good maintenance and safety of personnel.

Lighting should be provided to give a level of illumination of at least 200 lx around the controller and machine.

Machine room and pulley room walls, ceiling and floor should be faced in materials that do not produce dust, e.g. tiles, etc., or at least painted to stop dust circulation which otherwise could damage rotating machinery and cause failure of switchgear. It is also essential that these rooms should be weatherproof. **(Add.)**

2.32.4.9.2 Lift well enclosures should be constructed to be weatherproof and be faced in materials that do not produce dust or at least be painted to stop dust circulation on to moving apparatus and from being pumped by the car movement into machine rooms or on to landings. **(Add.)**

2.32.4.9.3 Lighting should be provided in each lift well for safety of maintenance personnel when stepping on to lift car tops or into lift pits. **(Add.)**

2.32.4.9.4 Lift entrances that open out into an area exposed to the weather should be protected by a suitable canopy and the landing level sloped up to the lift entrance to prevent driving rain or surface drainage from entering the lift well through the clearances around the landing doors. Any push-buttons so exposed should be of a weatherproof type. **(Add.)**

2.32.4.10 Stair well enclosure (Add.)

The location of lifts in stair wells is not recommended. The use of stair stringers for the fixing of guides normally involves extensive site measurement in order to fabricate purpose-made brackets.

The resulting attachments are often unreliable and lacking in robustness. For stair wells of normal width, the span required for the lift machine support beams is excessive and unless uneconomic sections are used, the deflections under varying load adversely affect the motion of the lift. In addition, the provision of suitable continuous enclosures can be very expensive. **(Add.)**

2.32.4.11 Emergency door release key (Add.)

If a lift is being considered for installation in an environment where it is likely to be subjected to interference or vandalism, then an alternative mechanism should be considered. A number of lift manufacturers have developed vandal resistant lock release mechanisms that make it difficult to open landing doors unless a special tool is employed. **(Add.)**

2.32.4.12 Car door locks (Add.)

Normally it is undesirable to specify any further restriction upon the requirements specified in Section 2.12, ASME A17.1-2000 for opening the car door.

If the car is stopped away from floor level through power supply failure, fault conditions or maintenance operation, the possibility of opening the car door easily from within the car is beneficial for a number of reasons, as follows.

a) Car ventilation is increased and if, as is often the case, the car door opening partially overlaps a landing opening, claustrophobic conditions are lessened.

b) In some cases passengers may be released through the restricted opening available by unlocking the landing door with the release key. Even if this is not possible, communication may be improved, aid given and panic averted.

c) In circumstances such as fire, rescue should be facilitated by minimizing obstruction as far as is compatible with safety requirements. **(Add.)**

2.32.4.13 Hand winding release procedure and indication (Add.)

2.32.4.13.1 General (Add.)

The release procedure by hand winding or emergency electrical operation should only be carried out by authorized persons who have received the necessary instruction, because it is dangerous for any other persons to attempt to do so.

Any failure to take adequate pre-cautions may render the authorized persons concerned guilty of negligence should an accident occur.

It is essential that all release operations should be carried out according to the manufacturer's instructions for the lift concerned. These instructions should be clearly stated and permanently displayed in the form of a notice in the machine room.

It may be worthwhile providing an indicator in the machine room to indicate the proximity of the lift car to a floor level. An audible indication is preferable from this point of view and, in addition, for lifts whose doors are not fitted with vision panels or whose machine room is not directly over the lift well, visual means of quickly determining the floor at which the car is located should be available. During emergency operation, and audible indicator (common to all lifts in a group) should be connected to the alarm circuit supply and to the individual lift to be moved. **(Add.)**

2.32.4.13.2 Hand winding (Add.)

Before attempting to hand wind the lift machine, it is vital that the electrical supply is isolated at the main switch.

It is usually necessary to have two persons in the machine room; one to operate the brake release and the other to carry out the hand winding. The exceptions are small lift machines where the hand winding and brake release equipment are so located that they can be easily controlled by one person, and larger machines which require two persons to operate the hand winding alone with an additional person to control the brake release.

Before attempting to move the car, it is imperative that any persons in the car be warned of the intention to move the car and that they do not attempt to leave the car until they are advised that it is safe to do so.

If the car cannot be moved when an attempt is made to move it in a downward direction, then no attempt at hand winding should be made because the car safety gear may have set. Any further procedure should be carried out under the instruction of an experienced lift mechanic.

Providing the car is free to be moved in the downward direction, then it should be hand wound to the nearest floor below the car.

However, this may not always be practical owing to the distance involved and the time taken to complete the movement; the amount of out of balance load on the counterweight side, due to the size of car and the small number of persons inside it, may make it easier to wind the car upwards.

(Add.)

2.32.4.13.3 Electrical emergency winding (Add.)

Electrical emergency winding is applicable to certain machines where hand winding operating forces would be too high; (greater than 400N). emergency electrical operation switch shall be installed in the machine room.

The machine shall be supplied from the normal mains supply or from the standby supply if there is one. Operation of the emergency electrical operation switch shall permit, from the machine room, the control of car movement by constant pressure on buttons protected against accidental operation. The direction of movement shall be clearly indicated.

After operation of the emergency electrical operation switch, all movement of the car except that controlled by this switch shall be prevented. **(Add.)**

2.32.4.14 Guide shoes (Add.)

Guide shoes should be selected on the basis of the following recommendations.

Goods lifts have relatively heavy reaction forces between guide shoe and guide; for this reason, sliding guide shoes should be used since roller guide shoes are not generally suitable.

For passenger lifts, including bed lifts, sliding or roller guide shoes may be used.

For installations with a high mechanical efficiency, such as gearless lifts, roller guide shoes are preferable. Sliding guide shoes can be used but they have a variable coefficient of friction due to variations in the state of lubrication.

Roller guide shoes have the advantage of nor requiring any lubricant on the guides and so promote cleanliness and reduce the fire risk. On the other hand, they require some provision for horizontal movement of the car and generally cost more than sliding shoes. For a rated speed of 5.0 m/s, the roller diameter for car and counterweight should be not less than 250 mm and 150 mm respectively, and for a rated speed of 2.5 m/s, 150 mm and 75 mm respectively.

At rated speeds exceeding 1.0 m/s, sliding guide shoes should be resiliently mounted and self-aligning. For lower speeds, solid adjustable sliding guide shoes are generally sufficient. Sliding guide shoes will normally require lubrication by appropriate means **(Add.)**

2.32.4.15 Car extension for stretchers (Add.)

Recesses and extensions, even of height less than 1 m, whether protected or not by separating doors, should only be permitted if their area is taken into account in the calculation of maximum available car area related to the rated load. **(Add.)**

2.32.4.16 Lift motor rating (Add.)

Lift motors should be designed to operate for an unlimited period on a duty cycle appropriate to the power system selected. For rating purposes the duty cycle should be based upon repeated up and down non-stop journeys of the empty car between two landings. The functional time periods should be as given in Table 2.32.6. **(Add.)**

TABLE 2.32.6 - LIFT FUNCTIONAL TIME PERIODS (Add.)

Starts Per h	**90**	**120**	**150**	**180**
Type of Motor	Single Speed	Two Speed	Two Speed	Variable Speed
Acceleration/Deceleration Time, s	5	5	5	5
Door Open/Door Close Time, s	6	6	6	4
Full Speed Running Time, s	14	10	6	6
Idle Time,s	15	9	7	5
Total Cycle Time, s	40	30	24	20

Notes:

1) The times are based upon a combined acceleration and deceleration distance not exceeding 3m and total journey distance not exceeding 10m.

2) For variable speed systems it is assumed that the doors commence to open whilst the car is leveling. Starts Per h 90 120 150 180 (Add.)

PART 3

HYDRAULIC ELEVATORS

SECTION 3.30 SELECTION AND INSTALLATION OF HYDRAULIC ELEVATORS FOR PASSENGER AND GOODS (Add.)

3.30.1 General (Add.)

3.30.1.1 Description (Add.)

Hydraulic lifts are complementary to the conventional electric lift. They operate on the principle of using fluid (generally oil) under pressure for transmission and raising the car by a ram or rams. The design of these lifts for safe operation should be as specified in Part 3. The car and entrance dimensions should follow those specified in Section 2.31 for electric lifts. The well dimensions of these lifts may differ according to the design of the lift. A leveling accuracy of 10 mm or better can be normally achieved.

A feature of hydraulic lifts is that the machine room need not be located above the well. Overall headroom dimensions are therefore reduced.

Hydraulic lifts generally operate under drive pressure in the 'up' direction only the 'down' direction, under gravity, is controlled by valves and it is possible to specify a hydraulic lift with a greater 'down' than 'up' speed, thus providing greater flexibility for special applications.

There are two types of hydraulic lift:

a) direct acting, of which there are two variations:

1) jack(s) under the car, for which a lined bore hole is required;

2) jack(s) at the sides of the car, located in the lift well, for which no bore hole, or only a reduced depth bore hole, is required;

b) indirect acting, in which there are one or two jacks to suit the load, which are located in the lift well with reeving mechanisms associated with the suspension system. **(Add.)**

3.30.1.2 Performance data (Add.)

The field of application of hydraulic lifts is for passenger and goods transport in low and medium rise buildings. Traffic calculations for planning purposes may be made on the basis outlined in 2.32.1.1.

Applications for hydraulic lifts for low and medium travels may be summarized as follows:

a) heavy or general duty goods and motor car lifts (normally at low speed);

b) passenger lifts up to 1.0 m/s and 25 m travel;

c) light duty goods lifts;

d) hospital and bed/passenger lifts. **(Add.)**

3.30.1.3 Quiet operation (Add.)

Since machine rooms are frequently situated near occupied space the guidance given in 2.32.1.6 of this Standard should be adopted. Attention should particularly be given to the transmission of sound by the treatment of the apertures through which the fluid pipes pass. **(Add.)**

3.30.1.4 Machine and machine room (Add.)

It is normal to locate the pumping unit and a controller in a machine room adjacent to the lift well at the lowest level served but, if this is not practicable, the machine room may, subject to consult with the purchaser's representative, be located at a distance from the lift.

The pumping unit comprise motor, pump, controlling valves and fluid reservoir. Anti-vibration mountings for the unit are also generally provided. **(Add.)**

3.30.1.5 Goods lifts (Add.)

The recommendations given in 2.32.1.7 for electric lifts should be followed, however, only the car and entrance dimensions should be selected from Section 2.31. **(Add.)**

3.30.1.6 Lifts for old people's homes (Add.)

Hydraulic passenger lifts are frequently installed in old people's homes. The usual rated speed is 0.25 m/s. **(Add.)**

3.30.2 Power and Control Systems (Add.)

3.30.2.1 General (Add.)

The motors normally used to drive hydraulic pumps are single speed a.c. motors specially designed for the purpose. In contrast to electric lift practice, the motor operates only on upward journeys, the rating has to be in terms of motor starts, rather than lift starts, per hour. A figure of 45 motor starts per hour is typical for light traffic passenger lifts. Lifts in residential buildings and goods lifts operate at a lower rating in terms of starts per hour.

The number of motor starts per hour is limited by hydraulic fluid heat output and to achieve higher duty cycles the provision of facilities for cooling the fluid may be necessary.

To maintain the anti-creep device it is essential that the lift power supply should be maintained during all periods when the building is unoccupied, e.g. night time, weekends, etc. In addition, the main switch should bear instructions to that effect.

The types of control systems should generally follow those described in 2.32.2.4, except that group supervisory control is not relevant.

Automatic leveling is a normal feature. The guidance relating to the use of solid state devices given in 2.32.2.1 is also applicable. **(Add.)**

3.30.2.2 Electrical controlgear and switching devices (Add.)

Control equipment for lift power systems is characterized by its high duty cycle and its high rupturing capacity. It should not be assumed that general purpose switchgear with normal industrial rating is suitable for use in lifts. **(Add.)**

3.30.2.3 Anti-Creep (Add.)

It is essential that an anti-creep system should be provided for hydraulic lifts. **(Add.)**

3.30.2.4 Features of control systems (Add.)

The recommendations given in 2.32.2.5 should be followed except that the references to Part 2 for electric lift should be considered as references to hydraulic lift proportion. **(Add.)**

PART 8

GENERAL REQUIREMENTS

SECTION 8.11 PERIODIC INSPECTIONS AND WITNESSING OF TEST **(Mod.)**

For periodic inspection and testing of elevators reference is made to IPS-I-GN-335. **(Mod.)**