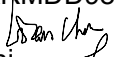



## TEST REPORT

EN ISO 12100:2010  
**Safety of machinery — Basic concepts, general principles for design — Risk assessment and risk reduction**  
 EN 60204-1:2018  
**Safety of machinery — Electrical equipment of machines — Part 1: General requirements**  
 EN 1175:2020  
**Safety of industrial trucks — Electrical and electronic requirements**  
 EN ISO 3691-1:2015+AC:2016+A1:2020  
**Industrial trucks — Safety requirements and verification — Part 1: Self-propelled trucks excluding pedestrian controlled trucks (Incorporating Amendment AC:2016 and Amendment A1:2020)**  
 EN 16307-1:2020  
**Industrial trucks — Test methods for exhaust emissions — Part 1: Engine powered industrial trucks**

Report Reference No. .... : 0P230505.XRMDD98  
 Compiled by (+ signature) ..... : Lizan Chen   
 Approved by (+ signature) ..... : Luca Bedonni   
 Date of issue ..... : 5th May, 2023

**Testing Laboratory** ..... : Ente Certificazione Macchine Srl  
 Address ..... : Via Ca' Bella, 243 – Loc. Castello di Serravalle – 40053  
 Valsamoggia (BO) - ITALY  
 Testing location ..... : XIAMEN RUNTX MACHINERY CO., LTD.  
 Address ..... : No.86, Anling 2nd Road, Huli District, Xiamen, Fujian,  
 China

**Applicant's name** ..... : XIAMEN RUNTX MACHINERY CO., LTD.  
 Address ..... : No.86, Anling 2nd Road, Huli District, Xiamen, Fujian,  
 China

**Test specification:**  
 Standard ..... : EN ISO 12100:2010, EN 60204-1:2018, EN 1175:2020,  
 EN ISO 3691-1:2015+AC:2016+A1:2020, EN 16307-1:2020

**Test procedure** ..... : CE-MD  
 Non-standard test method..... : N/A

**Test Report Form No.** ..... : RTX23042602EF  
 TRF Originator ..... : Ente Certificazione Macchine Srl  
 Master TRF ..... : Dated 2023-05

**Test item description** ..... : Electric Forklift  
 Trade Mark ..... : **RUNTX**  
 Manufacturer ..... : Same as applicant  
 Model/Type reference ..... : CPD10, CPD15, CPD18, CPD20, CPD25, CPD30,  
 CPD35, CPD40, CPD45, CPD50, CPD60, CPD70, CPD80, CPD100, CPD120, CPD130,  
 CPD150, CPD160, CPD180, CPD200  
 Ratings ..... : See below item "General products information"  
 Remark ..... : None

**Test item particulars:**  
 Classification of installation and use ..... : N/A  
 Supply Connection ..... : N/A

**Possible test case verdicts:**  
 - test case does not apply to the test object ..... : N/A  
 - test object does meet the requirement ..... : P(ass)  
 - test object does not meet the requirement ..... : F(ail)

**Testing:**  
 Date of receipt of test item ..... : 2023-04-25  
 Date (s) of performance of tests ..... : 2023-04-26

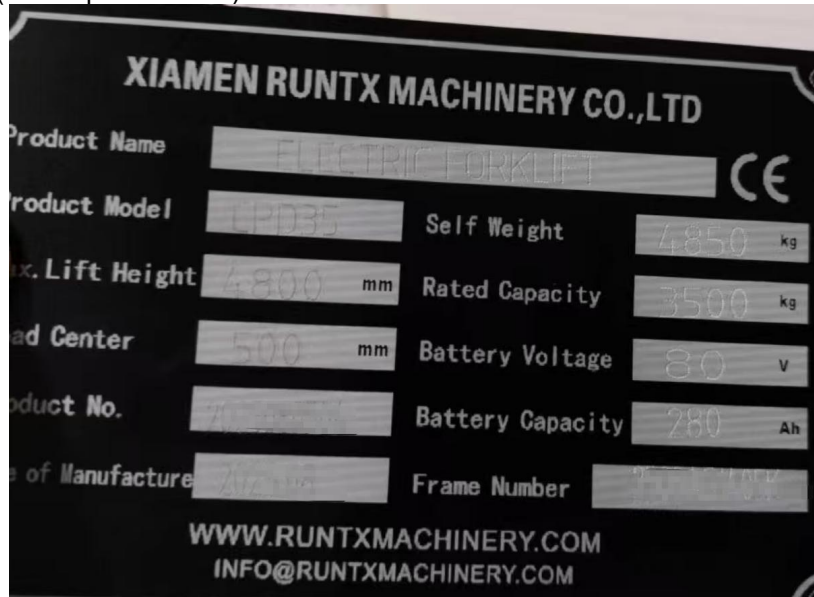
**General remarks:**  
 "(see remark #)" refers to a remark appended to the report.  
 "(see appended table)" refers to a table appended to the report.  
 Throughout this report a comma is used as the decimal separator.  
 The test results presented in this report relate only to the object tested.

<p>This report shall not be reproduced except in full without the written approval of the testing laboratory.          Determination of the test result include consideration of measurement uncertainty from the test equipment and methods.</p>
<p><b>Testing Environment:</b>          Ambient Temperature: 9-14 °C          Relative Humidity: 63-78 %          Atmospheric Pressure: 101.1 KPa</p>
<p><b>Additional remarks:</b>          All of the models of this product series have the same working characteristics and circuit. All tests performed on model CPD35.</p>

This document has been issued by Ente Certificazione Macchine confirms that the documentation made available as containing sensitive data, meets the essential requirements of the above-mentioned directives. The above conformity mark can be affixed to the technical documentation in accordance with the ECM regulation on its issue and use, published on the website [www.entecerma.it](http://www.entecerma.it)

Model		CPCD20	CPCD25	CPCD30	CPCD35	CPCD40	CPCD45
Power Type		Electric	Electric	Electric	Electric	Electric	Electric
Rated Load Capacity	KG	2000	2500	3000	3500	4000	4500
Load Center Distance	mm	500	500	500	500	500	500
Front Wheel Size		7.00-12-12PR	7.00-12-12PR	28x9-15	28x9-15	250-15	300-15
Rear Wheel Size		6.00-9-10PR	6.00-9-10PR	6.50-10	6.50-10	6.50-10	700-12
Overall Length (excluding forks)		2530	2580	2700	2800	2900	3050
Overall Width		1150	1150	1220	1220	1220	1400
Overhead Guard Height		2070	2070	2122	2122	2122	2180
Wheel Track		1600	1600	1800	1800	1900	1900
Front/Rear Overhang	mm	477/440	477/440	485/515	485/515	485/550	560
Front/Rear Wheel Track		970/970	970/970	1210/1240	1210/1240	1210/1240	1130/1100
Minimum Ground Clearance		110	110	150	150	150	150
Standard Lifting Height		3000	3000	3000	3000	3000	3000
Minimum Turning Radius		2170	2240	2470	2470	2550	2620
Mast Angle (Front/Rear)	(°)	6°/12°	6°/12°	6°/12°	6°/12°	6°/12°	6°/12°
Fork Length		1070	1070	1070	1070	1070	1070
Maximum Lifting Speed (Unloaded/Full Load)	mm/s	550/530	550/530	500/450	500/450	480/440	420
Maximum Travel Speed (Unloaded/Full Load)	Km/h	19/19	19/19	19.5/18	19.5/18	19/18	22
Grade Gradeability	%	≤20	≤20	≤20	≤20	≤20	≤20
Weight	Kg	3320	3680	4350	4605	4850	5860

Copy of marking plate (as a representative):



**Summary of testing:**

All tests are carried out in according to the EN ISO 12100:2010, EN 60204-1:2018, EN 1175:2020, EN ISO 3691-1:2015+AC:2016+A1:2020, EN 16307-1:2020 and the test results meet the requirements specified in the above-mentioned standards.

# Content

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Industrial trucks – Safety requirement and verification Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks**
- 2.6 EN 16307-1:2020  
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## **Annex : Technical Information**

- A.1 Instruction manual**

**Part I : General****1.1 General description**

In order to ensure the conformity for CE marking for these machines, some main European and/or International standards have been used to made assessment of conformity, they are

-EN ISO 12100:2010 Safety of machinery - General principles for design - Risk assessment and risk reduction

-EN 60204-1:2018 Safety of machinery - Electrical equipment of machines - Part 1: General requirements

- EN 1175:2020 Safety of industrial trucks - Electrical/electronic requirements.

- EN ISO 3691-1:2015+AC:2016+A1:2020

Industrial trucks – Safety requirement and verification Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks

-EN 16307-1:2020

Industrial trucks - Safety requirements and verification - Part 1: Supplementary requirements for self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and

burden-carrier trucks

These applicable standards in detail have been included in the relevant sub-clauses of this technical construction file.

**1.2 Variations of the series products**

Regarding the whole family of the series, they can be divided into different models according to their main features. They are CPD10, CPD15, CPD18, CPD20, CPD25, CPD30, CPD35, CPD40, CPD45, CPD50, CPD60, CPD70, CPD80, CPD100, CPD120, CPD130, CPD150, CPD160, CPD180, CPD200

To present the conformity of this series machine with Machinery Directive, we discuss the conformity systematically with the relative Directive and standards for CPD15 as a basic evaluation in clause.

### 1.3 Quality control system

In order to ensure the conformity of the series production, the XIAMEN RUNTX

MACHINERY CO., LTD.has taken the related procedures mentioned below :

- ( 1 ) XIAMEN RUNTX MACHINERY CO., LTD.has applied for the certification in ECM.
- ( 2 ) Carry out the inspection for parts and components according to the TCF  
Before the assemblies of the series production, the QC engineers of XIAMEN RUNTX MACHINERY CO., LTD. has to check and inspect the technical specifications and intended functions of parts and components to ensure the correct use of them according to the contents of TCF and principle described in the related technical information.
- ( 3 ) Carry out the inspection&testing for the products before packing  
Before packing the products, the QC engineers of XIAMEN RUNTX MACHINERY CO., LTD.have to do the necessary inspection and testing to ensure the conformity of related requirements, in particularly, the testing and inspection of electrical characteristics and outer feature.
- ( 4 ) Carry out the inspection for the packing  
After finishing the necessary inspection and testing for the products, an inspection for the packing has to be done to ensure the necessary elements being included in this packing before shipment.
- ( 5 ) Provision for the change of design  
Any change of the products described in this TCF must be checked in detail and written down again in the TCF by the designer of XIAMEN RUNTX MACHINERY CO., LTD. if the change may effects the related electrical or mechanical characteristics.
- ( 6 ) Provision for the Quality Assurance  
For the provisions of internal control measures to ensure the conformity of series production of the machines, XIAMEN RUNTX MACHINERY CO., LTD. has built an internal quality control system in accordance with the international standards.

## 1.4 Declaration of conformity

### EC DECLARATION OF CONFORMITY

According to the following EC Directives



2006/42/EC Machinery Directive

Manufacturer: XIAMEN RUNTX MACHINERY CO., LTD.  
No.86, Anling 2nd Road, Huli District, Xiamen, Fujian, China.

Manufacturer declares that the machine described hereafter:

Product name: Electric Forklift

Models: CPD10, CPD15, CPD18, CPD20, CPD25, CPD30, CPD35, CPD40, CPD45,  
CPD50, CPD60, CPD70, CPD80, CPD100, CPD120, CPD130, CPD150, CPD160,  
CPD180, CPD200

Fulfills all the relevant provisions of the directives:

2006/42/EC Machinery Directive

EN ISO 12100:2010,  
EN 60204-1:2018,  
EN 1175:2020,  
EN ISO 3691-1:2015+AC:2016+A1:2020,  
EN 16307-1:2020,

Signature: \_\_\_\_\_

*Lizan Chen*  
(Manager)



Date: \_\_\_\_\_

*28th. Apr. 2023*

Part II : Assessment of conformity

2.1 Essential health and safety requirements

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
1	Essential health and safety requirements		-
1.1	General remarks		-
1.1.1	Definitions		-
1.1.2	Principles of safety integration		-
a)	Machinery must be designed and constructed so that it is fitted for its function, and can be operated, adjusted and maintained without putting persons at risk when these operations are carried out under the conditions foreseen but also taking into account any reasonably foreseeable misuse thereof.		P
	The aim of measures taken must be to eliminate any risk throughout the foreseeable lifetime of the machinery including the phases of transport, assembly, dismantling, disabling and scrapping.		P
b)	In selecting the most appropriate methods, the manufacturer or his authorized representative must apply the following principles, in the order given:		-
	- eliminate or reduce risks as far as possible		P
	- take the necessary protection measure in relation to risks that can't be eliminated		P
	- inform users of the residual risks due to any shortcomings of the protection measures adopted, indicate whether any particular training is required and specify any need to provide personal protection equipment		P
c)	When designing and constructing machinery and when drafting the instructions, the manufacturer or his authorised representative must envisage not only the intended use of the machinery but also any reasonably foreseeable misuse thereof.		P
	The machinery must be designed and constructed in such a		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	way as to prevent abnormal use if such use would engender a risk. Where appropriate, the instructions must draw the user's attention to ways – which experience has shown might occur – in which the machinery should not be used.		
d)	Machinery must be designed and constructed to take account of the constraints to which the operator is subject as a result of the necessary or foreseeable use of personal protective equipment.		P
e)	Machinery must be supplied with all the special equipment and accessories essential to enable it to be adjusted, maintained and used safely.		P.
1.1.3	Materials and products		-
	The materials used to construct machinery or products used or created during its use must not endanger persons' safety or health.		P
	In particular, where fluids are used, machinery must be designed and constructed to prevent risks due to filling, use, recovery or draining.		P
1.1.4	Lighting		-
	Machinery must be supplied with integral lighting suitable for the operations concerned where the absence thereof is likely to cause a risk despite ambient lighting of normal intensity.		P
	Machinery must be designed and constructed so that there is no area of shadow likely to cause nuisance, that there is no irritating dazzle and that there are no dangerous stroboscopic effects on moving parts due to the lighting.		P
	Internal parts requiring frequent inspection, and adjustment and maintenance areas, must be provided with appropriate lighting		P
1.1.5	Design of machinery to facilitate its handling		-
	Machinery or each component part thereof must:		-
	- be capable of being handled and transported safely,		P
	- be packaged or designed so that it can be stored safely and without damage.		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	Where the weight, size or shape of machinery or its various component parts prevents them from being moved by hand, the machinery or each components part must:		-
	- either be fitted with attachments for lifting gear		P
	- be designed so that it can be fitted with such attachments, or		P
	- be shaped in such a way that standard lifting gear can easily be attached		P
	Where machinery or one of its component parts is to be moved by hand, it must:		-
	- either be easily movable, or		P
	- be equipped for picking up and moving in complete safety		P
	Special arrangement must be made for the handling of tools and/or machinery parts, even if lightweight, which could be dangerous		P
1.1.6	Ergonomics		-
	Under the intended conditions of use,the discomfort, fatigue and physical and psychological stress faced by the operator must be reduced to the minimum possible,taking into account ergonomic principle ssuch as:		P
	– allowing for the variability of the operator’s physical dimensions, strength and stamina,		P
	– providing enough space for movements of the parts of the operator’s body,		P
	– avoiding a machine-determined work rate,		P
	– avoiding monitoring that requires lengthy concentration,		P
	– adapting the man/machinery interface to the foreseeable characteristics of the operators.		P
1.1.7	Operating positions		-
	The operating position must be designed and constructed in such a way as to avoid any risk due to exhaust gases and/or lack of oxygen.		P
	If the machinery is intended to be used in a hazardous environment presenting risks to the health and safety of the operator or if the machinery itself gives rise to a hazardous		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	environment, adequate means must be provided to ensure that the operator has good working conditions and is protected against any foreseeable hazards.		
	Where appropriate, the operating position must be fitted with an adequate cabin designed, constructed and/or equipped to fulfill the above requirements.		P
	The exit must allow rapid evacuation. Moreover, when applicable, an emergency exit must be provided in a direction which is different from the usual exit.		P
1 · 1 · 8	<b>Seating</b>		-
	Where appropriate and where the working conditions so permit, work stations constituting an integral part of the machinery must be designed for the installation of seats.		P
	If the operator is intended to sit during operation and the operating position is an integral part of the machinery, the seat must be provided with the machinery		P
	The operator's seat must enable him to maintain a stable position. Furthermore, the seat and its distance from the control devices must be capable of being adapted to the operator.		P
	If the machinery is subject to vibrations, the seat must be designed and constructed in such a way as to reduce the vibrations transmitted to the operator to the lowest level that is reasonably possible. The seat mountings must withstand all stresses to which they can be subjected. Where there is no floor beneath the feet of the operator, footrests covered with a slip-resistant material must be provided.		P
1.2	<b>CONTROL SYSTEMS</b>		-
1.2.1	<b>Safety and reliability of control systems</b>		-
	Control systems must be designed and constructed in such a way as to prevent hazardous situations from arising.		P
	Above all, they must be designed and constructed in such a way that:		-
	- they can withstand the intended operating stresses and external influences,		P
	-a fault in the hardware or the software of the control system		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	does not lead to hazardous situations,		
	- errors in logic don't lead to dangerous situations		P
	-reasonably foreseeable human error during operation does not lead to hazardous situations.		P
	Particular attention must be given to the following points:		-
	- the machinery must not start unexpectedly		P
	- the parameters of the machinery must not change in an uncontrolled way, where such change may lead to hazardous situations,		P
	- the machinery must not be prevented from stopping if the stop command has already been given,		P
	- no moving part of the machinery or piece held by the machinery must fall or be ejected,		P
	- automatic or manual stopping of the moving parts, whatever they may be, must be unimpeded,		P
	- the protective devices must remain fully effective or give a stop command,		P
	- the safety-related parts of the control system must apply in a coherent way to the whole of an assembly of machinery and/or partly completed machinery.		P
	For cable-less control, an automatic stop must be activated when correct control signals are not received, including loss of communication.		P
1.2.2	Control devices		-
	Control devices must be:		-
	- clearly visible and identifiable, using pictograms where appropriate,		P.
	- positioned in such a way as to be safely operated without hesitation or loss of time and without ambiguity,		P
	- designed in such a way that the movement of the control device is consistent with its effect,		P.
	- located outside the danger zones, except where necessary for certain control devices such as an emergency stop or a teach pendant,		P
	- positioned in such a way that their operation cannot cause		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	additional risk,		
	- designed or protected in such a way that the desired effect, where a hazard is involved, can only be achieved by a deliberate action,		P
	- made in such a way as to withstand foreseeable forces; particular attention must be paid to emergency stop devices liable to be		P
	Where a control device is designed and constructed to perform several different actions, namely where there is no one-to-one correspondence, the action to be performed must be clearly displayed and subject to confirmation, where necessary.		P
	their layout, travel and resistance to operation are compatible with the action to be performed, taking account of ergonomic principles.		P
	Machinery must be fitted with indicators as required for safe operation. The operator must be able to read them from the control position.		P
	The operator must be able to read them from the control position		P
	From each control position, the operator must be able to ensure that no-one is in the danger zones, or the control system must be designed and constructed in such a way that starting is prevented while someone is in the danger zone.		P
	If neither of these possibilities is applicable, before the machinery starts,		P
	an acoustic and/or visual warning signal must be given. The exposed persons must have time to leave the danger zone or prevent the machinery starting up.		
	If necessary, means must be provided to ensure that the machinery can be controlled only from control positions located in one or more predetermined zones or locations.		P
	Where there is more than one control position, the control system must be designed in such a way that the use of one of them precludes the use of the others, except for stop controls and emergency stops.		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	When machinery has two or more operating positions, each position must be provided with all the required control devices without the operators hindering or putting each other into a hazardous situation.		P
1.2.3	Starting		-
	It must be possible to start machinery only by voluntary actuation of a control provided for the purpose		P
	The same requirement applies:		-
	- when restarting the machinery after stoppage, whatever the cause		P
	- when effecting a significant change in the operating conditions		P
	However, the restarting of the machinery or a change in operating conditions may be effected by voluntary actuation of a device other than the control device provided for the purpose, on condition that this does not lead to a hazardous situation.		P
	For machinery functioning in automatic mode, the starting of the machinery, restarting after a stoppage, or a change in operating conditions may be possible without intervention, provided this does not lead to a hazardous situation.		P
	Where machinery has several starting controls and the operators can therefore put each other in danger, additional devices must be fitted to rule out such risks		P
	must be fitted to rule out such risks. If safety requires that starting and/or stopping must be performed in a specific sequence, there must be devices which ensure that these operations are performed in the correct order		P
1.2.4	Stopping		-
1.2.4.1	Normal stopping		-
	Machinery must be fitted with a control device whereby the machinery can be brought safely to a complete stop.		P
	Each workstation must be fitted with a control device to stop some or all of the functions of the machinery, depending on the existing hazards, so that the machinery is rendered safe.		P
	The machinery's stop control must have priority over the start		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	controls		
	Once the machinery or its hazardous functions have stopped, the energy supply to the actuators concerned must be cut off.		P
1.2.4.2	Operational stop		-
	Where, for operational reasons, a stop control that does not cut off the energy supply to the actuators is required, the stop condition must be monitored and maintained.		P
1.2.4.3	Emergency stop		-
	Machinery must be fitted with one or more emergency stop devices to enable actual or impending danger to be averted		P
	The following exceptions apply:		-
	machinery in which an emergency stop device would not lessen the risk, either because it would not reduce the stopping time or because it would not enable the special measures required to deal with the risk to be taken,		P
	– portable hand-held and/ handguided machinery.		-
	The device must:		-
	– have clearly identifiable, clearly visible and quickly accessible control devices,		P
	– stop the hazardous process as quickly as possible, without creating additional risks,		P
	- where necessary, trigger or permit the triggering of certain safeguard movements		P
	Once active operation of the emergency stop device has ceased following a stop command, that command must be sustained by engagement of the emergency stop device until that engagement is specifically overridden		P
	It must be possible to disengage the device only by an appropriate operation, and disengaging the device must not restart the machinery but only permit restarting		P
	The emergency stop function must be available and operational at all times, regardless of the operating mode.		P
	Emergency stop devices must be a back-up to other safeguarding measures and not a substitute for them.		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
1.2.4.4	<b>Assembly of machinery</b>		-
	In the case of machinery or parts of machinery designed to work together, the machinery must be designed and constructed in such a way that the stop controls, including the emergency stop devices, can stop not only the machinery itself but also all related equipment, if its continued operation may be dangerous.		N
1.2.5	<b>Selection of control or operating modes</b>		-
	The control or operating mode selected must override all other control or operating modes, with the exception of the emergency stop.		N
	If machinery has been designed and Constructed to allow its use in several control or operating modes requiring different protective measures and/or work procedures, it must be fitted with a mode selector which can be locked in each position.		N
	Each position of the selector must be clearly identifiable and must correspond to a single operating or control mode.		N
	The selector may be replaced by another selection method which restricts the use of certain functions of the machinery or certain categories of operator		N
	If, for certain operations, the machinery must be able to operate with a guard displaced or removed and/or a protective device disabled,		N
	the control or operating mode selector must simultaneously:		-
	- disable all other control or operating modes,		N
	- permit operation of hazardous functions only by control devices requiring sustained action,		N
	- permit the operation of hazardous functions only in reduced risk conditions		N
	while preventing hazards from linked sequences,		N
	- prevent any operation of hazardous functions by voluntary or involuntary action on the machine's sensors.		N
	If these four conditions cannot be fulfilled simultaneously, the control or operating mode selector must activate other protective measures designed and constructed to ensure a		N

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	safe intervention zone.		
	In addition, the operator must be able to control operation of the parts he is working on from the adjustment point.		N
1.2.6	Failure of the power supply		-
	The interruption, re-establishment after an interruption or fluctuation in whatever manner of the power supply to the machinery must not lead to a dangerous situation		P
	Particular attention must be given to the following points:		-
	- the machinery must not start unexpectedly		P
	- the parameters of the machinery must not change in an uncontrolled way when such change can lead to hazardous situations,		P
	- the machinery must not be prevented from stopping if the command has already been given		P
	- no moving part of the machinery or piece held by the machinery must fall or be ejected		P
	- automatic or manual stopping of the moving parts whatever they may be must be unimpeded		P
	- the protective devices must remain fully effective or give a stop command.		P
1.3	Protection against mechanical hazards		-
1.3.1	Risk of loss of stability		-
	Machinery and its components and fittings must be stable enough to avoid overturning, falling or uncontrolled movements during transportation, assembly, dismantling, and any other action involving the machinery.		P
	If the shape of the machinery itself or its intended installation doesn't offer sufficient stability, appropriate means of anchorage must be incorporated and indicated in the instructions		P
1.3.2	Risk of break-up during operation		-
	The various parts of machinery and their linkages must be able to withstand the stresses to which they are subject when used.		P
	The durability of the materials used must be adequate for the		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	nature of the working environment foreseen by the manufacturer or his authorised representative, in particular as regards the phenomena of fatigue, ageing, corrosion and abrasion.		
	The instructions must indicate the type and frequency of inspections and maintenance required for safety reasons.		P
	They must, where appropriate, indicate the parts subject to wear and the criteria for replacement.		P
	Where a risk of rupture or disintegration remains despite the measures taken, the parts concerned must be mounted, positioned and/or guarded in such a way that any fragments will be contained, preventing hazardous situations.		P
	Both rigid and flexible pipes carrying fluids, particularly those under high pressure, must be able to withstand the foreseen internal and external stresses and must be firmly attached and/or protected to ensure that no risk is posed by a rupture.		P
	Where the material to be processed is fed to the tool automatically, the following conditions must be fulfilled to avoid risks to persons:		P
	- when the work piece comes into contact with the tool the latter must have attained its normal working conditions		P
	- when the tool starts and/or stops the feed movement and the tool movement must be coordinated		P
1.3.3	Risked due to falling or ejected objects		-
	Precautions must be taken to prevent risks from falling or ejected objects.		P
1.3.4	Risks due to surfaces, edges or angles		-
	In so far as their purpose allows, accessible parts of the machinery must have no sharp edges, no sharp angles, and no rough surfaces likely to cause injury		P
1.3.5	Risks related to combined machinery		-
	Where the machinery is intended to carry out several different operations with manual removal of the piece between each operation (combined machinery), it must be designed and constructed in such a way as to enable each		N

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Items	Requirements	Result-Remark	Verdict
	element to be used separately without the other elements constituting a risk for exposed persons.		
	For this purpose, it must be possible to start and stop separately and elements that are not protected		N
1.3.6	Risks related to variations in operating conditions		-
	Where the machinery performs operations under different conditions of use,		-.
	it must be designed and constructed in such a way that selection and adjustment of these conditions can be carried out safely and reliably.		P
1.3.7	Risks related to moving parts		-
	The moving parts of machinery must be designed and constructed in such a way as to prevent risks of contact which could lead to accidents or must, where risks persist, be fitted with guards or protective devices.		P
	All necessary steps must be taken to prevent accidental blockage of moving parts involved in the work. In cases where, despite the precautions taken, a blockage is likely to occur, the necessary specific protective devices and tools must, when appropriate, be provided to enable the equipment to be safely unblocked.		P
	The instructions and, where possible, a sign on the machinery shall identify these specific protective devices and how they are to be used.		P
1.3.8	Choice of protection against risks arising from moving parts		-
	Guards or protective devices designed to protect against risks arising from moving parts must be selected on the basis of the type of risk. The following guidelines must be used to help to make the choice.		P
1.3.8.1	. Moving transmission parts		-
	Guards designed to protect persons against the hazards generated by moving transmission parts must be:		P
	– either fixed guards as referred to in section 1.4.2.1, or		P
	— interlocking movable guards as referred to in section 1.4.2.2.		P

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Items	Requirements	Result-Remark	Verdict
	Interlocking movable guards should be used where frequent access is envisaged.		P
1.3.8.2	Moving parts involved in the process		-
	Guards or protective devices designed to protect persons against the hazards generated by moving parts involved in the process must be:		-
	– either fixed guards as referred to in section 1.4.2.1, or		P
	– interlocking movable guards as referred to in section 1.4.2.2, or		P
	– protective devices as referred to in section 1.4.3, or		P
	– a combination of the above.		P
	However, when certain moving parts directly involved in the process cannot be made completely inaccessible during operation owing to operations requiring operator intervention		P
	such parts must be fitted with:		-
	– fixed guards or interlocking movable guards preventing access to those sections of the parts that are not used in the work, and		P
	– adjustable guards as referred to in section 1.4.2.3 restricting access to those sections of the moving parts where access is necessary.		N
1.3.9	Risks of uncontrolled movements		-
	When a part of the machinery has been stopped, any drift away from the stopping position, for whatever reason other than action on the control devices, must be prevented or must be such that it does not present a hazard.		N
1.4	Required characteristics of guards and protection devices		-
1.4.1	General requirement		-
	Guards and protection devices must:		-
	- be of robust construction		P
	– be securely held in place,		P
	- not give rise to any additional hazard,		P
	- not be easy to bypass or render non-operational		P
	- be located at an adequate distance from the danger zone		P

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Items	Requirements	Result-Remark	Verdict
	- cause minimum obstruction to the view id the production process		P
	– enable essential work to be carried out on the installation and/or replacement of tools and for maintenance purposes by restricting access exclusively to the area where the work has to be done, if possible without the guard having to be removed or the protective device having to be disabled.		P
	In addition, guards must, where possible,protect against the ejection or falling of materials or objects and against emissions generated by the machinery.		P
1.4.2	Special requirements for guards		-
1.4.2.1	Fixed guards		-
	Fixed guards must be fixed by systems that can be opened or removed only with tools		P
	Their fixing systems must remain attached to the guards or to the machinery when the guards are removed.		P
	Where possible, guards must be incapable to remain in place without their fixings		P
1.4.4.2	Interlocking movable guards must:		-
	– as far as possible remain attached to the machinery when open,		P
	– be designed and constructed in such a way that they can be adjusted only by means of an intentional action. [See 3rd hyphen of old 1.4.2.2		P
	Interlocking movable guards must be associated with an interlocking device that:		-
	– prevents the start of hazardous machinery functions until they are closed, and		P
	– gives a stop command whenever they are no longer closed.		P
	Where it is possible for an operator to reach the danger zone before the risk due to the hazardous machinery functions has ceased, movable guards must be associated with a guard locking		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	device in addition to an interlocking device that:		
	– prevents the start of hazardous machinery functions until the guard is closed and locked, and		P
	– keeps the guard closed and locked until the risk of injury from the hazardous machinery functions has ceased.		P
	Interlocking movable guards must be designed in such a way that the absence or failure of one of their components prevents starting or stops the hazardous machinery functions		P
1.4.2.3	Adjustable guards restricting access		-
	Adjustable guards restricting access to those areas of the moving parts strictly necessary for the work must:		-
	- be adjustable manually or automatically according to the type of work involved		P
	- be readily adjustable without the use of tools		P.
1.4.3	Special requirements for protective devices		-
	Protective devices must be designed and incorporated into the control system in such a way that:		-
	– moving parts cannot start up while they are within the operator's reach,		P
	– persons cannot reach moving parts while the parts are moving, and		P
	– the absence or failure of one of their components prevents starting or stops the moving parts.		P.
	Protective devices must be adjustable only by means of an intentional action.[See 3rd hyphen of old 1.4.3]		P
1.5	RISKS DUE TO OTHER HAZARDS		-
1.5.1.	Electricity supply		-
	Where machinery has an electricity supply it must be designed, constructed and equipped so that all hazards of an electrical nature are or can be prevented		N
	The safety objectives set out in Directive 73/23/EEC shall apply to machinery. However, the obligations concerning conformity assessment and the placing on the market and/or		N

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Items	Requirements	Result-Remark	Verdict
	putting into service of machinery with regard to electrical hazards are governed solely by this Directive.		
1.5.2	Static electricity		-
	Machinery must be so designed and constructed as to prevent or limit the build-up of potentially dangerous electrostatic charges and/or be fitted with a discharging system		P
1.5.3	Energy supply other than electricity		-
	Where machinery is powered by source of energy other than electricity, it must be so designed, constructed and equipped as to avoid all potential risks associated with such sources of energy.		N
1.5.4	Error of fitting		-
	Errors likely to be made when fitting or refitting certain parts which could be a source of risk must be made impossible by the design and construction of such parts or, failing this, by information given on the parts themselves and/or their housings. The same information must be given on moving parts and/or their housings where the direction of movement needs to be known in order to avoid a risk.		P
	Where necessary, the instructions must give further information on these risks.		P
	Where a faulty connection can be the source of risk, incorrect connections must be made impossible by design or, failing this, by information given on the elements to be connected and, where appropriate, on the means of connection.		N
1.5.5	Extreme temperatures		-
	Steps must be taken to eliminate any risk of injury arising from contact with or proximity to machinery parts or materials at high or very low temperatures. The necessary steps must also be taken to avoid or protect against the risk of hot or very cold material being ejected.		P
1.5.6	Fire		-
	Machinery must be designed and constructed in such a way as to avoid any risk of fire or overheating posed by the		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	machinery itself or by gases, liquids, dust, vapours or other substances produced or used by the machinery.		
1.5.7	Explosion		-
	Machinery must be designed and constructed in such a way as to avoid any risk of explosion posed by the machinery itself or by gases, liquids, dust, vapours or other substances produced or used by the machinery.		N
	Machinery must comply, as far as the risk of explosion due to its use in a potentially explosive atmosphere is concerned, with the provisions of the specific Community Directives.		N
1.5.8	Noise		-
	Machinery must be designed and constructed in such a way that risks resulting from the emission of airborne noise are reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, in particular at source. The level of noise emission may be assessed with reference to comparative emission data for similar machinery.		P
1.5.9	Vibration		-
	Machinery must be designed and constructed in such a way that risks resulting from vibrations produced by the machinery are reduced to the lowest level, taking account of technical progress and the availability of means of reducing vibration, in particular at source.		P
	The level of vibration emission may be assessed with reference to comparative emission data for similar machinery.		
1.5.10	Radiation		-
	Undesirable radiation emissions from the machinery must be eliminated or be reduced to levels that do not have adverse effects on persons.		N
	Any functional ionising radiation emissions must be limited to		N

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	the lowest level which is sufficient for the proper functioning of the machinery during setting, operation and cleaning. Where a risk exists, the necessary protective measures must be taken.		
	Any functional non-ionising radiation emissions during setting, operation and cleaning must be limited to levels that do not have adverse effects on persons.		N
1.5.11	External radiation		-
	Machinery must be designed and constructed in such a way that external radiation does not interfere with its operation.		N
1.5.12	Laser equipment		-
	Where laser equipment is used, the following provisions should be taken into account;		N
	– laser equipment on machinery must be designed and constructed in such a way as to prevent any accidental radiation,		N
	– laser equipment on machinery must be protected in such a way that effective radiation, radiation produced by reflection or diffusion and secondary radiation do not damage health,		N
	– optical equipment for the observation or adjustment of laser equipment on machinery must be such that no health risk is created by laser radiation.		N
1.5.13	Emissions of hazardous materials and substances		-
	Machinery must be designed and constructed in such a way that risks of inhalation, ingestion, contact with the skin, eyes and mucous membranes and penetration through the skin of hazardous materials and substances which it produces can be avoided.		P
	Where a hazard cannot be eliminated, the machinery must be so equipped that hazardous materials and substances can be contained, evacuated, precipitated by water spraying, filtered or treated by another equally effective method.		P
	Where the process is not totally enclosed during normal operation of the machinery, the devices for containment and/or evacuation must be situated in such a way as to have		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	the maximum effect.		
1.5.14	Risk of being trapped in a machine		-
	Machinery must be designed, constructed or fitted with a means of preventing a person from being enclosed within it or, if that is impossible, with a means of summoning help.		P
1.5.15	Risk of slipping, tripping or falling		-
	Parts of the machinery where persons are liable to move about or stand must be designed and constructed in such a way as to prevent persons slipping, tripping or falling on or off these parts.		P
	Where appropriate, these parts must be fitted with handholds that are fixed relative to the user and that enable them to maintain their stability.		P
1.5.16	Lightning		
	Machinery in need of protection against the effects of lightning while being used must be fitted with a system for conducting the resultant electrical charge to earth.		P
1.6	Maintenance		-
1.6.1	Machinery maintenance		-
	Adjustment and maintenance points must be located outside danger zones. It must be possible to carry out adjustment, maintenance, repair, cleaning and servicing operations while machinery is at a standstill.		P
	If one or more of the above conditions cannot be satisfied for technical reasons, measures must be taken to ensure that these operations can be carried out safely (see section 1.2.5).		P
	In the case of automated machinery and, where necessary, other machinery, a connecting device for mounting diagnostic fault-finding equipment must be provided.		P
	Automated machinery components which have to be changed frequently		P
	must be capable of being removed and replaced easily and		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	safely. Access to the components must enable these tasks to be carried out with the necessary technical means in accordance with a specified operating method.		
1.6.2	Access to operating position and servicing points		-
	Machinery must be designed and constructed in such a way as to allow access in safety to all areas where intervention is necessary during operation, adjustment and maintenance of the machinery.		P
1.6.3	Isolation of energy sources		-
	Machinery must be fitted with means to isolate it from all energy sources. Such isolators must be clearly identified. They must be capable of being locked if reconnection could endanger persons.		N
	Isolators must also be capable of being locked where an operator is unable, from any of the points to which he has access, to check that the energy is still cut off.		N
	In the case of machinery capable of being plugged into an electricity supply, removal of the plug is sufficient, provided that the operator can check from any of the points to which he has access that the plug remains removed.		P
	After the energy is cut off, it must be possible to dissipate normally any energy remaining or stored in the circuits of the machinery without risk to persons.		P
	As an exception to the requirement laid down in the previous paragraphs, certain circuits may remain connected to their energy sources in order, for example, to hold parts, to protect information, to light interiors, etc. In this case, special steps must be taken to ensure operator safety.		P
1.6.4	Operator intervention		-
	Machinery must be so designed, constructed and equipped that the need for operator intervention is limited		P
	If operator intervention can't be avoided, it must be possible to carry it out easily and in safety		P
1.6.5	Cleaning of internal parts		-
	The machinery must be designed and constructed in such a way that it is possible to clean internal parts which have		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	contained dangerous substances or preparations without entering them; any necessary unblocking must also be possible from the outside		
	If it is impossible to avoid entering the machinery, it must be designed and constructed in such a way as to allow cleaning to take place safely.		P
1.7	<b>INFORMATION</b>		-
1.7.1	Information and warnings on the machinery		-
	Information and warnings on the machinery should preferably be provided in the form of readily understandable symbols or pictograms. Any written or verbal information and warnings must be expressed in an official Community language or languages, which may be determined in accordance with the Treaty by the Member State in which the machinery is placed on the market and/or put into service and may be accompanied, on request, by versions in any other official Community language or languages understood by the operators. [Compare with 1.7.2 of the old directive]		P
1.7.1.1	. Information and information devices		
	The information needed to control machinery must be provided in a form that is unambiguous and easily understood. It must not be excessive to the extent of overloading the operator.		P
	Visual display units or any other interactive means of communication between the operator and the machine must be easily understood and easy to use.		P
1.7.1.2.	Warning devices Where the health and safety of persons may be endangered by a fault in the operation of unsupervised machinery, the machinery must be equipped in such a way as to give an appropriate acoustic or light signal as a warning.		P
	Where machinery is equipped with warning devices these must be unambiguous and easily perceived. The operator must have facilities to check the operation of such warning		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	devices at all times.		
	The requirements of the specific Community Directives concerning colours and safety signals must be complied with.		P.
1.7.2	Warning of residual risks		-
	Where risks remain despite the inherent safe design measures, safeguarding and complementary protective measures adopted, the necessary warnings, including warning devices, must be provided.		P
1.7.3	Marking of machinery		-
	All machinery must be marked visibly, legibly and indelibly with the following minimum particulars:		-
	– the business name and full address of the manufacturer and, where applicable, his authorised representative,		P
	– designation of the machinery,		P
	– the CE Marking (see Annex III),		P
	– designation of series or type		P
	– serial number, if any,		P
	– the year of construction, that is the year in which the manufacturing process is completed.		P
	It is prohibited to pre-date or post-date the machinery when affixing the CE marking.		P
	Furthermore, machinery designed and constructed for use in a potentially explosive atmosphere must be marked accordingly.		P
	Machinery must also bear full information relevant to its type and essential for safe use. Such information is subject to the requirements set out in section 1.7.1.		
	Where a machine part must be handled during use with lifting equipment, its mass must be indicated legibly, indelibly and unambiguously.		P
1.7.5	Instruction		-
	All machinery must be accompanied by instructions in the official Community language or languages of the Member State in which it is placed on the market and/or put into service.		P

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	The instructions accompanying the machinery must be either 'Original instructions' or a 'Translation of the original instructions', in which case the translation must be accompanied by the original instructions.		P
	By way of exception, the maintenance instructions intended for use by specialized personnel mandated by the manufacturer or his authorised representative may be supplied in only one Community language which the specialised personnel understand.[Compare with old 1.7.4 b]		P
	The instructions must be drafted in accordance with the principles set out below.		P
1.7.5.1	. General principles for the drafting of instructions		P
	(a) The instructions must be drafted in one or more official Community languages. The words 'Original instructions' must appear on the language version(s) verified by the manufacturer or his authorized representative.		P
	(b) Where no 'Original instructions' exist in the official language(s) of the country where the machinery is to be used, a translation into that/those language(s) must be provided by the manufacturer or his authorised representative or by the person bringing the machinery into the language area in question. The translations must bear the words 'Translation of the original instructions'.		P
	(c) The contents of the instructions must cover not only the intended use of the machinery but also take into account any reasonably foreseeable misuse thereof.		P
	(d) In the case of machinery intended for use by non-professional operators, the wording and layout of the instructions for use must take into account the level of general education and acumen that can reasonably be expected from such operators.		P
1.7.5.2	. Contents of the instructions		P
	-Each instruction manual must contain, where applicable, at least the following information:		P
	(a) the business name and full address of the manufacturer and of his authorized representative;		P

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Items	Requirements	Result-Remark	Verdict
	(b) the designation of the machinery as marked on the machinery itself, except for the serial number (see section 1.7.3);		P
	(c) the EC declaration of conformity, or a document setting out the contents of the EC declaration of conformity, showing the particulars of the machinery, not necessarily including the serial number and the signature;		P
	(d) a general description of the machinery;		P
	(e) the drawings, diagrams, descriptions and explanations necessary for the use, maintenance and repair of the machinery and for checking its correct functioning;		P
	(f) a description of the workstation(s) likely to be occupied by operators;		P
	(g) a description of the intended use of the machinery;		P
	(h) warnings concerning ways in which the machinery must not be used that experience has shown might occur;		P
	(i) assembly, installation and connection instructions, including drawings, diagrams and the means of attachment and the designation of the chassis or installation on which the machinery is to be mounted;		P
	(j) instructions relating to installation and assembly for reducing noise or vibration;		P
	(k) instructions for the putting into service and use of the machinery and, if necessary, instructions for the training of operators;		P
	(l) information about the residual risks that remain despite the inherent safe design measures, safeguarding and complementary protective measures adopted;		N
	(m) instructions on the protective measures to be taken by the user, including, where appropriate, the personal protective equipment to be provided;		P
	(n) the essential characteristics of tools which may be fitted to the machinery;		P
	(o) the conditions in which the machinery meets the requirement of stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable		P

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Items	Requirements	Result-Remark	Verdict
	breakdowns;		
	(p) instructions with a view to ensuring that transport, handling and storage operations can be made safely, giving the mass of the machinery and of its various parts where these are regularly to be transported separately; [Compare with the 10th hyphen of old 1.7.4. (a)]		P
	(q) the operating method to be followed in the event of accident or breakdown; if a blockage is likely to occur, the operating method to be followed so as to enable the equipment to be safely unblocked;		P
	(r) the description of the adjustment and maintenance operations that should be carried out by the user and the preventive maintenance measures that should be observed;		P
	(s) instructions designed to enable adjustment and maintenance to be carried out safely, including the protective measures that should be taken during these operations;		P
	(t) the specifications of the spare parts to be used, when these affect the health and safety of operators;		P
	(u) the following information on airborne noise emissions:		P
	– the A-weighted emission sound pressure level at workstations, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this fact must be indicated,		P
	– the peak C-weighted instantaneous sound pressure value at workstations, where this exceeds 63 Pa (130 dB in relation to 20 µPa),		P
	– the A-weighted sound power level emitted by the machinery, where the A-weighted emission sound pressure level at workstations exceeds 80 dB(A).		P
	These values must be either those actually measured for the machinery in question or those established on the basis of measurements taken for technically comparable machinery which is representative of the machinery to be produced.		P

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Items	Requirements	Result-Remark	Verdict
	In the case of very large machinery, instead of the A-weighted sound power level, the A-weighted emission sound pressure levels at specified positions around the machinery may be indicated		P
	Where the harmonised standards are not applied, sound levels must be measured using the most appropriate method for the machinery. Whenever sound emission values are indicated the uncertainties surrounding these values must be specified.		P
	The operating conditions of the machinery during measurement and the measuring methods used must be described.		P
	Where the workstation(s) are undefined or cannot be defined, A-weighted sound pressure levels must be measured at a distance of 1 metre from the surface of the machinery and at a height of 1,6 metre from the floor or access platform. The position and value of the maximum sound pressure must be indicated.		P
	Where specific Community Directives lay down other requirements for the measurement of sound pressure levels or sound power levels, those Directives must be applied and the corresponding provisions of this section shall not apply;		P
	(v) where machinery is likely to emit nonionising radiation which may cause harm to persons, in particular persons with active or non-active implantable medical devices, information concerning the radiation emitted for the operator and exposed persons.		P
1.7.5.3	. Sales literature		
	Sales literature describing the machinery must not contradict the instructions as regards health and safety aspects. Sales literature describing the performance characteristics of machinery must contain the same information on emissions as is contained in the instructions.		P
2	SUPPLEMENTARY ESSENTIAL HEALTH AND SAFETY		-

Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	<b>REQUIREMENTS FOR CERTAIN CATEGORIES OF MACHINERY</b>		
2.1	<b>FOODSTUFFS MACHINERY AND MACHINERY FOR COSMETICS OR PHARMACEUTICAL PRODUCTS</b>		-
2.1.1	<b>General</b>		-
	Machinery intended for use with foodstuffs or with cosmetics or pharmaceutical products must be designed and constructed in such a way as to avoid any risk of infection, sickness or contagion. The following requirements must be observed:		-
	(a) materials in contact with, or intended to come into contact with, foodstuffs or cosmetics or pharmaceutical products must satisfy the conditions set down in the relevant Directives. The machinery must be designed and constructed in such a way that these materials can be cleaned before each use. Where this is not possible disposable parts must be used;		P
	(b) all surfaces in contact with foodstuffs or cosmetics or pharmaceutical products, other than surfaces of disposable parts, must:		-
	– be smooth and have neither ridges nor crevices which could harbour organic materials. The same applies to their joinings,		P
	– be designed and constructed in such a way as to reduce the projections, edges and recesses of assemblies to a minimum,		P
	– be easily cleaned and disinfected, where necessary after removing easily dismantled parts; the inside surfaces must have curves with a radius sufficient to allow thorough cleaning;		P
	(c) it must be possible for liquids, gases and aerosols deriving from foodstuffs, cosmetics or pharmaceutical products as well as from cleaning, disinfecting and rinsing fluids to be completely discharged from the machinery (if possible, in a 'cleaning' position);		P
	(d) machinery must be designed and constructed in such a		P

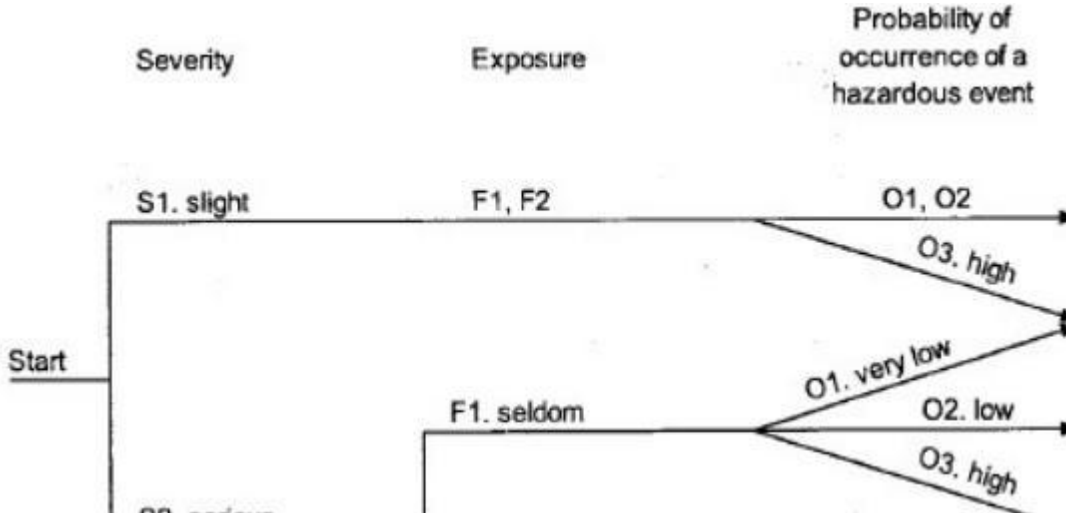
Directive 2006/42/EC Machinery			
Items	Requirements	Result-Remark	Verdict
	way as to prevent any substances or living creatures, in particular insects, from entering, or any organic matter from accumulating in areas that cannot be cleaned;		
	(e) machinery must be designed and constructed in such a way that no ancillary substances hazardous to health, including the lubricants used, can come into contact with foodstuffs, cosmetics or pharmaceutical products. Where necessary, machinery must be designed and constructed in such a way that continuing compliance with this requirement can be checked		P
2.1.2.	Instructions		-
	The instructions for foodstuffs machinery and machinery for use with cosmetics or pharmaceutical products must indicate recommended products and methods for cleaning, disinfecting and rinsing, not only for easily accessible areas but also for areas to which access is impossible or inadvisable.		P
2.2	PORTABLE HAND-HELD AND/OR HAND-GUIDED MACHINERY		N
2.3	MACHINERY FOR WORKING WOOD AND MATERIAL WITH SIMILAR PHYSICAL CHARACTERISTICS		N.
3	SUPPLEMENTARY ESSENTIAL HEALTH AND SAFETY REQUIREMENTS TO OFFSET HAZARDS DUE TO THE MOBILITY OF MACHINER		-
4	SUPPLEMENTARY ESSENTIAL HEALTH AND SAFETY REQUIREMENTS TO OFFSET HAZARDS DUE TO LIFTING OPERATIONS		-
5	SUPPLEMENTARY ESSENTIAL HEALTH AND SAFETY REQUIREMENTS FOR MACHINERY INTENDED FOR UNDERGROUND WORK		-
6	SUPPLEMENTARY ESSENTIAL HEALTH AND SAFETY REQUIREMENTS FOR MACHINERY PRESENTING PARTICULAR HAZARDS DUE TO THE LIFTING OF PERSONS		-

## 2.2 EN ISO 12100:2010 Safety of machinery — General principles for design —

### Risk assessment and risk reduction

#### 2.1 Risk Estimation Method

For risk estimation, the risk graph method of ISO / TR 14121-2, figure A.3, was used as the following.



Despite the rough estimation of the risk index, if after application of well-tried protective measure it is considered that the risk is adequately reduced, no further actions will be required. Otherwise, a specific risk estimation method should be used.

#### 2.2 Risk Assessment Methodology

The risk assessment is based on a method recommended in ISO / TR 14121-2: 2007, in which the factors Se-CI (Fr + Pr + Av) and diagram are used to evaluate the level of risk. The meaning of those is described in the following:

(1) Se, severity of the possible harm:

1. Scratched, bruises that are cured by first aid or similar.
2. More severe scratches, bruises, stabbing which require medical attention from professionals.
3. Normally irreversible injury; it will be slightly difficult to continue work after healing, if possible at all.
4. Irreversible injury in such a way that it will very difficult to continue work after healing, if possible at all.

(2) Fr, average interval between frequency of the exposure and its duration;

1. Interval between exposures is more than a year.
2. Interval between exposures is more than two weeks but less than or equal to a year.
3. Interval between exposures is more than a day but less than or equal to two days.
4. Interval between exposure is more than an hour but less than or equal to a day. Where the duration is short than 10 minutes, the above values may  
be decreased to the next level.

5. Interval less than or equal to an hour. This value is not to be decreased at any time.

(3) Pr, possibility of occurrence of a hazardous event:

1. Negligible
2. Rarely
3. Possible
4. Likely
5. Very high

(4) Av, possibility of avoiding or limiting harm:

1. Likely
2. Possible
3. Impossible

The risk is evaluated by using matrix as below:

Severity	Class CI (Fr + Pr + Av)				
	3-4	5-7	8-10	11-13	14-15
S					
4					
3					
2					
1					

Where the severity, Se, cross the class, CI:

In the black area, protective measures have to be implemented to reduce risk;

In the gray area, protective measures are recommended to be implemented to further reduce risk;

In the remaining area, the risk is already adequately reduced.

### 2.3 Acceptance Criteria

A form is filled in with the result of this risk assessment; each hazardous situation is allocated a risk index. In this example, the estimation of each hazardous situation is made with consideration given to the following:

- a risk of 1 or 2 corresponds to the lowest priority of action (priority 3);
- a risk index of 3 or 4 corresponds to the medium priority of action (priority 2);
- and a risk index of 5 or 6 corresponds to the highest priority of action (priority 1).

Possible means of reducing risk are considered and the risk is then estimated for the final design using the same risk graph in the same manner as for the initial design. In this specific case, a risk index of 2 or less have been evaluated as representing the level at which no further risk reduction is required.

1. Mechanical				
Sub-clause of EN 12100:2010	-6.2.2.1; -6.2.2.2; -6.2.3 a); -6.2.3 b); -6.2.6; -6.2.10; -6.3.1; -6.3.2; - 6.3.3; - 6.3.5.2; - 6.3.5.4; - 6.3.5.5; - 6.3.5.6; -6.4.1; - 6.4.3; - 6.4.4; - 6.4.5			
Origin	- acceleration, deceleration;- angular parts;- approach of a moving element to a fixed part; - cutting parts;- elastic elements;- falling objects;- high pressure;- instability; - moving elements;- rotating elements;- rough, slippery surface;- sharp edges;			
No.	Potential Consequences	Hazardous Situation	Risk Estimation	Risk Reduction and Protective Measures
1.1	Being run over	When the machine is running	Se 3, Fr 1, Pr 2, Av 1, Cl 4	1.Designed to comply with the standards 2. Read the instructions before using the machine
1.2	Being thrown	When the machine is running	Se 3, Fr 1, Pr 2, Av 1, Cl 4	1.Designed to comply with the standards 2. Read the instructions before using the machine
1.3	Crushing	When the machine is running	Se 3, Fr 3, Pr 2, Av 1, Cl 6	1.Designed to comply with the standards 2. Read the instructions before using the machine
1.4	Cutting or severing	Not applicable		

1.5	Drawing in or trapping	When the machine is running	Se 3, Fr 1, Pr 2, Av 1, CI 4	<ol style="list-style-type: none"> <li>1. warning signs was used</li> <li>2. appropriate brake system was provided</li> <li>3. Read the instructions before using the machine</li> <li>4. appropriate safety guard was provided</li> </ol>
1.6	Entanglement	When maintaining the machine	Se 3, Fr 1, Pr 2, Av 1, CI 4	<ol style="list-style-type: none"> <li>1. Designed to comply with the standards</li> <li>2. Read the instructions before using the machine</li> </ol>
1.7	Friction or abrasion	When maintaining the machine or the machine is running	Se 2, Fr 4, Pr 1 Av 1, CI 6	<ol style="list-style-type: none"> <li>1. warning signs was used</li> <li>2. appropriate brake system was provided</li> <li>3. Read the instructions before using the machine</li> </ol>
1.8	Impact	When maintaining the machine or the machine is running	Se 2, Fr 4, Pr 1 Av 1, CI 6	<ol style="list-style-type: none"> <li>1. warning signs was used</li> <li>2. appropriate brake system was provided</li> <li>3. Read the instructions before using the machine</li> </ol>
1.9	Injection	Not applicable		
1.10	Shearing	When maintaining the machine or the machine is running	Se 2, Fr 2, Pr 1 Av 1, CI 6	<ol style="list-style-type: none"> <li>1. warning signs was used</li> <li>2. appropriate brake system was provided</li> <li>3. Read the instructions before using the machine</li> </ol>

1.11	Slip, trip and fall of person	When maintaining the machine or the machine is running	Se 2, Fr 4, Pr 1 Av 1, CI 6	<ol style="list-style-type: none"><li>1. warning signs was used</li><li>2. appropriate safety guard was provided</li><li>3. Read the instructions before using the machine</li></ol>
1.12	Stabbing or puncture	When maintaining the machine or the machine is running	Se 2, Fr 4, Pr 1 Av 1, CI 6	<ol style="list-style-type: none"><li>1. Designed to comply with the standards</li><li>2. Read the instructions before using the machine</li></ol>
1.13	Suffocation	Not applicable		

2. Electrical				
Sub-clause of EN 12100:2010		-6.2.9; -6.3.2; -6.3.3.2; -6.3.5.4; -6.4.4; -6.4.5		
Origin		- electromagnetic phenomena; - live parts; - not enough distance to live parts under high voltage; - overload; – short-circuit		
No.	Potential Consequences	Hazardous Situations	Risk Estimation	Risk Reduction and Protective Measures
2.1	Burn	1. The main power's input	Se 2 ,Fr 1, Pr 1, Av 1, CI 3	1. warning signs was used 2. Read the instructions before using the machine
2.2	Electrocution	When the machine is running	Se 3, Fr 1, Pr 2, Av 1, CI 4	-1.Designed to comply with the standards 2. Read the instructions before using the machine
2.3	Falling, being thrown	Not applicable	-	-
2.4	Fire	Not applicable		

<p>2.5</p>	<p>Shock</p>	<p>1. The main power's input</p>	<p>-Se 1, - Fr2 -Pr 2, -Av 1 -Cl 5</p>	<p>1. Affixing the flash sign in the entrance. 2. The cabinet's door should be open by key or tools. 3. warning signs was used 4. Read the instructions before using the machine</p>
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<b>3. Thermal</b>				
<b>Sub-clause of EN 12100:2010</b>	– 6.2.4 b); – 6.2.8 c); – 6.3.2.7; – 6.3.3.2.1; – 6.3.4.5;			
<b>Origin</b>	– explosion; – flame; – objects or materials with a high or low temperature;.			
<b>No.</b>	<b>Potential Consequences</b>	<b>Hazardous Situations</b>	<b>Risk Estimation</b>	<b>Risk Reduction and Protective Measures</b>
3.1	Burn	Not applicable		
3.2	Dehydration;	Not applicable	-	-
3.3	Discomfort;	Not applicable	-	-

4. Noise				
Sub-clause of EN 12100:2010	– 6.2.2.2; – 6.2.3 c); – 6.2.4 c); – 6.2.8 c); – 6.3.1; – 6.3.2.1 b); – 6.3.2.5.1; – 6.3.3.2.1; – 6.3.4.2; – 6.4.3; – 6.4.5.1 b) and c);			
Origin	– cavitation phenomena; – exhausting system; – gas leaking at high speed; – manufacturing process (stamping, cutting, etc.); – moving parts; – scraping surfaces; – unbalanced rotating parts; – whistling pneumatics; – worn parts.			
No.	Potential Consequences	Hazardous Situation	Risk Estimation	Risk Reduction and Protective Measures
4.1	Discomfort	1. when machine is running	Se 3, Fr 1, Pr 2, Av 1, CI 4-	1.Designed to comply with the standards
4.2	Loss of awareness	Not applicable	-	-
4.3	Loss of balance	Not applicable	-	-
4.4	Permanent hear loss	Not applicable		
4.5	Stress	Not applicable		
4.6	Tinnitus	Not applicable		
4.7	Tiredness	Not applicable		

	<p>Any other (for example, mechanical, electrical) as a consequence of an interference with speech</p>	<p>Not applicable</p>		
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5. Vibration				
Sub-clause of EN 12100:2010	– 6.2.2.2 ; – 6.2.3 c) ; – 6.2.8 c) ; – 6.3.3.2.1 ; – 6.3.4.3 ; – 6.4.5.1 c) ;			
Origin	– cavitation phenomena;– misalignment of moving parts;– mobile equipment;– scraping surfaces;– unbalanced rotating parts;– vibrating equipment;– worn parts.			
No.	Potential Consequences	Hazardous Situation	Risk Estimation	Risk Reduction and Protective Measures
5.1	Discomfort	1. when machine is running	Se 3, Fr 1, Pr 2, Av 1, Cl 4-	1.Designed to comply with the standards
5.2	Low-back morbidity	Not applicable		
5.3	Neurological disorder	Not applicable		
5.4	Osteo-articular disorder	Not applicable		
5.5	Trauma of the spine	Not applicable		
5.6	Vascular disorder	Not applicable		

6. Radiation				
Sub-clause of EN 12100:2010		– 6.2.2.2;– 6.2.3 c);– 6.3.3.2.1;– 6.3.4.5;– 6.4.5.1 c);		
Origin		– ionizing radiation source;– low frequency electromagnetic radiation; – optical radiation (infrared, visible and ultraviolet), including laser; – radio frequency electromagnetic radiation.		
No.	Potential Consequences	Hazardous Situation	Risk Estimation	Risk Reduction and Protective Measures
6.1	Burn	Not applicable		
6.2	Damage to eyes and skin	Not applicable		
6.3	Effects on reproductive capability	Not applicable		
6.4	Genetic mutation	Not applicable		
6.5	Headache, insomnia,	Not applicable		

7. Material/ substance hazards				
Sub-clause of EN 12100:2010		– 6.2.2.2; – 6.2.3 b); – 6.2.3 c); – 6.2.4 a); – 6.2.4 b); – 6.3.1; – 6.3.3.2.1; – 6.3.4.4; – 6.4.5.1 c); – 6.4.5.1 g);		
Origin		– aerosol; – biological and microbiological (viral or bacterial) agent; – combustible; – dust; – explosive; – fibre; – flammable; – fluid; – fume; – oxidizer.		
No.	Potential Consequences	Hazardous Situation	Risk Estimation	Risk Reduction and Protective Measures
7.1	Breathing difficulties, suffocation	Not applicable		
7.2	Cancer	Not applicable		
7.3	Corrosion	Not applicable		
7.4	Effects on reproductive capability	Not applicable		
7.5	Explosion	Not applicable		
7.6	Fire	Not applicable		
7.7	Infection	Not applicable		
7.8	Mutation	Not applicable		

7.9	Poisoning	Not applicable		
7.10	Sensitization	Not applicable		

8. Ergonomic hazards				
Sub-clause of EN 12100:2010		– 6.2.2.1; – 6.2.7; – 6.2.8; – 6.2.11.8; – 6.3.2.1; – 6.3.3.2.1;		
Origin		– access; – design or location of indicators and visual displays units; – design, location or identification of control devices; – effort; – flicker, dazzling, shadow, stroboscopic effect; – local lighting; – mental overload/underload; – posture; – repetitive activity; – visibility – oxidizer.		
No.	Potential Consequences	Hazardous Situation	Risk Estimation	Risk Reduction and Protective Measures
8.1	Breathing difficulties, suffocation	Not applicable		
8.2	Cancer	Not applicable		
8.3	Corrosion	Not applicable		
8.4	Effects on reproductive capability	Not applicable		
8.5	Explosion	Not applicable		

9. Associated with Environment in which the Machine is Used				
Sub-clause of EN 12100:2010		– 6.2.6; – 6.2.11.11; – 6.3.2.1; – 6.4.5.1 b);		
Origin		– dust and fog; – electromagnetic disturbance; – lightning; – moisture; – snow; – temperature; – water; – wind; – lack of oxygen.		
No.	Potential Consequences	Hazardous Situation	Risk Estimation	Risk Reduction and Protective Measures
9.1	Burn	Not applicable		
9.2	Slight disease	Not applicable		
9.3	Slipping, falling	Not applicable		
9.4	Suffocation	Not applicable		

**2.3 EN 60204-1:2018 Safety of machinery - Electrical equipment of machines - Part 1: General requirements**

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
4	General requirements		-
4.1	General		-
	This standard specifies requirements for the electrical equipment of machines. The risks associated with the hazards relevant to the electrical equipment shall be assessed as part of the overall requirements for risk assessment of the machine. This will:		-
	<ul style="list-style-type: none"> <li>- identify the need for risk reduction; and</li> <li>- determine and adequate risk reductions;</li> <li>- determine the necessary protective measures for persons who can be exposed to those hazards, while still maintaining an appropriate performance of the machine and its equipment.</li> </ul>		P
	Hazardous situations can result from, but are not limited to, the following causes:		-
	<ul style="list-style-type: none"> <li>-failures or faults in the electrical equipment resulting in the possibility of electric shock, arc, or fire;</li> <li>- failures or faults in control circuits (or components and devices associated with those circuits) resulting in the malfunctioning of the machine;</li> <li>- disturbances or disruptions in power sources as well as failures or faults in the power circuits resulting in the malfunctioning of the machine;</li> <li>- loss of continuity of circuits that can result in a failure of a safety function, for example those that depend on sliding or rolling contacts;</li> <li>- electrical disturbances for example, electromagnetic, electrostatic either from outside the electrical equipment or internally generated, resulting in the malfunctioning of the machine;</li> <li>- release of stored energy (either electrical or mechanical) resulting in, for example, electric</li> </ul>		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	<p>shock, unexpected movement that can cause injury;</p> <ul style="list-style-type: none"> <li>– acoustic noise and mechanical vibration at levels that cause health problems to persons;</li> <li>– surface temperatures that can cause injury.</li> </ul>		
	<p>The design and development process shall identify hazards and the risks arising from them.</p> <p>Where the hazards cannot be removed and/or the risks cannot be sufficiently reduced by inherently safe design measures, protective measures (for example safeguarding,) shall be provided to reduce the risk.</p> <p>Additional means (for example, awareness means) shall be provided where further risk reduction is necessary. In addition, working procedures that reduce risk can be necessary.</p>		P
4.2	Selection of equipment		-
4.2.1	General		-
	Electrical components and devices shall:		-
	– be suitable for their intended use; and		P
	– conform to relevant IEC standards where such exist; and		P
	– be applied in accordance with the supplier's instructions		P
4.2.2	Switchgear		-
	In addition to the requirements of IEC 60204-1, depending upon the machine, its intended use and its electrical equipment, the designer may select parts of the electrical equipment of the machine that are in compliance with relevant parts of the IEC 61439 series (see also Annex F).		P
4.3	Electrical supply		-
4.3.1	General		-
	The electrical equipment shall be designed to operate correctly with the conditions of the supply:		-
	– as specified in 4.3.2 or 4.3.3, or		P
	as otherwise specified by the user, or		N
	– as specified by the supplier of a special source of supply		N

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	(see 4.3.4)		
4.3.2	AC supplies		-
	<p><b>Voltage: Steady state voltage: 0,9 to 1,1 of nominal voltage.</b>  <b>Frequency: 0,99 to 1,01 of nominal frequency continuously;</b>  <b>0,98 to 1,02 short time.</b></p> <p><b>Harmonics: Harmonic distortion not exceeding 12 % of the total r.m.s. voltage between live conductors for the sum of the 2nd through to the 30<sup>th</sup> harmonic.</b></p> <p><b>Voltage unbalance: Neither the voltage of the negative sequence component nor the voltage of the zero sequence component in three-phase supplies exceeding 2 % of the positive sequence component.</b></p> <p><b>Voltage interruption: Supply interrupted or at zero voltage for not more than 3 ms at any random time in the supply cycle with more than 1 s between successive interruptions.</b></p> <p><b>Voltage dips: Voltage dips not exceeding 20 % of the rms voltage of the supply for more than one cycle with more than 1 s between successive dips.</b></p>		P
4.3.3	DC supplies		-
	<p><b>From batteries:</b>  <b>Voltage: 0,85 to 1,15 of nominal voltage;</b>  <b>0,7 to 1,2 of nominal voltage in the case of battery-operated vehicles.</b>  <b>Voltage interruption: Not exceeding 5 ms.</b></p>		N
	<p><b>From converting equipment:</b>  <b>Voltage: 0,9 to 1,1 of nominal voltage.</b>  <b>Voltage interruption: Not exceeding 20 ms with more than 1 s between successive interruptions.</b></p>		N
4.3.4	Special supply systems		-
	<p><b>For special supply systems (e.g. on-board generators, DC bus, etc.) the limits given in 4.3.2 and 4.3.3 may be exceeded provided that the equipment is designed to operate correctly with those conditions.</b></p>		N
4.4	Physical environment and operating conditions		-
4.4.1	General		-

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	The electrical equipment shall be suitable for the physical environment and operating conditions of its intended use. The requirements of 4.4.2 to 4.4.8 cover the physical environment and operating conditions of the majority of machines covered by this part of		P
4.4.2	Electromagnetic compatibility (EMC)		-
	The electrical equipment shall not generate electromagnetic disturbances above levels that are appropriate for its intended operating environment. In addition, the electrical equipment shall have a sufficient level of immunity to electromagnetic disturbances so that it can function in its intended environment.		P
4.4.3	Ambient air temperature		-
	Electrical equipment shall be capable of operating correctly in the intended ambient air temperature. The minimum requirement for all electrical equipment is correct operation in ambient air temperatures outside of enclosures (cabinet or box) between +5 °C and +40 °C.		P
4.4.4	Humidity		-
	The electrical equipment shall be capable of operating correctly when the relative humidity does not exceed 50 % at a maximum temperature of +40 °C. Higher relative humidities are permitted at lower temperatures (for example 90 % at 20 °C). Harmful effects of occasional condensation shall be avoided by design of the equipment or, where necessary, by additional measures (for example built-in heaters, air conditioners, drain holes).		P
4.4.5	Altitude		-
	Electrical equipment shall be capable of operating correctly at altitudes up to 1 000 m above mean sea level..		P
4.4.6	Contaminants		-
	Electrical equipment shall be adequately protected against the ingress of solids and liquids (see 11.3).		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	The electrical equipment shall be adequately protected against contaminants (for example dust, acids, corrosive gases, salts) that can be present in the physical environment in which the electrical equipment is to be installed.		P
4.4.7	Ionizing and non-ionizing radiation		-
	When equipment is subject to radiation (for example microwave, ultraviolet, lasers, X-rays), additional measures shall be taken to avoid malfunctioning of the equipment and accelerated deterioration of the insulation.		P
4.4.8	Vibration, shock, and bump		-
	_ Undesirable effects of vibration, shock and bump (including those generated by the machine and its associated equipment and those created by the physical environment) shall be avoided by the selection of suitable equipment, by mounting it away from the machine, or by provision of anti-vibration mountings.		P
4.5	Transportation and storage		-
	Electrical equipment shall be designed to withstand, or suitable precautions shall be taken to protect against, the effects of transportation and storage temperatures within a range of -25 °C to +55 °C and for short periods not exceeding 24 h at up to +70 °C. Suitable means shall be provided to prevent damage from humidity, vibration, and shock.		P
4.6	Provisions for handling		-
	Heavy and bulky electrical equipment that has to be removed from the machine for transport, or that is independent of the machine, shall be provided with suitable means for handling, including where necessary means for handling by cranes or similar equipment.		P
5	Incoming supply conductor terminations and devices for disconnecting and switching off		-
5.1	Incoming supply conductor terminations		-
	It is recommended that, where practicable, the electrical equipment of a machine is connected to a single incoming supply. Where another supply is necessary for certain parts of		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	the equipment (for example, electronic equipment that operates at a different voltage), that supply should be derived, as far as is practicable, from devices (for example, transformers, converters) forming part of the electrical equipment of the machine. For large complex machinery comprising a number of widely-spaced machines working together in a coordinated manner, there can be a need for more than one incoming supply depending upon the site supply arrangements (see 5.3.1).		
	Unless a plug is provided with the machine for the connection to the supply (see 5.3.2 e)), it is recommended that the supply conductors are terminated at the supply disconnecting device. Where a neutral conductor is used it shall be clearly indicated in the technical documentation of the machine, such as in the installation diagram and in the circuit diagram, and a separate insulated terminal, labelled N in accordance with 16.1, shall be provided for the neutral conductor. The neutral terminal may be provided as part of the supply disconnecting device. There shall be no connection between the neutral conductor and the protective bonding circuit inside the electrical equipment.		P
5.2	Terminal for connection of the external protective conductor		-
	For each incoming supply, a terminal shall be provided in the same compartment as the associated line conductor terminals for connection of the machine to the external protective conductor.		P
5.3	Supply disconnecting (isolating) device		-
5.3.1	General		-
	A supply disconnecting device shall be provided:		-
	– for each incoming supply to (a) machine(s);		P
	– for each on-board power supply.		N
	The supply disconnecting device shall disconnect (isolate) the electrical equipment of the machine from the supply when required (for example for work on the machine, including the electrical equipment).		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	When two or more supply disconnecting devices are provided, protective interlocks for their correct operation shall also be provided in order to prevent a hazardous situation, including damage to the machine or to the work in progress.		N
5.3.2	Type		-
	The supply disconnecting device shall be one of the following types:		-
	a) switch-disconnector, with or without fuses, in accordance with IEC 60947-3, utilization category AC-23B or DC-23B;		N
	b) disconnector, with or without fuses, in accordance with IEC 60947-3, that has an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector;		N
	c) a circuit-breaker suitable for isolation in accordance with IEC 60947-2;		N
	d) any other switching device in accordance with an IEC product standard for that device and which meets the isolation requirements of IEC 60947-1 as well as a utilization category defined in the product standard as appropriate for on-load switching of motors or other inductive loads;		P
	e) a plug/socket combination for a flexible cable supply.		N
5.3.3	Requirements		
	When the supply disconnecting device is one of the types specified in 5.3.2 a) to d) it shall fulfil all of the following requirements:		
	<ul style="list-style-type: none"> <li>- isolate the electrical equipment from the supply and have one OFF (isolated) and one ON position marked with "O" and "I" (symbols IEC 60417-5008 (2002-10) and IEC 60417-5007 (2002-10), see 10.2.2);</li> <li>- have a visible contact gap or a position indicator which cannot indicate OFF (isolated) until all contacts are actually open and the requirements for the isolating function have been satisfied;</li> <li>- have an operating means (see 5.3.4);</li> <li>- be provided with a means permitting it to be locked in the</li> </ul>		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	<p>OFF (isolated) position (for example by padlocks). When so locked, remote as well as local closing shall be prevented;</p> <ul style="list-style-type: none"> <li>– disconnect all live conductors of its power supply circuit. However, for TN supply systems, the neutral conductor may or may not be disconnected except in countries where disconnection of the neutral conductor (when used) is compulsory;</li> <li>– have a breaking capacity sufficient to interrupt the current of the largest motor when stalled together with the sum of the normal running currents of all other motors and other loads. The calculated breaking capacity may be reduced by the use of a proven diversity factor. Where motor(s) are supplied by converter(s) or similar devices, the calculation should take into account the possible effect on the required breaking capacity.</li> </ul>		
	<p>Where the supply disconnecting device is a plug/socket combination, it shall comply with the requirements of 13.4.5 and shall have the breaking capacity, or be interlocked with a switching device that has a breaking capacity, sufficient to interrupt the current of the largest motor when stalled together with the sum of the normal running currents of all other motors and other loads. The calculated breaking capacity may be reduced by the use of a proven diversity factor.</p> <p>Where the interlocked switching device is electrically operated (for example a contactor) it shall have an appropriate utilisation category. Where motor(s) are supplied by converter(s) or similar devices, the calculation should take into account the possible effect on the required breaking capacity.</p>		N
	<p>Where the supply disconnecting device is a plug/socket combination, a switching device with an appropriate utilisation category shall be provided for switching the machine on and off. This can be achieved by the use of the interlocked switching device described above.</p>		N

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
5.3.4	Operating means of the supply disconnecting device		-
	The operating means (for example, a handle) of the supply disconnecting device shall be external to the enclosure of the electrical equipment.		P
	Exception: power-operated switchgear need not be provided with a handle outside the enclosure where other means (e.g. pushbuttons) are provided to open the supply disconnecting device from outside the enclosure.		N
	The operating means of the supply disconnecting device shall be easily accessible and located between 0,6 m and 1,9 m above the servicing level. An upper limit of 1,7 m is recommended.		P
	Where the external operating means is not intended for emergency operations:		-
	it is recommended that it be coloured BLACK or GREY (see 10.2) – supplementary cover or door that can be readily opened without the use of a key or tool may be provided, for example for protection against environmental conditions or mechanical damage. Such a cover/door shall clearly show that it provides access to the operating means. This can be achieved, for example, by use of the relevant symbol IEC 60417-6169-1 (2012-08) (Figure 2) or IEC 60417-6169-2 (2012-08), (Figure 3).		P
5.3.5	Excepted circuits		-
	The following circuits need not be disconnected by the supply disconnecting device:		-
	<ul style="list-style-type: none"> <li>– lighting circuits for lighting needed during maintenance or repair; socket outlets for the exclusive connection of repair or maintenance tools and equipment (for example hand drills, test equipment) (see 15.1);</li> <li>– undervoltage protection circuits that are only provided for automatic tripping in the event of supply failure;</li> <li>– circuits supplying equipment that should normally remain energized for correct operation for example temperature</li> </ul>		N

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	controlled measuring devices, heaters, program storage devices).		
	Control circuits supplied via another supply disconnecting device, regardless of whether that disconnecting device is located in the electrical equipment or in another machine or other electrical equipment, need not be disconnected by the supply disconnecting device of the electrical equipment.		N
	Where excepted circuits are not disconnected by the supply disconnecting device:		N
	– permanent warning label(s) shall be appropriately placed in proximity to the operating means of the supply disconnecting device to draw attention to the hazard;		N
	a corresponding statement shall be included in the maintenance manual, and one or more of the following shall apply: <ul style="list-style-type: none"> <li>• the conductors are identified by colour taking into account the recommendation of 13.2.4;</li> <li>• excepted circuits are separated from other circuits;</li> <li>• excepted circuits are identified by permanent warning label(s).</li> </ul>		N
5.4	Devices for removal of power for prevention of unexpected start-up		-
	Devices for removal of power for the prevention of unexpected start-up shall be provided where a start-up of the machine or part of the machine can create a hazard (for example during maintenance). Such devices shall be appropriate and convenient for the intended use, be suitably placed, and readily identifiable as to their function and purpose. Where their function and purpose is not otherwise obvious (e.g. by their location) these devices shall be marked to indicate the extent of removal of power.		P
	The supply disconnecting device or other devices in accordance with 5.3.2 may be used for prevention of unexpected start-up.		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	<p>Disconnectors, withdrawable fuse links and withdrawable links may be used for protection of unexpected start-up only if they are located in an enclosed electrical operating area (see 3.1.23).</p>		P
	<p>Devices that do not fulfil the isolation function (for example a contactor switched off by a control circuit, or Power Drive System (PDS) with a Safe Torque Off (STO) function in accordance with IEC 61800-5-2) may only be used for prevention of unexpected start-up during tasks such as:</p> <ul style="list-style-type: none"> <li>– inspections;</li> <li>– adjustments;</li> <li>– work on the electrical equipment where: <ul style="list-style-type: none"> <li>• there is no hazard arising from electric shock (see Clause 6) and burn;</li> <li>• the switching off means remains effective throughout the work;</li> <li>• the work is of a minor nature (for example, replacement of plug-in devices without disturbing existing wiring).</li> </ul> </li> </ul> <p>The selection of a device will be dependent on the risk assessment, taking into account the intended use of the device, and the persons who are intended to operate them.</p>		P
5.5	<p>Devices for isolating electrical equipment</p>		-
	<p>Devices shall be provided for isolating (disconnecting) the electrical equipment or part(s) of the electrical equipment to enable work to be carried out when it is de-energised and isolated. Such devices shall be:</p>		P
	<p>– appropriate and convenient for the intended use;</p>		P
	<p>– suitably placed;</p>		P
	<p>–readily identifiable as to which part(s) or circuit(s) of the equipment is served. Where their function and purpose is not otherwise obvious (e.g. by their location) these devices shall be marked to indicate the extent of the equipment that they isolate.</p>		P
	<p>The supply disconnecting device (see 5.3) may, in some cases, fulfil that function. However, where it is necessary to</p>		P

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Clause	Requirements	Result-Remark	Verdict
	work on individual parts of the electrical equipment of a machine, or on one of the machines fed by a common conductor bar, conductor wire or inductive power supply system, a disconnecting device shall be provided for each part, or for each machine, requiring separate isolation.		
	In addition to the supply disconnecting device, the following devices that fulfil the isolation function may be provided for this purpose: – devices described in 5.3.2; – disconnectors, withdrawable fuse links and withdrawable links only if located in an enclosed electrical operating area (see 3.1.23) and relevant information is provided with the electrical equipment (see Clause 17).		P
5.6	Protection against unauthorized, inadvertent and/or mistaken connection		-
	Where the devices described in 5.4 and 5.5 are located outside an enclosed electrical operating area they shall be equipped with means to secure them in the OFF position (disconnected state), (for example by provisions for padlocking, trapped key interlocking). When so secured, remote as well as local reconnection shall be prevented. Where the devices described in 5.4 and 5.5 are located inside an enclosed electrical operating area other means of protection against reconnection (for example warning labels) can be sufficient. However, when a plug/socket combination according to 5.3.2 e) is so positioned that it can be kept under the immediate supervision of the person carrying out the work, means for securing in the disconnected state need not be provided.		P
6	Protection against electric shock		-
6.1	General		-
	The electrical equipment shall provide protection of persons against electric shock by:		P

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Clause	Requirements	Result-Remark	Verdict
	<p>– basic protection (see 6.2 and 6.4), and;                      – fault protection (see 6.3 and 6.4).</p> <p>The measures for protection given in 6.2, 6.3, and, for PELV, in 6.4, are a selection from IEC 60364-4-41. Where those measures are not practicable, for example due to the physical or operational conditions, other measures from IEC 60364-4-41 may be used (e.g. SELV).</p>		
6.2	Basic protection		-
6.2.1	General		-
	For each circuit or part of the electrical equipment, the measures of either 6.2.2 or 6.2.3 and, where applicable, 6.2.4 shall be applied.		P
	Where the equipment is located in places open to all persons, which can include children, measures of either 6.2.2 with a minimum degree of protection against contact with live parts corresponding to IP4X or IPXXD (see IEC 60529), or 6.2.3 shall be applied.		N
6.2.2	Protection by enclosures		-
	Live parts shall be located inside enclosures that provide protection against contact with live parts of at least IP2X or IPXXB (see IEC 60529).		P
	Where the top surfaces of the enclosure are readily accessible, the minimum degree of protection against contact with live parts provided by the top surfaces shall be IP4X or IPXXD.		P
6.2.3	Protection by insulation of live parts		-
	Live parts protected by insulation shall be completely covered with insulation that can only be removed by destruction. Such insulation shall be capable of withstanding the mechanical, chemical, electrical, and thermal stresses to which it can be subjected under normal operating conditions.		P
6.2.4	Protection against residual voltages		-
	Live parts having a residual voltage greater than 60 V when		P

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Clause	Requirements	Result-Remark	Verdict
	<p>the supply is disconnected shall be discharged to 60 V or less within a time period of 5 s provided that this rate of discharge does not interfere with the proper functioning of the equipment. Exempted from this requirement are components having a stored charge of 60 <math>\mu</math>C or less. Where this specified rate of discharge would interfere with the proper functioning of the equipment, a durable warning notice drawing attention to the hazard and stating the delay required before the enclosure may be opened shall be displayed at an easily visible location on or immediately adjacent to the enclosure that contains the live parts.</p>		
	<p>In the case of plugs or similar devices, the withdrawal of which results in the exposure of conductors (for example pins), the discharge time to 60 V shall not exceed 1 s, otherwise such conductors shall be protected to at least IP2X or IPXXB. If neither a discharge time of 1 s nor a protection of at least IP2X or IPXXB can be achieved (for example in the case of removable collectors on conductor wires, conductor bars, or slip-ring assemblies, see 12.7.4), additional switching devices or an appropriate warning, for example a warning sign drawing attention to the hazard and stating the delay required shall be provided. When the equipment is located in places open to all persons, which can include children, warnings are not sufficient and therefore a minimum degree of protection against contact with live parts to IP4X or IPXXD is required.</p>		N
6.2.5	Protection by barriers		-
	For protection by barriers, the requirements of IEC 60364-4-41 shall apply.		P
6.2.6	Protection by placing out of reach or protection by obstacles		-
	<p>For protection by placing out of reach, the requirements of IEC 60364-4-41 shall apply. For protection by obstacles, the requirements of IEC 60364-4-41 shall apply.</p> <p>For conductor wire systems or conductor bar systems with a degree of protection less than IP2X or IPXXB, see 12.7.1.</p>		P

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Clause	Requirements	Result-Remark	Verdict
6.3	Fault protection		-
6.3.1	General		-
	Fault protection (3.31) is intended to prevent hazardous situations due to an insulation fault between live parts and exposed conductive parts.		-
	For each circuit or part of the electrical equipment, at least one of the measures in accordance with 6.3.2 to 6.3.3 shall be applied: – measures to prevent the occurrence of a touch voltage (6.3.2); or		P
	–automatic disconnection of the supply before the time of contact with a touch voltage can become hazardous (6.3.3).		N
6.3.2	Prevention of the occurrence of a touch voltage		-
6.3.2.1	General Measures to prevent the occurrence of a touch voltage include the following: – provision of class II equipment or by equivalent insulation; – electrical separation		P
6.3.2.2	Protection by provision of class II equipment or by equivalent insulation		-
	This measure is intended to prevent the occurrence of touch voltages on the accessible parts through a fault in the basic insulation. This protection is provided by one or more of the following: – class II electrical devices or apparatus (double insulation, reinforced insulation or by equivalent insulation in accordance with IEC 61140); – switchgear and control gear assemblies having total insulation in accordance with IEC 61439-1; – supplementary or reinforced insulation in accordance with IEC 60364-4-41.		P
6.3.2.3	Protection by electrical separation		-
	Electrical separation of an individual circuit is intended to prevent a touch voltage through contact with exposed conductive parts that can be energized by a fault in the basic		P

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Clause	Requirements	Result-Remark	Verdict
	insulation of the live parts of that circuit.		
6.3.3	<b>Protection by automatic disconnection of supply</b>		
	Automatic disconnection of the supply of any circuit affected by an insulation fault is intended to prevent a hazardous situation resulting from a touch voltage. This measure consists of the interruption of one or more of the line conductors by the automatic operation of a protective device in case of a fault. This interruption shall occur within a sufficiently short time to limit the duration of a touch voltage to a time within the limits specified in Annex A for TN and TT systems		P
	This measure necessitates co-ordination between:		-
	– the type of supply system, the supply source impedance and the earthing system; – the impedance values of the different elements of the line and of the associated fault current paths through the protective bonding circuit; – the characteristics of the protective devices that detect insulation fault(s).		P
6.4	<b>Protection by the use of PELV</b>		-
6.4.1	<b>General requirements</b>		-
	The use of PELV (Protective Extra-Low Voltage) is to protect persons against electric shock from indirect contact and limited area direct contact (see 8.2.1).		P
6.4.2	<b>Sources for PELV</b>		-
	The source for PELV shall be one of the following:		-
	– a safety isolating transformer in accordance with IEC 61558-1 and IEC 61558-2-6;		P
	– a source of current providing a degree of safety equivalent to that of the safety isolating transformer (for example a motor generator with winding providing equivalent isolation);		N
	-an electrochemical source (for example a battery) or another source independent of a higher voltage circuit (for example a diesel-driven generator);		N
	– an electronic power supply conforming to appropriate		N

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Clause	Requirements	Result-Remark	Verdict
	standards specifying measures to be –taken to ensure that, even in the case of an internal fault, the voltage at the outgoing terminals cannot exceed the values specified in 6.4.1.		
7	Protection of equipment		-
7.1	General		-
	<p>This Clause 7 details the measures to be taken to protect equipment against the effects of:</p> <ul style="list-style-type: none"> <li>– overcurrent arising from a short-circuit;</li> <li>– overload and/or loss of cooling of motors;</li> <li>– abnormal temperature;</li> <li>– loss of or reduction in the supply voltage;</li> <li>– overspeed of machines/machine elements;</li> <li>– earth fault/residual current;</li> <li>– incorrect phase sequence;</li> <li>– overvoltage due to lightning and switching surges.</li> </ul>		P
7.2	Overcurrent protection		-
7.2.1	General		-
	Overcurrent protection shall be provided where the current in any circuit can exceed either the rating of any component or the current carrying capacity of the conductors, whichever is the lesser value. The ratings or settings to be selected are detailed in 7.2.10.		P
7.2.2	Supply conductors		-
	<p>Unless otherwise specified by the user, the supplier of the electrical equipment is not responsible for providing the supply conductors and the overcurrent protective device for the supply conductors to the electrical equipment.</p> <p>The supplier of the electrical equipment shall state in the installation documents the data necessary for conductor dimensioning (including the maximum cross-sectional area of the supply conductor that can be connected to the terminals of the electrical equipment) and for selecting the overcurrent protective device (see 7.2.10 and 17).</p>		P
7.2.3	Power circuits		-

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Clause	Requirements	Result-Remark	Verdict
	Devices for detection and interruption of overcurrent, selected in accordance with 7.2.10, shall be applied to each live conductor including circuits supplying control circuit transformers.		P
	The following conductors, as applicable, shall not be disconnected without disconnecting all associated live conductors: – the neutral conductor of AC power circuits; – the earthed conductor of DC power circuits; – DC power conductors bonded to exposed conductive parts of mobile machines.		P
	Where the cross-sectional area of the neutral conductor is at least equal to or equivalent to that of the line conductors, it is not necessary to provide overcurrent detection for the neutral conductor nor a disconnecting device for that conductor. For a neutral conductor with a cross sectional area smaller than that of the associated line conductors, the measures detailed in 524 of IEC 60364-5-52:2009 shall apply.		P
	In IT systems, it is recommended that the neutral conductor is not used. However, where a neutral conductor is used, the measures detailed in 431.2.2 of IEC 60364-4-43:2008 shall apply.		P
7.2.4	Control circuits		-
	Conductors of control circuits directly connected to the supply voltage shall be protected against overcurrent in accordance with 7.2.3.		P
	Conductors of control circuits supplied by a transformer or DC supply shall be protected against overcurrent (see also 9.4.3.1.1): – in control circuits connected to the protective bonding circuit, by inserting an overcurrent protective device into the switched conductor; – in control circuits not connected to the protective bonding circuit; • where all control circuits of the equipment have the same		P

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Clause	Requirements	Result-Remark	Verdict
	<p>current carrying capacity, by inserting an overcurrent protective device into the switched conductor, or;</p> <ul style="list-style-type: none"> <li>• where different control circuits of the equipment have different current carrying capacity, by inserting an overcurrent protective device into both switched and common conductors of each control circuit.</li> </ul>		
7.2.5	<p><b>Socket outlets and their associated conductors</b></p> <p>Overcurrent protection shall be provided for the circuits feeding the general purpose socket outlets intended primarily for supplying power to maintenance equipment. Overcurrent protective devices shall be provided in the unearthed live conductors of each circuit feeding such socket outlets. See also 15.1.</p>		-
7.2.6	<p><b>Lighting circuits</b></p> <p>All unearthed conductors of circuits supplying lighting shall be protected against the effects of short-circuits by the provision of overcurrent devices separate from those protecting other circuits.</p>		P
7.2.7	<p><b>Transformers</b></p> <p>Transformers shall be protected by an overcurrent protective device having a type and setting in accordance with the transformer manufacturer's instructions. Such protection shall (see also 7.2.10):</p> <ul style="list-style-type: none"> <li>– avoid nuisance tripping due to transformer magnetizing inrush currents;</li> <li>– avoid a winding temperature rise in excess of the permitted value for the insulation class of transformer when it is subjected to the effects of a short-circuit at its secondary terminals.</li> </ul>		-
7.2.8	<p><b>Location of overcurrent protective devices</b></p> <p>An overcurrent protective device shall be located at the point where a reduction in the crosssectional area of the conductors or another change reduces the current-carrying</p>		P

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Clause	Requirements	Result-Remark	Verdict
	<p>capacity of the conductors, except where all the following conditions are satisfied:</p> <ul style="list-style-type: none"> <li>– the current carrying capacity of the conductors is at least equal to that of the load;</li> <li>– the part of the conductor(s) between the point of reduction of current-carrying capacity and the position of the overcurrent protective device is no longer than 3 m;</li> <li>– the conductors are installed in such a manner as to reduce the possibility of a shortcircuit, for example, protected by an enclosure or duct.</li> </ul>		
7.2.9	Overcurrent protective devices		-
	The rated short-circuit breaking capacity shall be at least equal to the prospective fault current at the point of installation. Where the short-circuit current to an overcurrent protective device can include additional currents other than from the supply (for example from motors, from power factor correction capacitors), those currents shall be taken into consideration.		P
7.2.10	Rating and setting of overcurrent protective devices		-
	The rated current of fuses or the setting current of other overcurrent protective devices shall be selected as low as possible but adequate for the anticipated overcurrents (for example during starting of motors or energizing of transformers). When selecting those protective devices, consideration shall be given to the protection of switching devices against damage due to overcurrents		P
	The rated current or setting of an overcurrent protective device for conductors is determined by the current carrying capacity of the conductors to be protected in accordance with 12.4, Clause D.3 and the maximum allowable interrupting time $t$ in accordance with Clause D.4, taking into account the needs of co-ordination with other electrical devices in the protected circuit.		P
7.3	Protection of motors against overheating		-
7.3.1	General		-

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Clause	Requirements	Result-Remark	Verdict
	<p>Protection of motors against overheating shall be provided for each motor rated at more than 0,5 kW.</p> <p>Exception: In applications where an automatic interruption of the motor operation is unacceptable (for example fire pumps), the means of detection shall give a warning signal to which the operator can respond.</p>		P
	<p>Protection of motors against overheating can be achieved by:</p> <ul style="list-style-type: none"> <li>- overload protection (7.3.2),</li> <li>- over-temperature protection (7.3.3), or</li> <li>- current-limiting protection.</li> </ul>		P
	<p>Automatic restarting of any motor after the operation of protection against overheating shall be prevented where this can cause a hazardous situation or damage to the machine or to the work in progress.</p>		P
7.3.2	Overload protection		-
	<p>Where overload protection is provided, detection of overload(s) shall be provided in each live conductor except for the neutral conductor.</p>		P
	<p>However, where the motor overload detection is not used for cable overload protection (see also Clause D.2), detection of overload may be omitted in one of the live conductors. For motors having single-phase or DC power supplies, detection in only one unearthed live conductor is permitted.</p>		P
	<p>Where overload protection is achieved by switching off, the switching device shall switch off all live conductors. The switching of the neutral conductor is not necessary for overload protection.</p>		P
	<p>Where motors with special duty ratings are required to start or to brake frequently (for example, motors for rapid traverse, locking, rapid reversal, sensitive drilling) it can be difficult to provide overload protection with a time constant comparable with that of the winding to be protected.</p> <p>Appropriate protective devices designed to accommodate special duty motors or over-temperature protection (see</p>		P

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Clause	Requirements	Result-Remark	Verdict
	7.3.3) can be necessary.		
	For motors that cannot be overloaded (for example torque motors, motion drives that either are protected by mechanical overload protection devices or are adequately dimensioned), overload protection is not required.		P
7.3.3	Over-temperature protection		-
	The provision of motors with over-temperature protection in accordance with IEC 60034-11 is recommended in situations where the cooling can be impaired (for example dusty environments). Depending upon the type of motor, protection under stalled rotor or loss of phase conditions is not always ensured by over-temperature protection, and additional protection should then be provided. Over-temperature protection is also recommended for motors that cannot be overloaded (for example torque motors, motion drives that are either protected by mechanical overload protection devices or are adequately dimensioned), where the possibility of over-temperature exists (for example due to reduced cooling).		P
7.4	Protection against abnormal temperature		-
	Equipment shall be protected against abnormal temperatures that can result in a hazardous situation.		P
7.5	Protection against supply interruption or voltage reduction and subsequent restoration		-
	Where a supply interruption or a voltage reduction can cause a hazardous situation, damage to the machine, or to the work in progress, undervoltage protection shall be provided by, for example, switching off the machine at a predetermined voltage level.		P
	Where the operation of the machine can allow for an interruption or a reduction of the voltage for a short time period, delayed undervoltage protection may be provided. The operation of the undervoltage device shall not impair the operation of any stopping control of the machine.		P
	Upon restoration of the voltage or upon switching on the		P

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Clause	Requirements	Result-Remark	Verdict
	incoming supply, automatic or unexpected restarting of the machine shall be prevented where such a restart can cause a hazardous situation.		
	Where only a part of the machine or of the group of machines working together in a coordinated manner is affected by the voltage reduction or supply interruption, the undervoltage protection shall initiate appropriate control responses to ensure co-ordination.		P
7.6	Motor overspeed protection		-
	Overspeed protection shall be provided where overspeeding can occur and could possibly cause a hazardous situation taking into account measures in accordance with 9.3.2. Overspeed protection shall initiate appropriate control responses and shall prevent automatic restarting. The overspeed protection should operate in such a manner that the mechanical speed limit of the motor or its load is not exceeded		P
7.7	Additional earth fault/residual current protection		-
	I In addition to providing overcurrent protection for automatic disconnection as described in 6.3, earth fault/residual current protection can be provided to reduce damage to equipment due to earth fault currents less than the detection level of the overcurrent protection. The setting of the devices shall be as low as possible consistent with correct operation of the equipment. If fault currents with DC components are possible, an RCD of type B in accordance with IEC TR 60755 can be required.		P
7.8	Phase sequence protection		-
	Where an incorrect phase sequence of the supply voltage can cause a hazardous situation or damage to the machine, protection shall be provided.		P
7.9	Protection against overvoltages due to lightning and to switching surges		-
	Surge protective devices (SPDs) can be provided to protect		P

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Clause	Requirements	Result-Remark	Verdict
	against the effects of overvoltages due to lightning or to switching surges		
7.10	Short-circuit current rating		-
	The short-circuit current rating of the electrical equipment shall be determined. This can be done by the application of design rules or by calculation or by test.		P
8	Equipotential bonding		-
8.1	General		-
	This Clause 8 provides requirements for protective bonding and functional bonding. Figure 4 illustrates those concepts. Protective bonding is a basic provision for fault protection to enable protection of persons against electric shock (see 6.3.3 and 8.2).		P
8.2	Protective bonding circuit		-
8.2.1	General		-
	The protective bonding circuit consists of the interconnection of: <ul style="list-style-type: none"> <li>• PE terminal(s) (see 5.2);</li> <li>• the protective conductors (see 3.1.51) in the equipment of the machine including sliding contacts where they are part of the circuit;</li> <li>• the conductive structural parts and exposed conductive parts of the electrical equipment;</li> </ul> Exception: see 8.2.5. <ul style="list-style-type: none"> <li>• conductive structural parts of the machine.</li> </ul>		P
8.2.2	Protective conductors		-
	Protective conductors shall be identified in accordance with 13.2.2. Copper conductors are preferred. Where a conductor material other than copper is used, its electrical resistance per unit length shall not exceed that of the allowable copper conductor and such conductors shall be not less than 16 mm <sup>2</sup> in cross-sectional area for reasons of mechanical durability.		P
8.2.3	Continuity of the protective bonding circuit		-

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Clause	Requirements	Result-Remark	Verdict
	Where a part is removed for any reason (for example routine maintenance), the protective bonding circuit for the remaining parts shall not be interrupted.		P
	Connection and bonding points shall be so designed that their current-carrying capacity is not impaired by mechanical, chemical, or electrochemical influences. Where enclosures and conductors of aluminium or aluminium alloys are used, particular consideration should be given to the possibility of electrolytic corrosion		P
	Where the electrical equipment is mounted on lids, doors, or cover plates, continuity of the protective bonding circuit shall be ensured and a protective conductor (see 8.2.2) is recommended. Where a protective conductor is not provided, fastenings, hinges or sliding contacts designed to have a low resistance shall be used (see 18.2.2, Test 1). The continuity of conductors in cables that are exposed to damage (for example flexible trailing cables) shall be ensured by appropriate measures (for example monitoring).		P
	For requirements for the continuity of conductors using conductor wires, conductor bars and slip-ring assemblies, see 12.7.2.		P
	The protective bonding circuit shall not incorporate a switching device, an overcurrent protective device (for example switch, fuse), or other means of interruption.		P
	Exception: links that cannot be opened without the use of a tool and that are located in an enclosed electrical operating area may be provided for test or measurement purposes.		P
	Where the continuity of the protective bonding circuit can be interrupted by means of removable current collectors or plug/socket combinations, the protective bonding circuit shall be interrupted by a first make last break contact. This also applies to removable or withdrawable plug-in units (see also 13.4.5).		P
8.2.4	Protective conductor connecting points		-
	All protective conductors shall be terminated in accordance		P

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Clause	Requirements	Result-Remark	Verdict
	with 13.1.1. The protective conductor connecting points are not intended, for example, to attach appliances or parts		
	Each protective conductor connecting point shall be marked or labelled as such using the symbol IEC 60417-5019:2006-08 as illustrated in Figure 5, or with the letters PE, the graphical symbol being preferred, or by use of the bicolour combination GREEN-AND-YELLOW, or by any combination of these.		P
8.2.5	Mobile machines		-
	On mobile machines with on-board power supplies, the protective conductors, the conductive structural parts of the electrical equipment, and those extraneous-conductive-parts which form the structure of the machine shall all be connected to a protective bonding terminal to provide protection against electric shock. Where a mobile machine is also capable of being connected to an external incoming power supply, this protective bonding terminal shall be the connection point for the external protective conductor.		N
8.2.6	Additional requirements for electrical equipment having earth leakage currents higher than 10 mA		N
	Where electrical equipment has an earth leakage current that is greater than 10 mA AC or DC in any protective conductor, one or more of the following conditions for the integrity of each section of the associated protective bonding circuit that carries the earth leakage current shall be satisfied:		N
	a) the protective conductor is completely enclosed within electrical equipment enclosures or otherwise protected throughout its length against mechanical damage; b) the protective conductor has a cross-sectional area of at least 10 mm <sup>2</sup> Cu or 16 mm <sup>2</sup> Al; c) where the protective conductor has a cross-sectional area of less than 10 mm <sup>2</sup> Cu or 16 mm <sup>2</sup> Al, a second protective conductor of at least the same cross-sectional area is provided up to a point where the		N

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Clause	Requirements	Result-Remark	Verdict
	<p>protective conductor has a cross-sectional area not less than 10 mm<sup>2</sup> Cu or 16 mm<sup>2</sup> Al. This can require that the electrical equipment has a separate terminal for a second protective conductor.</p> <p>d) the supply is automatically disconnected in case of loss of continuity of the protective conductor;</p> <p>e) where a plug-socket combination is used, an industrial connector in accordance with IEC 60309 series, with adequate strain relief and a minimum protective earthing conductor cross-section of 2,5 mm<sup>2</sup> as part of a multi-conductor power cable is provided.</p>		
	<p>A statement shall be given in the instructions for installation that the equipment shall be installed as described in this 8.2.6.</p>		N
8.3	<p>Measures to restrict the effects of high leakage current</p>		N
	<p>The effects of high leakage current can be restricted to the equipment having high leakage current by connection of that equipment to a dedicated supply transformer having separate windings. The protective bonding circuit shall be connected to exposed conductive parts of the equipment and, in addition, to the secondary winding of the transformer. The protective conductor(s) between the equipment and the secondary winding of the transformer shall comply with one or more of the arrangements described in 8.2.6.</p>		N
8.4	<p>Functional bonding</p>		-
	<p>Protection against maloperation as a result of insulation failures can be achieved by connecting to a common conductor in accordance with 9.4.3.1.1.</p> <p>For recommendations regarding functional bonding to avoid maloperation due to electromagnetic disturbances, see 4.4.2 and Annex H.</p> <p>Functional bonding connecting points should be marked or labelled as such using the symbol IEC 60417-5020:2002-10 (see Figure 6).</p>		P

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Clause	Requirements	Result-Remark	Verdict
9	Control circuits and control functions		-
9.1	Control circuits		-
9.1.1	Control circuit supply		-
	Where control circuits are supplied from an AC source, transformers having separate windings shall be used to separate the power supply from the control supply.		P
	Exception: Transformers or switch mode power supply units fitted with transformers are not mandatory for machines with a single motor starter and/or a maximum of two control devices (for example, interlock device, start/stop control station).		P
	Where DC control circuits derived from an AC supply are connected to the protective bonding circuit (see 8.2.1), they shall be supplied from a separate winding of the AC control circuit transformer or by another control circuit transformer.		P
9.1.2	Control circuit voltages		-
	The nominal value of the control voltage shall be consistent with the correct operation of the control circuit.		-
	– 230 V for circuits with 50 Hz nominal frequency,		P
	– 277 V for circuits with 60 Hz nominal frequency		P
	The nominal voltage of DC control circuits should preferably not exceed 220 V.		P
9.1.3	Protection		-
	Control circuits shall be provided with overcurrent protection in accordance with 7.2.4 and 7.2.10.		P
9.2	Control functions		-
9.2.2	Categories of stop functions		-
	There are three categories of stop functions as follows: – stop category 0: stopping by immediate removal of power to the machine actuators (i.e. an uncontrolled stop – see 3.1.64); – stop category 1: a controlled stop (see 3.1.14) with power available to the machine actuators to achieve the stop and then removal of power when the stop is achieved; – stop category 2: a controlled stop with power remaining		P

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Clause	Requirements	Result-Remark	Verdict
	available to the machine actuators.		
9.2.3	Operation		
9.2.3.1	General		P
	Safety functions and/or protective measures (for example interlocks (see 9.3)) shall be provided where required to reduce the possibility of hazardous situations.		P
	Where a machine has more than one control station, measures shall be provided to ensure that initiation of commands from different control stations do not lead to a hazardous situation.		P
9.2.3.2	Start		-
	Start functions shall operate by energizing the relevant circuit		P
	The start of an operation shall be possible only when all relevant safety functions and/or protective measures are in place and are operational, except for conditions as described in 9.3.6.		P
	For those machines (for example mobile machines) where safety functions and/or protective measures cannot be applied for certain operations, starting of such operations shall be by hold-to-run controls, together with enabling devices, as appropriate.		P
	The provision of acoustic and/or visual warning signals before the starting of hazardous machine operation shall be considered during the risk assessment. Where the risk assessment determines that either or both are required the emission level of noise/light shall be suitable for the intended environment		P
	Suitable interlocks shall be provided where necessary for correct sequential starting.		P
	In the case of machines requiring the use of more than one control station to initiate a start, each of these control stations shall have a separate manually actuated start control device. The conditions to initiate a start shall be:		P
	• all required conditions for machine operation shall be met,		P

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	and <ul style="list-style-type: none"> <li>• all start control devices shall be in the released (off) position, then</li> <li>• all start control devices shall be actuated concurrently (see 3.1.7).</li> </ul>		
9.2.3.3	Stop		-
	Stop category 0 and/or stop category 1 and/or stop category 2 stop functions shall be provided as indicated by the risk assessment and the functional requirements of the machine (see 4.1).		P
	Stop functions shall override related start functions.		P
	Where more than one control station is provided, stop commands from any control station shall be effective when required by the risk assessment of the machine		P
9.2.3.4	Emergency operations (emergency stop, emergency switching off)		P
9.2.3.4.1	General		P
	Emergency stop and emergency switching off are complementary protective measures that are not primary means of risk reduction for hazards (for example trapping, entanglement, electric shock or burn) at a machine (see ISO 12100).		P
	This part of IEC 60204 specifies the requirements for the emergency stop and the emergency switching off functions of the emergency operations listed in Annex E, both of which are intended to be initiated by a single human action		P
	Once active operation of an emergency stop (see 10.7) or emergency switching off (see 10.8) actuator has ceased following a stop or switching off command, the effect of this command shall be sustained until it is reset. This reset shall be possible only by a manual action at the device where the command has been initiated. The reset of the command shall not restart the machinery but only permit restarting.		P
	It shall not be possible to restart the machinery until all		P

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	emergency stop commands have been reset. It shall not be possible to reenergize the machinery until all emergency switching off commands have been reset.		
9.2.3.4.2	Emergency stop		-
	Requirements for functional aspects of emergency stop equipment are given in ISO 13850.		P
	The emergency stop shall function either as a stop category 0 or as a stop category 1. The choice of the stop category of the emergency stop depends on the results of a risk assessment of the machine		P
	Exception: In some cases, to avoid creating additional risks, it can be necessary to perform a controlled stop and maintain the power to machine actuators even after stopping is achieved. The stopped condition shall be monitored and upon detection of failure of the stopped condition, power shall be removed without creating a hazardous situation.		P
	In addition to the requirements for stop given in 9.2.3.3, the emergency stop function has the following requirements:		P
	<ul style="list-style-type: none"> <li>• it shall override all other functions and operations in all modes;</li> <li>• it shall stop the hazardous motion as quickly as practicable without creating other hazards;</li> <li>• reset shall not initiate a restart.</li> </ul>		P
9.2.3.4.3	Emergency switching off		-
	The functional aspects of emergency switching off are given in 536.4 of IEC 60364-5-53:2001.		P
	Emergency switching off should be provided where:		-
	<ul style="list-style-type: none"> <li>• basic protection (for example for conductor wires, conductor bars, slip-ring assemblies, controlgear in electrical operating areas) is achieved only by placing out of reach or by obstacles (see 6.2.6); or               <ul style="list-style-type: none"> <li>• there is the possibility of other hazards or damage caused</li> </ul> </li> </ul>		P

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Clause	Requirements	Result-Remark	Verdict
	by electricity.		
	Emergency switching off is accomplished by switching off the relevant supply by electromechanical switching devices, effecting a stop category 0 of machine actuators connected to this incoming supply. When a machine cannot tolerate this category 0 stop, it may be necessary to provide other measures, for example basic protection, so that emergency switching off is not necessary.		P
9.2.3.5	Operating modes		-
	Each machine can have one or more operating modes (for example manual mode, automatic mode, setting mode, maintenance mode) determined by the type of machine and its application.		P
	Where machinery has been designed and constructed to allow its use in several control or operating modes requiring different protective measures and having a different impact on safety, it shall be fitted with a mode selector which can be locked in each position (for example key operated switch). Each position of the selector shall be clearly identifiable and shall correspond to a single operating or control mode.		P
	The selector may be replaced by another selection method which restricts the use of certain functions of the machinery to certain categories of operator (for example access code).		P
	Mode selection by itself shall not initiate machine operation. A separate actuation of the start control shall be required		P
	For each specific operating mode, the relevant safety functions and/or protective measures shall be implemented.		P
	Indication of the selected operating mode shall be provided (for example the position of a mode selector, the provision of an indicating light, a visual display indication).		P
9.2.3.6	Monitoring of command actions		-
	Movement or action of a machine or part of a machine that can result in a hazardous situation shall be monitored by providing, for example, overtravel limiters, motor overspeed detection, mechanical overload detection or anti-collision		P

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	devices		
9.2.3.7	Hold-to-run controls		-
	Hold-to-run controls shall require continuous actuation of the control device(s) to achieve operation.		N
9.2.3.8	Two-hand control		-
	Three types of two-hand control are defined in ISO 13851, the selection of which is determined by the risk assessment. These shall have the following features:		N
	Type I: this type requires: <ul style="list-style-type: none"> <li>• the provision of two control devices and their concurrent actuation by both hands;</li> <li>• continuous concurrent actuation during the hazardous situation;</li> <li>• machine operation shall cease upon the release of either one or both of the control devices when hazardous situations are still present.</li> </ul> A Type I two-hand control device is not considered to be suitable for the initiation of hazardous operation.		N
	Type II: a Type I control requiring the release of both control devices before machine operation can be reinitiated.		N
	Type III: a Type II control requiring concurrent actuation of the control devices as follows: <ul style="list-style-type: none"> <li>• it shall be necessary to actuate the control devices within a certain time limit of each other, not exceeding 0,5 s;</li> <li>• where this time limit is exceeded, both control devices shall be released before machine operation can be initiated</li> </ul>		N
9.2.3.9	Enabling control		N
	Enabling control (see also 10.9) is a manually activated control function interlock that: <ol style="list-style-type: none"> <li>a) when activated allows a machine operation to be initiated by a separate start control, and</li> <li>b) when de-activated <ul style="list-style-type: none"> <li>• initiates a stop function, and</li> <li>• prevents initiation of machine operation.</li> </ul> </li> </ol> Enabling control shall be so arranged as to minimize the		N

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	possibility of defeating, for example by requiring the de-activation of the enabling control device before machine operation may be reinitiated		
9.2.3.10	Combined start and stop controls		N
	Push-buttons and similar control devices that, when operated, alternately initiate and stop motion shall only be provided for functions which cannot result in a hazardous situation.		N
9.2.4	Cableless control system (CCS)		N
9.2.4.1	General requirements		N
	Subclause 9.2.4 deals with the functional requirements of control systems employing cableless (for example radio, infra-red) techniques for transmitting control signals and data between operator control station(s) and other parts of the control system(s).		N
	The CCS shall have functionality and a response time suitable for the application based on the risk assessment		N
9.2.4.2	Monitoring the ability of a cableless control system to control a machine		N
	The ability of a cableless control system (CCS) to control a machine shall be automatically monitored, either continuously or at suitable intervals. The status of this ability shall be clearly indicated (for example, by an indicating light, a visual display indication, etc.)		N
	If the communication signal is degraded in a manner that might lead to the loss of the ability of a CCS to control a machine (e.g., reduced signal level, low battery power) a warning to the operator shall be provided before the ability of the CCS to control a machine is lost.		N
	When the ability of a CCS to control a machine has been lost for a time that is determined from a risk assessment of the application, an automatic stop of the machine shall be initiated.		N
	Restoration of the ability of a CCS to control a machine shall not restart the machine. Restart shall require a deliberate action, for example manual actuation of a start button.		N

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9.2.4.3	<b>Control limitation</b>		N
	Measures shall be taken (e.g. coded transmission) to prevent the machine from responding to signals other than those from the intended cableless operator control station(s).		N
	Cableless operator control station(s) shall only control the intended machine(s) and shall affect only the intended machine functions.		N
9.2.4.4	<b>Use of multiple cableless operator control stations</b>		N
	<p>When more than one cableless operator control station is used to control a machine, then:</p> <ul style="list-style-type: none"> <li>• only one cableless operator control station shall be enabled at a time except as necessary for the operation of the machine;</li> <li>• transfer of control from one cableless operator control station to another shall require a deliberate manual action at the control station that has control;</li> <li>• during machine operation, transfer of control shall only be possible when both cableless operator control stations are set to the same mode of machine operation and/or function(s) of the machine;</li> <li>• transfer of control shall not change the selected mode of machine operation and/or function(s) of the machine;</li> <li>• each cableless operator control station that has control of the machine shall be provided with an indication that it has control (by for example, the provision of an indicating light, a visual display indication).</li> </ul>		N
9.2.4.5	<b>Portable cableless operator control stations</b>		N
	Portable cableless operator control stations shall be provided with means (for example key operated switch, access code) to prevent unauthorized use.		N
	Each machine under cableless control should have an indication when it is under cableless control.		N
	When a portable cableless operator control station can be connected to one or more of several machines, means shall be provided on the portable cableless operator control station		N

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	to select which machine(s) is to be connected. Selecting a machine to be connected shall not initiate control commands.		
9.2.4.6	Deliberate disabling of cableless operator control stations		N
	Where a cableless operator control station is disabled when under control, the associated machine shall meet the requirements for loss of ability of a CCS to control a machine in 9.2.4.2.		N
	Where it is necessary to disable a cableless operator control station without interrupting machine operation, means shall be provided (for example on the cableless operator control station) to transfer control to another fixed or portable control station.		N
9.2.4.7	Emergency stop devices on portable cableless operator control stations		N
	Emergency stop devices on portable cableless operator control stations shall not be the sole means of initiating the emergency stop function of a machine.		N
	Confusion between active and inactive emergency stop devices shall be avoided by appropriate design and information for use. See also ISO 13850		N
9.2.4.8	Emergency stop reset		N
	Restarting of cableless control after power loss, disabling and re-enabling, loss of communication, or failure of parts of the CCS shall not result in a reset of an emergency stop condition		N
	The instructions for use shall state that the reset of an emergency stop condition initiated by a portable cableless operator control station shall only be performed when it can be seen that the reason for initiation has been cleared.		N
9.3	Protective interlocks		-
9.3.1	Reclosing or resetting of an interlocking safeguard		-
	The reclosing or resetting of an interlocking safeguard shall not initiate hazardous machine operation		P
9.3.2	Exceeding operating limits		-
	Where an operating limit (for example speed, pressure,		P

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	position) can be exceeded leading to a hazardous situation, means shall be provided to detect when a predetermined limit(s) is exceeded and initiate an appropriate control action.		
9.3.3	Operation of auxiliary functions		-
	The correct operation of auxiliary functions shall be checked by appropriate devices (for example pressure sensors). Where the non-operation of a motor or device for an auxiliary function (for example lubrication, supply of coolant, swarf removal) can cause a hazardous situation, or cause damage to the machine or to the work in progress, appropriate interlocking shall be provided.		P
9.3.4	Interlocks between different operations and for contrary motions		-
	All contactors, relays, and other control devices that control elements of the machine and that can cause a hazardous situation when actuated at the same time (for example those which initiate contrary motion), shall be interlocked against incorrect operation.		P
	Reversing contactors (for example those controlling the direction of rotation of a motor) shall be interlocked in such a way that in normal service no short-circuit can occur when switching.		P
	Where, for safety or for continuous operation, certain functions on the machine are required to be interrelated, proper co-ordination shall be ensured by suitable interlocks. For a group of machines working together in a co-ordinated manner and having more than one controller, provision shall be made to co-ordinate the operations of the controllers as necessary.		P
	Where a failure of a mechanical brake actuator can result in the brake being applied when the associated machine actuator is energized and a hazardous situation can result, interlocks shall be provided to switch off the machine actuator		P
9.3.5	Reverse current braking		-
	Where braking of a motor is accomplished by current		N

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	reversal, measures shall be provided to prevent the motor starting in the opposite direction at the end of braking where that reversal can cause a hazardous situation or damage to the machine or to the work in progress. For this purpose, a device operating exclusively as a function of time is not permitted.		
	Control circuits shall be so arranged that rotation of a motor shaft, for example by applying a manual force or any other force causing the shaft to rotate after it has stopped, shall not result in a hazardous situation.		N
9.3.6	Suspension of safety functions and/or protective measures		-
	Where it is necessary to suspend safety functions and/or protective measures (for example for setting or maintenance purposes), the control or operating mode selector shall simultaneously:		N
	<ul style="list-style-type: none"> <li>• disable all other operating (control) modes;</li> <li>• permit operation only by the use of a hold-to-run device or by a similar control device positioned so as to permit sight of the hazardous elements;</li> <li>• permit operation of the hazardous elements only in reduced risk conditions (e.g. reduced speed, reduced power / force, step-by-step operation, e.g. with a limited movement control device);</li> <li>• prevent any operation of hazardous functions by voluntary or involuntary action on the machine's sensors.</li> </ul>		N
	<ul style="list-style-type: none"> <li>• disable all other operating (control) modes;</li> <li>• permit operation only by the use of a hold-to-run device or by a similar control device positioned so as to permit sight of the hazardous elements;</li> <li>• permit operation of the hazardous elements only in reduced risk conditions (e.g. reduced speed, reduced power / force, step-by-step operation, e.g. with a limited movement control device);</li> <li>• prevent any operation of hazardous functions by voluntary or involuntary action on the machine's sensors.</li> </ul>		N

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Clause	Requirements	Result-Remark	Verdict
9.4	Control functions in the event of failure		-
9.4.1	General requirements		-
	Where failures or disturbances in the electrical equipment can cause a hazardous situation or damage to the machine or to the work in progress, appropriate measures shall be taken to minimize the probability of the occurrence of such failures or disturbances. The required measures and the extent to which they are implemented, either individually or in combination, depend on the level of risk associated with the respective application (see 4.1).		P
	Examples of such measures that can be appropriate include but are not limited to: <ul style="list-style-type: none"> <li>• protective interlocking of the electrical circuit;</li> <li>• use of proven circuit techniques and components (see 9.4.2.2);</li> <li>• provision of partial or complete redundancy (see 9.4.2.3) or diversity (see 9.4.2.4);</li> <li>• provision for functional tests (see 9.4.2.5).</li> </ul>		P
	The electrical control system(s) shall have an appropriate performance that has been determined from the risk assessment of the machine.		P
	The requirements for safety-related control functions of IEC 62061 and/or ISO 13849-1, ISO 13849-2 shall apply.		P
	Where functions performed by the electrical control system(s) have safety implications but application of IEC 62061 leads to a required safety integrity less than that required by SIL 1, compliance with the requirements of this part of IEC 60204 can lead to an adequate performance of the electrical control system(s).		P
	Where memory retention is achieved for example, by battery power, measures shall be taken to prevent hazardous situations arising from failure, undervoltage or removal of the battery.		P
	Means shall be provided to prevent unauthorized or inadvertent memory alteration by, for example, requiring the		P

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	use of a key, access code or tool.		
9.4.2	Measures to minimize risk in the event of failure		-
9.4.2.1	General		-
	<p>Measures to minimize risk in the event of failure include but are not limited to:</p> <ul style="list-style-type: none"> <li>• use of proven circuit techniques and components;</li> <li>• provisions of partial or complete redundancy;</li> <li>• provision of diversity;</li> <li>• provision for functional tests.</li> </ul>		P
9.4.2.2	Use of proven circuit techniques and components		-
	<p>These measures include but are not limited to:</p> <ul style="list-style-type: none"> <li>• bonding of control circuits to the protective bonding circuit for functional purposes (see 9.4.3.1.1 and Figure 4);</li> <li>• connection of control devices in accordance with 9.4.3.1.1;</li> <li>• stopping by de-energizing;</li> <li>• the switching of all control circuit conductors (for example both sides of a coil) of the device being controlled;</li> <li>• switching devices having direct opening action (see IEC 60947-5-1);</li> <li>• monitoring by: <ul style="list-style-type: none"> <li>– use of mechanically linked contacts (see IEC 60947-5-1);</li> <li>– use of mirror contacts (see IEC 60947-4-1);</li> </ul> </li> <li>• circuit design to reduce the possibility of failures causing undesirable operations.</li> </ul>		P
9.4.2.3	Provisions of partial or complete redundancy		-
	<p>By providing partial or complete redundancy, it is possible to minimize the probability that one single failure in the electrical circuit can result in a hazardous situation. Redundancy can be effective in normal operation (on-line redundancy) or designed as special circuits that take over the protective function (off-line redundancy) only where the operating function fails.</p>		P
	<p>Where off-line redundancy which is not active during normal operation is provided, suitable measures shall be taken to ensure that those control circuits are available when required</p>		P

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9.4.2.4	<b>Provision of diversity</b>		-
	The use of control circuits having different principles of operation, or using different types of components or devices can reduce the probability of hazards resulting from faults and/or failures. Examples include: – the use of a combination of normally open and normally closed contacts; – the use of different types of control devices in the circuit(s); – the combination of electromechanical and electronic equipment in redundant configurations		P
	The combination of electrical and non-electrical systems (for example mechanical, hydraulic, pneumatic) may perform the redundant function and provide the diversity.		P
9.4.2.5	<b>Provision for functional tests</b>		-
	Functional tests may be carried out automatically by the control system, or manually by inspection or tests at start-up and at predetermined intervals, or a combination as appropriate (see also 17.2 and 18.6).		P
9.4.3	<b>Protection against malfunction of control circuits</b>		-
9.4.3.1	<b>Insulation faults</b>		-
9.4.3.1.1	<b>General</b>		-
1	Measures shall be provided to reduce the probability that insulation faults on any control circuit can cause malfunction such as unintentional starting, potentially hazardous motions, or prevent stopping of the machine		P
	The measures to meet the requirements include but are not limited to the following methods: – method a) Earthed control circuits fed by transformers; – method b) Non-earthed control circuits fed by transformers; – method c) Control circuits fed by transformer with an earthed centre-tap winding; – method d) Control circuits not fed by a transformer		P
9.4.3.2	<b>Voltage interruptions</b>		-
	See also 7.5.		P

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	Where the control system uses a memory device(s), proper functioning in the event of power failure shall be ensured (for example by using a non-volatile memory) to prevent any loss of memory that can result in a hazardous situation.		
9.4.3.3	Loss of circuit continuity		-
	Where the loss of continuity of control circuits depending upon sliding contacts can result in a hazardous situation, appropriate measures shall be taken (for example by duplication of the sliding contacts).		P
10	Operator interface and machine-mounted control devices		-
10.1	General		-
10.1.1	General requirements		-
	Control devices for operator interface shall, as far as is practicable, be selected, mounted, and identified or coded in accordance with IEC 61310 series. The possibility of inadvertent operation shall be minimized by, for example, positioning of devices, suitable design, provision of additional protective measures. Particular consideration shall be given to the selection, arrangement, programming and use of operator input devices such as touchscreens, keypads and keyboards for the control of hazardous machine operations, and of sensors (for example position sensors) that can initiate machine operation. Further information can be found in IEC 60447. Ergonomic principles shall be taken into account in the location of operator interface devices		P
10.1.2	Location and mounting		-
	As far as is practicable, machine-mounted control devices shall be: <ul style="list-style-type: none"> <li>• readily accessible for service and maintenance;</li> <li>• mounted in such a manner as to minimize the possibility of damage from activities such as material handling.</li> </ul>		P
	The actuators of hand-operated control devices shall be selected and installed so that: <ul style="list-style-type: none"> <li>• they are not less than 0,6 m above the servicing level and are within easy reach of the normal working position of the</li> </ul>		P

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	operator; <ul style="list-style-type: none"> <li>the operator is not placed in a hazardous situation when operating them.</li> </ul>		
	The actuators of foot-operated control devices shall be selected and installed so that: <ul style="list-style-type: none"> <li>they are within easy reach of the normal working position of the operator;</li> <li>the operator is not placed in a hazardous situation when operating them.</li> </ul>		P
10.1.3	Protection		-
	The degree of protection (IP rating in accordance with IEC 60529) together with other appropriate measures shall provide protection against: <ul style="list-style-type: none"> <li>the effects of liquids, vapours, or gases found in the physical environment or used on the machine;</li> <li>the ingress of contaminants (for example swarf, dust, particulate matter).</li> </ul> In addition, the operator interface control devices shall have a minimum degree of protection against contact with live parts of IPXXD in accordance with IEC 60529.		P
10.1.4	Position sensors		-
	Position sensors (for example position switches, proximity switches) shall be so arranged that they will not be damaged in the event of overtravel.		N
	Position sensors in circuits with safety-related control functions (for example, to maintain the safe condition of the machine or prevent hazardous situations arising at the machine) shall have direct opening action (see IEC 60947-5-1) or shall provide similar reliability (see 9.4.2).		N
10.1.5	Portable and pendant control stations		-
	Portable and pendant operator control stations and their control devices shall be so selected and arranged as to minimize the possibility of machine operations caused by inadvertent actuation, shocks and vibrations (for example if		N

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	the operator control station is dropped or strikes an obstruction) (see also 4.4.8).		
10.2	Actuators		-
10.2.1	Colours		-
	Actuators (see 3.1.1) shall be colour-coded as follows.		-
	<p>The colours for START/ON actuators should be WHITE, GREY, BLACK or GREEN with a preference for WHITE. RED shall not be used.</p> <p>The colour RED shall be used for emergency stop and emergency switching off actuators (including supply disconnecting devices where it is foreseen that they are for use in an emergency). If a background exists immediately around the actuator, then this background shall be coloured YELLOW. The combination of a RED actuator with a YELLOW background shall only be used for emergency operation devices.</p> <p>The colours for STOP/OFF actuators should be BLACK, GREY, or WHITE with a preference for BLACK. GREEN shall not be used. RED is permitted, but it is recommended that RED is not used near an emergency operation device.</p> <p>WHITE, GREY, or BLACK are the preferred colours for actuators that alternately act as START/ON and STOP/OFF actuators. The colours RED, YELLOW, or GREEN shall not be used.</p> <p>WHITE, GREY, or BLACK are the preferred colours for actuators that cause operation while they are actuated and cease the operation when they are released (for example hold-to-run).</p> <p>The colours RED, YELLOW, or GREEN shall not be used.</p> <p>Reset actuators shall be BLUE, WHITE, GREY, or BLACK.</p> <p>Where they also act as a STOP/OFF actuator, the colours WHITE, GREY, or BLACK are preferred with the main preference being for BLACK. GREEN shall not be used.</p> <p>The colour YELLOW is reserved for use in abnormal conditions, for example, in the event of an abnormal condition</p>		P

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	of the process, or to interrupt an automatic cycle. Where the same colour WHITE, GREY, or BLACK is used for various functions (for example WHITE for START/ON and for STOP/OFF actuators) a supplementary means of coding (for example shape, position, symbol) shall be used for the identification of actuators.		
10.2.2	Markings		-
	In addition to the functional identification as described in 16.3, recommended symbols to be placed near to or preferably directly on certain actuators are given in Table 2 or 3.		P
10.3	Indicator lights and displays		-
10.3.1	General		-
	Indicator lights and displays serve to give the following types of information: – indication: to attract the operator's attention or to indicate that a certain task should be performed. The colours RED, YELLOW, BLUE, and GREEN are normally used in this mode; for flashing indicator lights and displays, see 10.3.3. – confirmation: to confirm a command, or a condition, or to confirm the termination of a change or transition period. The colours BLUE and WHITE are normally used in this mode and GREEN may be used in some case		P
	Indicator lights and displays shall be selected and installed in such a manner as to be visible from the normal position of the operator (see also IEC 61310-1). Circuits used for visual or audible devices used to warn persons of an impending hazardous event shall be fitted with facilities to check the operability of these devices.		P
10.3.2	Colours		-
	Indicator lights should be colour-coded with respect to the condition (status) of the machine in accordance with Table 4.		P
	Indicating towers on machines should have the applicable colours in the following order from the top down; RED, YELLOW, BLUE, GREEN and WHITE		P
10.3.3	Flashing lights and displays		-

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Clause	Requirements	Result-Remark	Verdict
	<p>For further distinction or information and especially to give additional emphasis, flashing lights and displays can be provided for the following purposes:</p> <ul style="list-style-type: none"> <li>– to attract attention;</li> <li>– to request immediate action;</li> <li>– to indicate a discrepancy between the command and actual state;</li> <li>– to indicate a change in process (flashing during transition). It is recommended that higher flashing frequencies are used for higher priority information (see IEC 60073 for recommended flashing rates and pulse/pause ratios).</li> </ul> <p>Where flashing lights or displays are used to provide higher priority information, additional acoustic warnings should be considered.</p>		P
10.4	<b>Illuminated push-buttons</b>		-
	<p>Illuminated push-button actuators shall be colour-coded in accordance with 10.2.1. Where there is difficulty in assigning an appropriate colour, WHITE shall be used.</p> <p>The colour of active emergency stop actuators shall remain RED regardless of the state of the illumination</p>		P
10.5	<b>Rotary control devices</b>		-
	<p>Devices having a rotational member, such as potentiometers and selector switches, shall have means of prevention of rotation of the stationary member. Friction alone shall not be considered sufficient.</p>		P
10.6	<b>Start devices</b>		-
	<p>Actuators used to initiate a start function or the movement of machine elements (for example slides, spindles, carriers) shall be constructed and mounted so as to minimize inadvertent operation.</p>		P
10.7	<b>Emergency stop devices</b>		-
10.7.1	<b>Location of emergency stop devices</b>		-
	<p>Devices for emergency stop shall be readily accessible</p>		P
	<p>Emergency stop devices shall be provided at each location where the initiation of an emergency stop can be required.</p>		P

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Clause	Requirements	Result-Remark	Verdict
	There can be circumstances where confusion can occur between active and inactive emergency stop devices caused by, for example, unplugging or otherwise disabling an operator control station. In such cases, means (for example, design and information for use) shall be provided to minimise confusion.		P
10.7.2	Types of emergency stop device		-
	The types of device for emergency stop include, but are not limited to: <ul style="list-style-type: none"> <li>• a push-button device for actuation by the palm or the fist (e.g. mushroom head type);</li> <li>• a pull-cord operated switch;</li> <li>• a pedal-operated switch without a mechanical guard. The devices shall be in accordance with IEC 60947-5-5.</li> </ul>		P
10.7.3	Operation of the supply disconnecting device to effect emergency stop		-
	Where a stop category 0 is suitable, the supply disconnecting device may serve the function of emergency stop where: <ul style="list-style-type: none"> <li>• it is readily accessible to the operator; and</li> <li>• it is of the type described in 5.3.2 a), b), c), or d).</li> </ul> Where intended for emergency use, the supply disconnecting device shall meet the colour requirements of 10.2.1.		P
10.8	Emergency switching off devices		-
10.8.1	Location of emergency switching off devices		-
	Emergency switching off devices shall be located as necessary for the given application. Normally, those devices will be located separate from operator control stations. Where confusion can occur between emergency stop and emergency switching off devices, means shall be provided to minimise confusion.		P
10.8.2	Types of emergency switching off device		-
	The types of device for initiation of emergency switching off include: <ul style="list-style-type: none"> <li>• a push-button operated switch with a palm or mushroom</li> </ul>		P

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Clause	Requirements	Result-Remark	Verdict
	<p>head type of actuator;</p> <ul style="list-style-type: none"> <li>• a pull-cord operated switch.</li> </ul> <p>The devices shall have direct opening action (see Annex K of IEC 60947-5-1:2003 and IEC 60947-5-1:2003/AMD1:2009</p>		
10.8.3	Local operation of the supply disconnecting device to effect emergency switching off		-
	Where the supply disconnecting device is to be locally operated for emergency switching off, it shall be readily accessible and shall meet the colour requirements of 10.2.1.		P
10.9	Enabling control device		-
	<p>The enabling control function is described in 9.2.3.9.</p> <p>Enabling control devices shall be selected and arranged so as to minimize the possibility of defeating.</p>		P
	<p>Enabling control devices shall be selected that have the following features:</p> <ul style="list-style-type: none"> <li>– designed in accordance with ergonomic principles;</li> <li>– for a two-position type: <ul style="list-style-type: none"> <li>• position 1: off-function of the switch (actuator is not operated);</li> <li>• position 2: enabling function (actuator is operated).</li> </ul> </li> <li>– for a three-position type: <ul style="list-style-type: none"> <li>• position 1: off-function of the switch (actuator is not operated);</li> <li>• position 2: enabling function (actuator is operated in its mid position);</li> <li>• position 3: off-function (actuator is operated past its mid position);</li> <li>• when returning from position 3 to position 2, the enabling function is not activated.</li> </ul> </li> </ul>		P
11	Controlgear: location, mounting, and enclosures		-
11.1	General requirements		-
	<p>All controlgear shall be located and mounted so as to facilitate:</p> <ul style="list-style-type: none"> <li>– its accessibility and maintenance;</li> <li>– its protection against the external influences or conditions</li> </ul>		P

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Clause	Requirements	Result-Remark	Verdict
	under which it is intended to operate; – operation and maintenance of the machine and its associated equipment		
11.2	Location and mounting		-
11.2.1	Accessibility and maintenance		-
	All items of controlgear shall be placed and oriented so that they can be identified without moving them or the wiring. For items that require checking for correct operation or that are liable to need replacement, those actions should be possible without dismantling other equipment or parts of the machine (except opening doors or removing covers, barriers or obstacles). Terminals not part of controlgear components or devices shall also conform to these requirements.		P
	All controlgear shall be mounted so as to facilitate its operation and maintenance. Where a special tool is necessary to adjust, maintain, or remove a device, such a tool shall be supplied. Where access is required for regular maintenance or adjustment, the relevant devices shall be located between 0,4 m and 2,0 m above the servicing level. It is recommended that terminals be at least 0,2 m above the servicing level and be so placed that conductors and cables can be easily connected to them.		P
	No devices except devices for operating, indicating, measuring, and cooling shall be mounted on doors or on access covers of enclosures that are expected to be removed.		P
	Where control devices are connected through plug-in arrangements, their association shall be made clear by type (shape), marking or reference designation, singly or in combination (see 13.4.5).		P
	Plug/socket combinations that are handled during normal operation shall be located and mounted so as to provide unobstructed access.		P
	Test points for connection of test equipment, where provided, shall be:		P

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Clause	Requirements	Result-Remark	Verdict
	<ul style="list-style-type: none"> <li>- mounted so as to provide unobstructed access;</li> <li>- clearly identified to correspond with the documentation;</li> <li>- adequately insulated;</li> <li>- sufficiently spaced.</li> </ul>		
11.2.2	<b>Physical separation or grouping</b>		-
	Non-electrical parts and devices, not directly associated with the electrical equipment, shall not be located within enclosures containing controlgear. Devices such as solenoid valves should be separated from the other electrical equipment (for example in a separate compartment).		P
	Control devices mounted in the same location and connected to the power circuits, or to both power and control circuits, should be grouped separately from those connected only to the control circuits.		P
	Terminals shall be separated into groups for: <ul style="list-style-type: none"> <li>- power circuits;</li> <li>- control circuits of the machine;</li> <li>- other control circuits, fed from external sources (for example for interlocking).</li> </ul>		P
	The groups may be mounted adjacently, provided that each group can be readily identified (for example by markings, by use of different sizes, by use of barriers or by colours).		P
	When arranging the location of devices (including interconnections), the clearances and creepage distances specified for them by the supplier shall be maintained, taking into account the external influences or conditions of the physical environment.		P
11.2.3	<b>Heating effects</b>		-
	The temperature rise inside electrical equipment enclosures shall not exceed the ambient temperature specified by the component manufacturers.		P
	Heat generating components (for example heat sinks, power resistors) shall be so located that the temperature of each component in the vicinity remains within the permitted limit.		P

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Clause	Requirements	Result-Remark	Verdict
11.3	Degrees of protection		-
	The protection of controlgear against ingress of solid foreign objects and of liquids shall be adequate taking into account the external influences under which the machine is intended to operate (i.e. the location and the physical environmental conditions) and shall be sufficient against dust, coolants, lubricants and swarf. Enclosures of controlgear shall provide a degree of protection of at least IP22 (see IEC 60529).		P
11.4	Enclosures, doors and openings		-
	Enclosures shall be constructed using materials capable of withstanding the mechanical, electrical and thermal stresses as well as the effects of humidity and other environmental factors that are likely to be encountered in normal service.		P
	Fasteners used to secure doors and covers should be of the captive type.		P
	Windows of enclosures shall be of a material suitable to withstand expected mechanical stress and chemical attack.		P
	It is recommended that enclosure doors having vertical hinges be not wider than 0,9 m, with an angle of opening of at least 95°.		P
	The joints or gaskets of doors, lids, covers and enclosures shall withstand the chemical effects of the aggressive liquids, vapours, or gases used on the machine. The means provided to maintain the degree of protection of an enclosure on doors, lids and covers that require opening or removal for operation or maintenance shall: <ul style="list-style-type: none"> <li>• be securely attached to either the door/cover or the enclosure;</li> <li>• not deteriorate due to removal or replacement of the door or the cover, and so impair the degree of protection.</li> </ul>		P
	Where openings in enclosures are provided (for example, for cable access), including those towards the floor or foundation or to other parts of the machine, means shall be provided to ensure the degree of protection specified for the equipment.		P

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Clause	Requirements	Result-Remark	Verdict
	Openings for cable entries shall be easy to re-open on site. A suitable opening may be provided in the base of enclosures within the machine so that moisture due to condensation can drain away.		
	There shall be no opening between enclosures containing electrical equipment and compartments containing coolant, lubricating or hydraulic fluids, or those into which oil, other liquids, or dust can penetrate. This requirement does not apply to electrical devices specifically designed to operate in oil (for example electromagnetic clutches) nor to electrical equipment in which coolants are used.		P
	Where there are holes in an enclosure for mounting purposes, means may be necessary to ensure that after mounting, the holes do not impair the required protection		P
	Equipment that, in normal or abnormal operation, can attain a surface temperature sufficient to cause a risk of fire or detrimental effect to an enclosure material shall: <ul style="list-style-type: none"> <li>– be located within an enclosure that will withstand, without risk of fire or harmful effect, such temperatures as can be generated; and</li> <li>– be mounted and located at a sufficient distance from adjacent equipment so as to allow safe dissipation of heat (see also 11.2.3); or</li> <li>– be otherwise screened by material that can withstand, without risk of fire or harmful effect, the heat emitted by the equipment.</li> </ul>		P
11.5	Access to electrical equipment		-
	Doors in gangways and for access to electrical operating areas shall: <ul style="list-style-type: none"> <li>– be at least 0,7 m wide and 2,0 m high;</li> <li>– open outwards;</li> <li>– have a means (for example panic bolts) to allow opening from the inside without the use of a key or tool.</li> </ul>		P
12	Conductors and cables		-

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Clause	Requirements	Result-Remark	Verdict
12.1	<b>General requirements</b>		-
	Conductors and cables shall be selected so as to be suitable for the operating conditions (for example voltage, current, protection against electric shock, grouping of cables) and external influences (for example ambient temperature, presence of water or corrosive substances, mechanical stresses (including stresses during installation), fire hazards) that can exist		P
	These requirements do not apply to the integral wiring of assemblies, subassemblies, and devices that are manufactured and tested in accordance with their relevant IEC standard (for example IEC 61800 series).		P
12.2	<b>Conductors</b>		-
	Conductors should be of copper. Where aluminium conductors are used, the cross-sectional area shall be at least 16 mm <sup>2</sup> .		P
	To ensure adequate mechanical strength, the cross-sectional area of conductors should not be less than as shown in Table 5. However, conductors with smaller cross-sectional areas or other constructions than shown in Table 5 may be used in equipment provided adequate mechanical strength is achieved by other means and proper functioning is not impaired.		P
12.3	<b>Insulation</b>		-
	Where the insulation of conductors and cables can constitute hazards due for example to the propagation of a fire or the emission of toxic or corrosive fumes, guidance from the cable supplier sh be sought. It is important to give special attention to the integrity of a circuit having a safety-related function		P
	The insulation of cables and conductors used, shall be suitable for a test voltage:		-
	– not less than 2 000 V AC for a duration of 5 min for operation at voltages higher than 50 V AC or 120 V DC, or		P
	– not less than 500 V AC for a duration of 5 min for PELV circuits (see IEC 60364-4-41, class III equipment).		N

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Clause	Requirements	Result-Remark	Verdict
	The mechanical strength and thickness of the insulation shall be such that the insulation cannot be damaged in operation or during laying, especially for cables pulled into ducts.		P
12.4	Current-carrying capacity in normal service		-
	The current-carrying capacity depends on several factors, for example insulation material, number of conductors in a cable, design (sheath), methods of installation, grouping and ambient temperature.		P
	One typical example of the current-carrying capacities for PVC insulated wiring between enclosures and individual items of equipment under steady-state conditions is given in Table 6.		P
12.5	Conductor and cable voltage drop		-
	The voltage drop from the point of supply to the load in any power circuit cable shall not exceed 5 % of the nominal voltage under normal operating conditions. In order to conform to this requirement, it can be necessary to use conductors having a larger cross-sectional area than that derived from Table 6.		P
	In control circuits, the voltage drop shall not reduce the voltage at any device below the manufacturer's specification for that device, taking into account inrush currents. See also 4.3. The voltage drop in components, for example overcurrent protective devices and switching devices, should be considered		P
12.6	Flexible cables		-
12.6.1	General		-
	Flexible cables shall have Class 5 or Class 6 conductors.		P
	Cables that are subjected to severe duties shall be of adequate construction to protect against: <ul style="list-style-type: none"> <li>- abrasion due to mechanical handling and dragging across rough surfaces;</li> <li>- kinking due to operation without guides;</li> <li>- stress resulting from guide rollers and forced guiding, being wound and re-wound on cable drums.</li> </ul>		P

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Clause	Requirements	Result-Remark	Verdict
12.6.2	<b>Mechanical rating</b>		-
	The cable handling system of the machine shall be so designed to keep the tensile stress of the conductors as low as is practicable during machine operations. Where copper conductors are used, the tensile stress applied to the conductors shall not exceed 15 N/mm <sup>2</sup> of the copper cross-sectional area. Where the demands of the application exceed the tensile stress limit of 15 N/mm <sup>2</sup> , cables with special construction features should be used and the allowed maximal tensile stress should be agreed with the cable manufacturer.		P
	The maximum stress applied to the conductors of flexible cables with material other than copper shall be within the cable manufacturer's specification.		P
12.6.3	<b>Current-carrying capacity of cables wound on drums</b>		-
	Cables to be wound on drums shall be selected with conductors having a cross-sectional area such that, when fully wound on the drum and carrying the normal service load, the maximum allowable conductor temperature is not exceeded.		
12.7	<b>Conductor wires, conductor bars and slip-ring assemblies</b>		-
12.7.1	<b>Basic protection</b>		-
	Conductor wires, conductor bars and slip-ring assemblies shall be installed or enclosed in such a way that, during normal access to the machine, basic protection is achieved by the application of one of the following protective measures: <ul style="list-style-type: none"> <li>- protection by partial insulation of live parts, or where this is not practicable;</li> <li>- protection by enclosures or barriers of at least IP2X or IPXXB</li> </ul>		P
	Horizontal top surfaces of barriers or enclosures that are readily accessible shall provide a degree of protection of at least IP4X or IPXXD.		P
	Where the required degree of protection is not achieved, protection by placing live parts out of reach in combination		P

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Clause	Requirements	Result-Remark	Verdict
	with emergency switching off in accordance with 9.2.3.4.3 shall be applied.		
	<p>Conductor wires and conductor bars shall be so placed and/or protected as to:</p> <ul style="list-style-type: none"> <li>– prevent contact, especially for unprotected conductor wires and conductor bars, with conductive items such as the cords of pull-cord switches, strain-relief devices and drive chains;</li> <li>– prevent damage from a swinging load.</li> </ul>		P
12.7.2	<b>Protective conductors</b>		-
	<p>Where conductor wires, conductor bars and slip-ring assemblies are installed as part of the protective bonding circuit, they shall not carry current in normal operation.</p> <p>Therefore, the protective conductor (PE) and the neutral conductor (N) shall each use a separate conductor wire, conductor bar or slip-ring.</p>		P
	The continuity of protective conductors using sliding contacts shall be ensured by taking appropriate measures (for example, duplication of the current collector, continuity monitoring).		P
12.7.3	<b>Protective conductor current collectors</b>		-
	Protective conductor current collectors shall have a shape or construction so that they are not interchangeable with the other current collectors. Such current collectors shall be of the sliding contact type.		P
12.7.4	<b>Removable current collectors with a disconnecter function</b>		-
	Removable current collectors having a disconnecter function shall be so designed that the protective conductor circuit is interrupted only after the live conductors have been disconnected, and the continuity of the protective conductor circuit is re-established before any live conductor is reconnected (see also 8.2.3).		P
12.7.5	<b>Clearances in air</b>		-
	Clearances between the respective conductors, and between adjacent systems, of conductor wires, conductor bars,		P

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Clause	Requirements	Result-Remark	Verdict
	slip-ring assemblies and their current collectors shall be suitable for at least a rated impulse voltage of an overvoltage category III in accordance with IEC 60664-1.		
12.7.6	Creepage distances		-
	Creepage distances between the respective conductors, between adjacent systems of conductor wires, conductor bars and slip-ring assemblies, and their current collectors shall be suitable for operation in the intended environment, for example open air, inside buildings, protected by enclosures.		P
	In abnormally dusty, moist or corrosive environments, the following creepage distance requirements apply: <ul style="list-style-type: none"> <li>- unprotected conductor wires, conductor bars, and slip-ring assemblies shall be equipped with insulators with a minimum creepage distance of 60 mm;</li> <li>- enclosed conductor wires, insulated multipole conductor bars and insulated individual conductor bars shall have a minimum creepage distance of 30 mm.</li> </ul>		P
	The manufacturer's recommendations shall be followed regarding special measures to prevent a gradual reduction in the insulation values due to unfavourable ambient conditions (for example deposits of conductive dust, chemical attack).		P
12.7.7	Conductor system sectioning		-
	Where conductor wires or conductor bars are arranged so that they can be divided into isolated sections, suitable design measures shall be employed to prevent the energization of adjacent sections by the current collectors themselves.		P
12.7.8	Construction and installation of conductor wire, conductor bar systems and slip-ring assemblies		-
	Conductor wires, conductor bars and slip-ring assemblies in power circuits shall be grouped separately from those in control circuits.		P
	Conductor wires, conductor bars and slip-ring assemblies, including their current collectors, shall be capable of withstanding, without damage, the mechanical forces and thermal effects of short-circuit currents		P

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Clause	Requirements	Result-Remark	Verdict
	Removable covers for conductor wire and conductor bar systems laid underground or underfloor shall be so designed that they cannot be opened by one person without the aid of a tool.		P
	Where conductor bars are installed in a common metal enclosure, the individual sections of the enclosure shall be bonded together and connected to the protective bonding circuit. Metal covers of conductor bars laid underground or underfloor shall also be bonded together and connected to the protective bonding circuit.		P
	The protective bonding circuit shall include the covers or cover plates of metal enclosures or underfloor ducts. Where metal hinges form a part of the protective bonding circuit, their continuity shall be verified (see Clause 18).		P
	Conductor bar ducts that can be subject to accumulation of liquid such as oil or water shall have drainage facilities		P
13	Wiring practices		-
13.1	Connections and routing		-
	All connections, especially those of the protective bonding circuit, shall be secured against accidental loosening.		P
	The means of connection shall be suitable for the cross-sectional areas and nature of the conductors being terminated.		P
	The connection of two or more conductors to one terminal is permitted only in those cases where the terminal is designed for that purpose. However, only one protective conductor shall be connected to one terminal connecting point.		P
	Soldered connections shall only be permitted where terminals are provided that are suitable for soldering.		P
	Terminals on terminal blocks shall be plainly marked or labelled to correspond with the identification used in the diagrams		P
	Where an incorrect electrical connection (for example, arising from replacement of devices) is identified as a source of risk that needs to be reduced and it is not practicable to reduce		P

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Clause	Requirements	Result-Remark	Verdict
	the possibility of incorrect connection by design measures, the conductors and/or terminations shall be identified.		
	The installation of flexible conduits and cables shall be such that liquids shall drain away from the fittings.		
	Means of retaining conductor strands shall be provided when terminating conductors at devices or terminals that are not equipped with this facility. Solder shall not be used for that purpose.		P
	Shielded conductors shall be so terminated as to prevent fraying of strands and to permit easy disconnection.		P
	Identification tags shall be legible, permanent, and appropriate for the physical environment.		P
	Terminal blocks shall be mounted and wired so that the wiring does not cross over the terminals.		P
13.1.2	Conductor and cable runs		-
	Conductors and cables shall be run from terminal to terminal without splices or joints. Connections using plug/socket combinations with suitable protection against accidental disconnection are not considered to be splices or joints for the purpose of 13.1.2.		P
	Where it is necessary to connect and disconnect cables and cable assemblies, sufficient extra length shall be provided for that purpose.		P
	The terminations of cables shall be adequately supported to prevent mechanical stresses at the terminations of the conductors.		P
	Wherever practicable, the protective conductor shall be placed close to the associated live conductors in order to decrease the impedance of the loop.		P
13.1.3	Conductors of different circuits		
	Conductors of different circuits may be laid side by side, may occupy the same duct (for example conduit, cable trunking system), or may be in the same multiconductor cable or in the same plug/socket combination provided that the arrangement does not impair the proper functioning of the respective		P

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Clause	Requirements	Result-Remark	Verdict
	circuits and: <ul style="list-style-type: none"> <li>• where those circuits operate at different voltages, the conductors are separated by suitable barriers or;</li> <li>• the conductors are insulated for the highest voltage to which any of the conductors can be subjected, for example line to line voltage for unearthed systems and phase to earth voltage for earthed systems.</li> </ul>		
13.1.4	AC circuits – Electromagnetic effects (prevention of eddy currents)		-
	Conductors of AC circuits installed in ferromagnetic enclosures shall be arranged so that all conductors of each circuit, including the protective conductor of each circuit, are contained in the same enclosure. Where such conductors enter a ferrous enclosure, they shall be arranged such that the conductors are not individually surrounded by ferromagnetic material. Single-core cables armoured with steel wire or steel tape should not be used for AC circuits.		P
13.1.5	Connection between pick-up and pick-up converter of an inductive power supply system		-
	The cable between the pick-up and the pick-up converter shall be: – as short as practicable; – adequately protected against mechanical damage.		P
13.2	Identification of conductors		-
13.2.1	General requirements		-
	Each conductor shall be identifiable at each termination in accordance with the technical documentation.		P
	It is recommended (for example to facilitate maintenance) that conductors be identified by number, alphanumeric, colour (either solid or with one or more stripes), or a combination of colour and numbers or alphanumeric. When numbers are used, they shall be Arabic; letters shall be Roman (either upper or lower case).		P
13.2.2	Identification of the protective conductor / protective bonding conductor		-
	The protective conductor / protective bonding conductor shall		P

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Clause	Requirements	Result-Remark	Verdict
	<p>be readily distinguishable from other conductors by shape, location, marking, or colour. When identification is by colour alone, the bicolour combination GREEN-AND-YELLOW shall be used throughout the length of the conductor. This colour identification is strictly reserved for protective conductors/protective bonding conductors.</p> <p>For insulated conductors, the bicolour combination GREEN-AND-YELLOW shall be such that on any 15 mm length, one of the colours covers at least 30 % and not more than 70 % of the surface of the conductor, the other colour covering the remainder of the surface.</p> <p>Where the protective conductor(s) can be easily identified by its shape, position, or construction (for example a braided conductor, uninsulated stranded conductor), or where the insulated conductor is not readily accessible or is part of a multicore cable, colour coding throughout its length is not necessary. However, where the conductor is not clearly visible throughout its length, the ends or accessible locations shall be clearly identified by the graphical symbol IEC 60417-5019:2006-08 (see Figure 16) or with the letters PE or by the bicolour combination GREEN-AND-YELLOW.</p>		
13.2.3	<p>Identification of the neutral conductor</p>		-
	<p>Where a circuit includes a neutral conductor that is identified by colour alone, the colour used for this conductor shall be BLUE. In order to avoid confusion with other colours, it is recommended that an unsaturated blue be used, called here "light blue" (see 6.2.2 of IEC 60445:2010). Where the selected colour is the sole identification of the neutral conductor, that colour shall not be used for identifying any other conductor where confusion is possible.</p>		P
	<p>Where identification by colour is used, bare conductors used as neutral conductors shall be either coloured by a stripe, 15 mm to 100 mm wide in each compartment or unit and at each accessible location, or coloured throughout their length.</p>		P

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Clause	Requirements	Result-Remark	Verdict
13.2.4	Identification by colour		-
	Where colour-coding is used for identification of conductors (other than the protective conductor (see 13.2.2) and the neutral conductor (see 13.2.3)), the following colours may be used: <b>BLACK, BROWN, RED, ORANGE, YELLOW, GREEN, BLUE</b> (including <b>LIGHT BLUE</b> ), <b>VIOLET, GREY, WHITE, PINK, TURQUOISE</b>		P
	It is recommended that, where colour is used for identification, the colour be used throughout the length of the conductor either by the colour of the insulation or by colour markers at regular intervals and at the ends or accessible location		P
	For safety reasons, the colour <b>GREEN</b> or the colour <b>YELLOW</b> should not be used where there is a possibility of confusion with the bicolour combination <b>GREEN-AND-YELLOW</b> (see 13.2.2).		P
	Colour identification using combinations of those colours listed above may be used provided there can be no confusion and that <b>GREEN</b> or <b>YELLOW</b> is not used except in the bicolour combination <b>GREEN-AND-YELLOW</b>		P
	Where colour-coding is used for identification of conductors, it is recommended that they be colour-coded as follows: – <b>BLACK</b> : AC and DC power circuits; – <b>RED</b> : AC control circuits; – <b>BLUE</b> : DC control circuits; – <b>ORANGE</b> : excepted circuits in accordance with 5.3.5.		P
	Exceptions to the above are permitted where insulation is not available in the colours recommended (for example in multiconductor cables).		P
13.3	Wiring inside enclosures		-
	Conductors inside enclosures shall be supported where necessary to keep them in place. Non-metallic ducts shall be permitted only when they are made with a flame-retardant insulating material (see the IEC 60332 series).		P

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Clause	Requirements	Result-Remark	Verdict
	It is recommended that electrical equipment mounted inside enclosures be designed and constructed in such a way as to permit modification of the wiring from the front of the enclosure (see also 11.2.1). Where that is not practicable and control devices are connected from the rear of the enclosure, access doors or swingout panels shall be provided.		P
	Connections to devices mounted on doors or to other movable parts shall be made using flexible conductors in accordance with 12.2 and 12.6 to allow for the frequent movement of the part. The conductors shall be anchored to the fixed part and to the movable part independently of the electrical connection (see also 8.2.3 and 11.2.1).		P
	Conductors and cables that do not run in ducts shall be adequately supported.		P
	Terminal blocks or plug/socket combinations shall be used for control wiring that extends beyond the enclosure. For plug/socket combinations, see also 13.4.5 and 13.4.6.		P
	Power cables and cables of measuring circuits may be directly connected to the terminals of the devices for which the connections were intended.		P
13.4	Wiring outside enclosures		-
13.4.1	General requirements		-
	The means of introduction of cables or ducts with their individual glands, bushings, etc., into an enclosure shall ensure that the degree of protection is not reduced (see 11.3). Conductors of a circuit shall not be distributed over different multi-core cables, conduits, cable ducting systems or cable trunking systems. This is not required where a number of multi-core cables, forming one circuit, are installed in parallel. Where multi-core cables are installed in parallel, each cable shall contain one conductor of each phase and the neutral if any.		P
13.4.2	External ducts		-
	Conductors and their connections external to the electrical equipment enclosure(s) shall be enclosed in suitable ducts		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	(i.e. conduit or cable trunking systems) as described in 13.5 except for suitably protected cables that may be installed without ducts and with or without the use of cable trays or cable support means. Where devices such as position switches or proximity switches are supplied with a dedicated cable, their cable need not be enclosed in a duct when the cable is suitable for the purpose, sufficiently short, and so located or protected, that the risk of damage is minimized.		
	Fittings used with ducts or cables shall be suitable for the physical environment		P
	Flexible conduit or flexible multiconductor cable shall be used where it is necessary to employ flexible connections to pendant push-button stations. The weight of the pendant stations shall be supported by means other than the flexible conduit or the flexible multiconductor cable, except where the conduit or cable is specifically designed for that purpose.		P
13.4.3	Connection to moving elements of the machine		-
	The design of connections to moving parts shall take into account the foreseeable frequency of movement and shall be made using conductors in accordance with 12.2 and 12.6. Flexible cable and flexible conduit shall be so installed as to avoid excessive flexing and straining, particularly at the fittings.		P
	Cables subject to movement shall be supported in such a way that there is no mechanical strain on the connection points nor any sharp flexing. When this is achieved by the provision of a loop, it shall have sufficient length to provide for a bending radius of the cable as specified by the cable manufacturer or if no such specification is given, at least 10 times the diameter of the cable.		P
	Flexible cables of machines shall be so installed or protected as to minimize the possibility of external damage due to factors that include the following cable use or potential abuse: – being run over by the machine itself; – being run over by vehicles or other machines;		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	<ul style="list-style-type: none"> <li>- coming into contact with the machine structure during movements;</li> <li>- running in and out of cable baskets, or on or off cable drums;</li> <li>- acceleration forces and wind forces on festoon systems or suspended cables;</li> <li>- excessive rubbing by cable collector;</li> <li>- exposure to excessive radiated heat.</li> </ul>		
	The cable sheath shall be resistant to the normal wear that can be expected from movement and to the effects of environmental contaminants (for example oil, water, coolants, dust).		P
	Where cables subject to movement are close to moving parts, precautions shall be taken to maintain a space of at least 25 mm between the moving parts and the cables. Where that distance is not practicable, fixed barriers shall be provided between the cables and the moving parts		P
	The cable handling system shall be so designed that lateral cable angles do not exceed 5°, avoiding torsion in the cable when: <ul style="list-style-type: none"> <li>- being wound on and off cable drums; and</li> <li>- approaching and leaving cable guidance devices</li> </ul>		P
	Measures shall be taken to ensure that at least two turns of flexible cables always remain on a drum.		P
	Devices serving to guide and carry a flexible cable shall be so designed that the inner bending radius at all points where the cable is bent is not less than the values given in Table 8, unless otherwise agreed with the cable manufacturer, taking into account the permissible tension and the expected fatigue life.		P
	The straight section between two bends shall be at least 20 times the diameter of the cable		P
	Where flexible conduit is adjacent to moving parts, the construction and supporting means shall prevent damage to the flexible conduit under all conditions of operation.		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	Flexible conduit shall not be used for connections subject to rapid or frequent movements except when specifically designed for that purpose		
13.4.4	Interconnection of devices on the machine		-
	Where several machine-mounted devices (for example position sensors, push-buttons) are connected in series or in parallel, it is recommended that the connections between those devices be made through terminals forming intermediate test points. Such terminals shall be conveniently placed, adequately protected, and shown on the relevant diagrams.		P
13.4.5	Plug/socket combinations		-
	Components or devices inside an enclosure, terminated by fixed plug/socket combinations (no flexible cable), or components connected to a bus system by a plug/socket combination, are not considered to be plug/socket combinations for the purpose of this 13.4.5.		N
	After installation in accordance with item a) below, plug/socket combinations shall be of such a type as to prevent unintentional contact with live parts at any time, including during insertion or removal of the connectors. The degree of protection shall be at least IP2X or IPXXB. PELV circuits are excepted from this requirement		N
	Where the plug/socket contains a contact for the protective bonding circuit, it shall have a first make last break contact (see also 8.2.4).		N
	Plug/socket combinations intended to be connected or disconnected during load conditions shall have sufficient load-breaking capacity. Where the plug/socket combination is rated at 30 A, or greater, it shall be interlocked with a switching device so that the connection and disconnection is possible only when the switching device is in the OFF position.		N
	Plug/socket combinations that are rated at more than 16 A shall have a retaining means to prevent unintended or		N

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	accidental disconnection		
	Where an unintended or accidental disconnection of plug/socket combinations can cause a hazardous situation, they shall have a retaining means.		
	<p>The installation of plug/socket combinations shall fulfil the following requirements as applicable:</p> <p>a) The component which remains live after disconnection shall have a degree of protection of at least IP2X or IPXXB, taking into account the required clearance and creepage distances. PELV circuits are excepted from this requirement.</p> <p>b) Metallic housings of plug/socket combinations shall be connected to the protective bonding circuit.</p> <p>c) Plug/socket combinations intended to carry power loads but not to be disconnected during load conditions shall have a retaining means to prevent unintended or accidental disconnection and shall be clearly marked that they are not intended to be disconnected under load.</p> <p>d) Where more than one plug/socket combination is provided in the same electrical equipment, the associated combinations shall be clearly identifiable. It is recommended that mechanical coding be used to prevent incorrect insertion.</p> <p>e) Plug/socket combinations used in control circuits shall fulfil the applicable requirements of IEC 61984.</p>		N
13.4.6	Dismantling for shipment		-
	Where it is necessary that wiring be disconnected for shipment, terminals or plug/socket combinations shall be provided at the sectional points. Such terminals shall be suitably enclosed and plug/socket combinations shall be protected from the physical environment during transportation and storage.		P
13.4.7	Additional conductors		-
	<p>Consideration should be given to providing additional conductors for maintenance or repair.</p> <p>When spare conductors are provided, they shall be connected to spare terminals or isolated in such a manner as</p>		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	to prevent contact with live parts		
13.5	Ducts, connection boxes and other boxes		-
13.5.1	General requirements		-
	Ducts shall provide a degree of protection (see IEC 60529) suitable for the application.		P
	All sharp edges, flash, burrs, rough surfaces, or threads with which the insulation of the conductors can come in contact shall be removed from ducts and fittings. Where necessary, additional protection consisting of a flame-retardant, oil-resistant insulating material shall be provided to protect conductor insulation.		P
	Drain holes of 6 mm diameter are permitted in cable trunking systems, connection boxes, and other boxes used for wiring purposes that can be subject to accumulations of oil or moisture.		P
	In order to prevent confusion of conduits with oil, air, or water piping, it is recommended that the conduits be either physically separated or suitably identified.		P
	Ducts and cable trays shall be rigidly supported and positioned at a sufficient distance from moving parts and in such a manner so as to minimize the possibility of damage or wear. In areas where human passage is required, the ducts and cable trays shall be mounted at least 2 m above the working surface.		P
	Cable trays that are partially covered should not be considered to be ducts or cable trunking systems (see 13.5.6), and the cables used shall be of a type suitable for installation on open cable trays.		P
	It is recommended that the dimensions and arrangement of ducts be such as to facilitate the insertion of the conductors and cables.		P
13.5.2	Rigid metal conduit and fittings		-
	Rigid metal conduit and fittings shall be of galvanized steel or of a corrosion-resistant material suitable for the conditions.		P
	Conduits shall be securely held in place and supported at		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
	each end. Fittings shall be compatible with the conduit and appropriate for the application. Fittings should be threaded unless structural difficulties prevent assembly. Where threadless fittings are used, the conduit shall be securely fastened to the equipment. Conduit bends shall be made in such a manner that the conduit shall not be damaged and the internal diameter of the conduit shall not be effectively reduced.		
13.5.3	<b>Flexible metal conduit and fittings</b>		-
	A flexible metal conduit shall consist of a flexible metal tubing or woven wire armour. It shall be suitable for the expected physical environment. Fittings shall be compatible with the conduit and appropriate for the application		P
13.5.4	<b>Flexible non-metallic conduit and fittings</b>		-
	Flexible non-metallic conduit shall be resistant to kinking and shall have physical characteristics similar to those of the sheath of multiconductor cables. The conduit shall be suitable for use in the expected physical environment. Fittings shall be compatible with the conduit and appropriate for the application.		P
13.5.5	<b>Cable trunking systems</b>		-
	Cable trunking systems external to enclosures shall be rigidly supported and clear of all moving parts of the machine and of sources of contamination.		P
	Covers shall be shaped to overlap the sides; gaskets shall be permitted. Covers shall be attached to cable trunking systems by suitable means. On horizontal cable trunking systems, the cover shall not be on the bottom unless specifically designed for such installation.		P
	Where the cable trunking system is furnished in sections, the joints between sections shall fit tightly but need not be gasketed. The only openings permitted shall be those required for wiring or for drainage. Cable trunking systems shall not have opened but unused knockouts		P

EN 60204-1:2018			
Clause	Requirements	Result-Remark	Verdict
13.5.6	<b>Machine compartments and cable trunking systems</b>		-
	The use of compartments or cable trunking systems within the column or base of a machine to enclose conductors is permitted provided the compartments or cable trunking systems are isolated from coolant or oil reservoirs and are entirely enclosed. Conductors run in enclosed compartments and cable trunking systems shall be so secured and arranged that they are not subject to damage.		P
13.5.7	<b>Connection boxes and other boxes</b>		-
	Connection boxes and other boxes used for wiring purposes shall be accessible for maintenance. Those boxes shall provide protection against the ingress of solid bodies and liquids, taking into account the external influences under which the machine is intended to operate (see 11.3).		P
	Those boxes shall not have opened but unused knockouts nor any other openings and shall be so constructed as to exclude materials such as dust, flyings, oil, and coolant.		P
13.5.8	<b>Motor connection boxes</b>		-
	Motor connection boxes shall enclose only connections to the motor and motor-mounted devices (for example brakes, temperature sensors, plugging switches, tachometer generators).		P
14	<b>Electric motors and associated equipment</b>		P
15	<b>Socket-outlets and lighting</b>		P
16	<b>Marking, warning signs and reference designations</b>		P
17	<b>Technical documentation</b>		P
18	<b>Verification</b>		P

2.4 EN 1175:2020 Safety of industrial trucks – Electrical/electronic requirements.

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
4	Requirements		-
4.1	Introduction		-
	Trucks shall comply with the safety requirements and/or protective measures of this clause. In addition, the truck shall be designed according to the principles of EN ISO 12100:2010 for relevant but not significant hazards which are not dealt with by this document.		-
4.2	Validation of safety functions		-
	The design of safety functions shall be validated in accordance with EN ISO 13849-1:2015, Clause 8.		P
4.3	General requirements		-
4.3.1	Low voltage/high voltage		-
	Safety shall not be compromised at any voltage level that can occur. Electrical systems of trucks powered by lead-acid batteries shall be designed so that all functions operate in the voltage range from 70 % up to 120 % of the nominal battery voltage. These limits shall be adapted to other energy sources technologies by the manufacturer		P
4.3.2	Frame fault		-
	The electric circuits shall be so designed or protected, that frame faults shall not cause hazardous inadvertent movements that cannot be corrected or compensated by the operator. Compliance shall be verified by means of the type test of 4.10.4.		P
4.3.3	Protection from ingress of water and dust		-
	The electrical installation of the trucks in operating condition shall be designed and constructed such that the protection from harmful ingress of water		P

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
	and dust is in accordance with the environmental conditions in which the truck is designed to operate, including reasonably foreseeable misuses, as defined in the instruction handbook (see EN ISO 3691-1:2015, 6.2.2).		
4.3.4	Protection against electric shock		-
	<p>Non-insulated live parts of trucks in the operating condition shall be protected to a degree of IPXXB preventing direct contact. For top surfaces, the minimum degree shall be IPXXD in accordance with EN 60529:1991.</p> <p>Access to an electrical enclosure containing uninsulated live parts in excess of nominal voltage 60 V DC or 25 V AC shall be possible only using a tool. Indirect contact with live parts shall be avoided by electric separation of the protection devices in accordance with EN 60204-1:2006, 6.3.2.3.</p> <p>It shall be possible to electrically disconnect the energy sources for maintenance and replacement operations. An easily accessible switch, connector or disconnectable battery terminals meets the intent of this requirement, For energy sources with nominal voltage greater than 60 V DC or 25 V AC live parts shall be protected against direct contact.</p>		P
4.3.5	Connection to the frame		-
4.3.5.1	Battery powered trucks		-
	There shall be no electrical connection to the truck frame, except for:		-
	<p>a) frame fault detection system;</p> <p>b) electric/electronic circuits with a nominal voltage not greater than 60 V DC which are galvanically separated from the energy source;</p> <p>c) connection to the earthing terminal of on-board chargers;</p> <p>d) suppression capacitors. If the nominal battery voltage exceeds 60 V DC, minimum</p>		P

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
	<p>requirement for the capacitor shall be Class Y in accordance with EN 60384-14;</p> <p>e) the screen of shielded cables and components. This condition shall meet the requirements of the insulation resistance testing in 4.10.2;</p> <p>f) suppression resistor for ESD reduction, the system shall meet the requirements of 4.10.2.</p>		
4.3.5.2	<p><b>IC trucks</b></p> <p>a) Electrical system with nominal voltage not greater than 48 V (starter battery):</p> <ul style="list-style-type: none"> <li>— one pole of the electrical system may be connected to the truck frame;</li> <li>— all conductors not connected to the truck frame shall be effectively insulated and where necessary protected against thermal and mechanical damage;</li> <li>— there shall be means to disconnect both poles of the starter battery from the truck for service purposes;</li> </ul> <p>b) electrical system with nominal voltage greater than 48 V (hybrid drive system):</p> <ul style="list-style-type: none"> <li>— electrical systems with nominal voltage greater than 48 V shall be electrically insulated and galvanically separated from frame, with the exceptions listed in 4.3.5.1 a), b), d), e) and f);</li> <li>— control and auxiliary circuits shall have a maximum voltage not greater than 120 V DC or 50 V AC. Where the energy source maximum voltage is greater, control and auxiliary circuits shall be electrically and galvanically separated from the energy source;</li> <li>— for maximum voltages greater than 120 V DC and 50 V AC, equipotential bonding shall be provided between the frame of the vehicle and conductive enclosures, e.g. motor frames.</li> </ul>		-
			P

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
4.3.6	Protection from residual voltages		-
	<p>After disconnecting energy sources, the voltage of the capacitors in power circuits shall be less than 60 V DC after 10 s.</p> <p>If the above condition is not technically achievable or practicable a warning/safety label shall be provided. This warning label shall be permanent and indelible and shall be affixed on, or in close proximity to, the enclosure containing the capacitors.</p>		P
4.3.7	Overcurrent protection		-
	<p>Power, control and auxiliary circuits shall be provided with overcurrent protection that is sized to prevent overheating of the smallest size conductor.</p> <p>Overcurrent protective devices shall be capable of interrupting the maximum fault current without creating a fire hazard. Overcurrent protective devices in the control and power circuits shall be as close as practicable to the energy source.</p> <p>Non-resettable overcurrent protective devices shall be identified according to the replacement rating of the device.</p> <p>If the overcurrent protection is realized by electronic systems, e.g. by inverters or DC/DC converters, this function shall be in accordance with PLr as defined in Table 6.</p> <p>Overcurrent protective devices shall be identified, and rating of these devices shall be indicated on the electrical diagram.</p> <p>Replaceable overcurrent protective devices shall be provided with rating which shall be located on the truck, adjacent or close to the device itself.</p>		P
4.3.8	Fire and heat hazards (installation of arcing and sparking parts)		-
	<p>Any arcing part in a power circuit shall be enclosed or installed to adequately reduce the possibility of flame or molten material causing a risk</p>		P

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
	of fire.Relevant parts shall be accessible for servicing and inspection		
4.3.9	Sparking or heat dissipating electrical components		-
	Sparking components and components which can reach a temperature of 300 °C or more under normal operating conditions, shall not be located where potentially explosive gas/air mixtures can be present. Battery connectors shall be accepted as non-sparking components if they are not used as an emergency switching-off device.		P
4.3.10	Electromagnetic radiation		P
4.4	Energy sources		-
4.4.1	General		-
	Energy sources shall conform to Annex C.		P
	Connectors used for connecting energy sources to industrial trucks and to the charging equipment shall conform to the requirements of Annex A.		P
4.4.2	Connection to the mains		-
4.4.2.1	Battery charging		-
	When external charging supply cables are connected to the truck, truck movement shall be prevented. This safety function shall be in accordance with PLr as defined in Table 6. This does not apply to trucks designed only for permanent charging during operation. The requirement is not intended for starter batteries.		P
4.4.2.2	On board charger and/or additional components		-
	When trucks are fitted with on-board chargers or other devices connected to the mains, e.g. heaters, the requirements of EN 60204-1:2006, 6.3, 7.2.1 and Clause 8 up to and including 8.2 shall apply. Enclosures containing equipment connected to the mains supply shall be in accordance with IPXXB of EN 60529:1991. However, for top surfaces the degree of protection shall be in		P

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
	<p>accordance with at least IPXXD.</p> <p>When the mains supply cables are connected to the truck it shall not be possible to induce any truck movement. This safety function shall be in accordance with PLr as defined in Table 6.</p> <p>NOTE 1 Where a main external power supply socket could be switched off this requirement can be met by an interlock when the charger plug is in the home stowed position.</p> <p>A position shall be provided on the truck to safely and properly store the cable, where permanently attached.</p>		
4.4.3	Electrical energy sources for IC trucks (hybrid systems)		-
	<p>warning signs for residual voltage.</p> <p>Energy sources based on battery technology shall be equipped with a switching off device in accordance with 4.9.1.3. They shall be manually disconnectable and shall be automatically disconnected in case of an electrical fault related to the power system. They shall be provided with warning signs referring to high stored energy at high voltage. The warning signs shall be permanent and indelible.</p>		P
4.4.4	Connectors		-
	<p>Connectors for energy sources shall conform to Annex A.</p> <p>Connectors not fitted with locking devices as defined in A.3.9 shall be arranged so that dead weight and environmental effects e.g. vibration or acceleration do not lead to an unintended disconnection of the connector</p>		P
4.4.5	Direct current contactors		-
	<p>Contactors shall be designed and manufactured to withstand the stresses occurring during installation and normal use. For additional</p>		P

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
	information see the relevant part of EN 60947. Electromagnetic contactors used for performing safety functions shall conform to Annex B. Truck manufacturers shall select and install contactors, and provide information for maintenance with the instruction handbook, in accordance with the specifications and instructions of the contactor manufacturer.		
4.4.6	Electric drive system		-
	Motors, converters, generators and energy sources shall conform to Annex D.		P
4.4.7	Electrical Components		-
	Conductors and cables shall conform to Annex G.		P
4.5	Travel and brake control systems		-
4.5.1	General		P
	For the drive system the following are considered as safe and can be used to achieve a safe state e.g. in case of a failure in the drive system:		-
	a) no driving torque, on the condition that the truck has an additional braking system which can be activated by the operator; b) automatic braking by the drive system and/or by the braking system till and during standstill; c) automatic speed reduction to a specific limit based on type, application and condition of the truck so long as the operator has full control and release of the speed control leads to the stopping of powered movement. Failures of the electrical system leading to behaviour as mentioned in a), b) or c) or any combination thereof may be treated as a non-safety relevant failures.		P
4.5.2	Travel control system		-
	The travel control system shall be so arranged that on level ground the truck will start from standstill only when the control(s) for speed and		P

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
	direction are activated. For IC trucks, after engaging direction control, low speed is allowed without activation of the speed control.		
	Means shall be provided to avoid any truck movement when:		-
	— switching on the travel control system; — starting the engine of an IC truck.		P
	Any initial activation of the drive system shall only be possible from the neutral position of the speed and/or directional control(s). These safety functions shall be in accordance with the PLr as defined in Table 2.		P
4.5.3	<b>Monitoring of operating position</b>		-
	<p>On sit-on rider-controlled trucks a separate device (OPC), independent of the speed control (accelerator), shall automatically bring an active drive system to a safe state, as defined in 4.5.1 a) or b) when the operator leaves the normal operating position.</p> <p>On stand-on rider-controlled trucks a separate device (OPC), independent of the speed control (accelerator), shall automatically bring an active drive system to a safe state, as defined in 4.5.1 b) when the operator leaves the normal operating position. Nuisance deactivation of the OPC due to operating conditions, such as rough ground, shall be prevented. The safe state shall be initiated not later than 2,0 s after deactivation of the OPC. This time delay shall be reduced to maximum 0,2 s when the speed control device is released. In addition to the deceleration provided by the OPC, the braking system shall be available to the operator. Powered travel movement from standstill after the operator returns to the normal operating position shall occur only when the traction control device is activated from the neutral position.</p>		P

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
	<p>During deceleration following release of the OPC while travelling, powered travel movement can be restored automatically provided that the speed control is active. Restoring the powered travel movement shall not cause hazardous accelerations which cannot be controlled by the operator.</p> <p>Where separate travel controls other than those at the normal operating position are provided according to EN ISO 3691-1:2015, 4.4.2.6 the OPC can be overridden when this system is used. It shall not be possible to override the OPC when operation is from the normal operation position (e.g. interlock).</p> <p>It shall be ensured that the resulting hazards when an additional control remote from the driving position is used are sufficiently reduced by additional measures, e.g. safe speed/acceleration limitation and/or personal detection means, where trucks are designed for travel controlled from outside and the detection device of operator position overridden.</p> <p>These safety functions shall be in accordance with the PLr as defined in Table 2.</p>		
4.5.4	Tiller controlled trucks		-
4.5.4.1	Tiller brake function for pedestrian controlled trucks		-
	<p>If the tiller brake function with tiller in upper or lower end position according to EN ISO 3691-1:2015, 4.4.2.4 b/c is realized using an electrical/electronic system, the safety function shall be in accordance with the PLr as defined in Table 2.</p> <p>If the tiller brake function can be overridden by a travel control device, additional measures shall be applied for travelling at the upper end position of the tiller, for example speed limitation or sustained action. These additional safety functions</p>		P

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
	shall be in accordance with the PLr as defined for the tiller brake function.		
4.5.4.2	<b>Tiller head safety device</b>		-
	<p>4.4.2.4, d.</p> <p>The tiller head safety device may be disabled when the truck is travelling away from the operator.</p> <p>Activation and deactivation shall be automatic and not accessible to the operator to ensure that the tiller head safety device is not disabled while the truck is travelling towards the operator.</p> <p>For trucks designed to operate with the tiller in its upper and/or lower rest position, the braking function shall be initiated by activating the tiller head safety device. This safety function shall be in accordance with the PLr as defined in Table 2.</p>		P
4.5.4.3	<b>Tiller head safety device on platform trucks</b>		-
	<p>On trucks with foldable operator platform the tiller head safety device may be automatically deactivated when the platform is folded down.</p> <p>Means can be provided to allow the operator to deactivate the tiller head safety device when the platform is folded down if the function is restored automatically to active mode by the operator presence system as well as by switching on the truck.</p> <p>Permanent activation and deactivation shall not be accessible to the operator.</p> <p>The mode of the tiller head safety device (active or inactive) shall be indicated to the operator if it can be deactivated in accordance with the requirements of the first paragraph of this subclause. If such indication is realized by electric/electronic means, this safety function shall be in accordance with the PLr as defined in Table 2.</p>		P
4.5.5	<b>Automatic restoration of drive system</b>		-
	The automatic release of the drive system from a limited mode shall not cause an unsafe		P

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
	<p>movement. If the truck speed near or equal to zero is caused by a speed limitation and the limitation is exceeding a time specified by the manufacturer, a release of the speed limitation shall be possible only after return to neutral position of the speed control. Speed and time duration can depend on truck type and acceleration rate.</p> <p>The return to neutral is not required if the operator activates a function that cancels the limiting condition, e.g. release of the speed limitation by lowering the load below a specific lift height.</p> <p>This safety function shall be in accordance with the PLr as defined in Table 2.</p>		
4.5.6	Deviation from setpoint		-
4.5.6.1	General		-
	<p>The drive system shall be so designed that any deviation from operator setpoint caused by an electrical fault which could result in hazardous truck movement that cannot be controlled by the operator in the normal operating position is prevented.</p>		P
4.5.6.2	Uncontrolled acceleration from standstill on level ground		-
	<p>The drive system shall be so designed that uncontrolled hazardous acceleration from standstill on level ground is prevented.</p> <p>This safety function shall be in accordance with the PLr as defined in Table 2.</p> <p>Any uncontrolled acceleration caused by an electrical failure is treated as hazardous when the criteria defined in Table 1 are exceeded.</p> <p>Movement from rest in the wrong direction shall be considered hazardous.</p>		P
4.5.6.3	Unintended truck behaviour while truck is moving		-
4.5.7	Unintended deceleration		-
	Under normal operating conditions as defined in EN		P

EN 1175:2020			
Items	Requirements	Result-Remark	Verdict
	<p>ISO 3691-1:2015, 4.1.3, unintended deceleration caused by an electric/electronic failure of the electronic controlled service brake, parking brake or the drive system shall not lead to tip-over. Inherently safe design of electronic controlled service brake shall be considered as satisfying this requirement.</p> <p>This safety function shall be in accordance with the PLr as defined in Table 2.</p>		
4.5.8	Electrically/electronic controlled service brake		-
	<p>Electrical and electronic control systems of the service brake shall be designed to ensure the required brake function operates correctly or fail safe. The design shall ensure that an electrical failure will not increase the risk of brake failure e.g. because of friction caused by a permanently partly released brake. This safety function shall be in accordance with the PLr as defined in Table 2.</p>		P
4.5.9	Parking brake systems		-
4.5.9.1	Trucks with automatic parking brake		-
	<p>a) Automatic operation of parking brakes shall not result in hazardous situations.</p> <p>The control system of the parking brake shall be designed to prevent the automatic release of the parking brake not intended by the operator.</p> <p>Where activating the travel control device can result in automatic release of the parking brake, it shall not result in hazardous truck movements which cannot be controlled by the operator. These safety functions shall be in accordance with the PLr as defined in Table 2.</p>		P
	<p>b) With the truck at standstill, the parking brake shall be applied if the operator is not in the normal operating position</p> <p>This safety function shall be in accordance with the PLr as defined in Table 2.</p>		P

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Items	Requirements	Result-Remark	Verdict
	<p>c) When the truck is designed to hold the truck on a ramp stationary or at low speed by the drive system and the travel control is released, the parking brake shall be activated automatically before the drive system loses the ability to hold the truck. This safety function shall be in accordance with the PLr as defined in Table 2.</p>		P
	<p>d) Failure of the control system of an automatically applied parking brake shall be indicated to the operator (see EN ISO 3691-1:2015, 4.2.2.1). The safety function of failure detection shall be in accordance with PLr as defined in Table 2</p>		P
4.5.9.2	Trucks without automatically applied parking brake		-
	<p>If the movement of a truck without an automatically applied parking brake is actively controlled or minimized by the drive system, measures shall be taken so that the operator becomes aware of this situation, e.g. creeping of the truck on a ramp at low speed.</p> <p>Measures shall be taken to warn the operator before leaving the truck (see EN ISO 3691-1:2015, 4.2.2.1) without applying the brake as long as the power supply of the truck is not switched off by the operator. If the required warning is realized by an electric/electronic system, it shall be in accordance with the PLr as defined in Table 2.</p>		P
4.5.9.3	Indication of parking brake state		-
	<p>Automatically or manually applied parking brake state shall be indicated to the operator when engaged. The exceptions to this requirement are brake systems fitted to stand-on and pedestrian controlled trucks equipped with a brake system that will automatically engage upon release of the brake actuating control in accordance with EN ISO 3691-1:2015, 4.3.3.</p> <p>An electrical indication of the parking brake state is</p>		P

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Items	Requirements	Result-Remark	Verdict
	not required when power supply of the truck has been switched off (see EN ISO 3691-1:2015, 4.2.2.1). This safety function shall be in accordance with the PLr as defined in Table 2.		
4.5.10	Speed limitation		-
	The electrical system limiting truck speed shall be so designed that the admissible maximum speed on level ground is not exceeded. In the event of an electrical fault the transition to the safe state, as defined in 4.5.1 a) and c) shall be initiated.		P
	The following speed limitation functions shall be in accordance with the PLr as defined in Table 2:		-
	a) lateral- and front-stacking trucks in accordance with EN ISO 3691-3:2016, 4.4.1; b) travel speed limitation to comply with braking and stability requirements, e.g. trucks specifically designed to travel with elevated loads; c) reach trucks with elevated mast in accordance with EN ISO 3691-1:2015, 4.2.3.3; d) speed limit of counterbalance trucks to ensure dynamic stability in accordance with EN 16307-1:2013+A1:2015, 4.11; e) pedestrian controlled trucks in accordance with EN 16307-1:2013+A1:2015, 4.3; f) if triggered by platform and/or side guards' position in accordance with EN ISO 3691-1:2015, 4.7.3.3; g) operating from outside the truck in accordance with EN ISO 3691-1:2015, 4.4.2.6; h) trucks with attachments for freight containers in accordance with EN ISO 3691-1:2015, 4.6.5.5; i) stand-on and foldable platform trucks in accordance with EN 16307-1:2013+A1:2015, 4.3.		P
4.5.11	Interface for speed limitation		-

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Items	Requirements	Result-Remark	Verdict
	<p>If trucks are provided with interfaces for external speed limitation, changes of speed caused by the external system shall be limited by the truck logic to a level that can be controlled by the operator (for instance see 4.5.5, 4.5.7). The external speed limitation shall not exceed the limit set by the truck controller.</p>		P
4.6	Electrical load handling system		-
4.6.1	General		-
	A stationary LHS is considered as a safe state		P
4.6.2	Movement from standstill		-
	Movement of a function of the LHS from standstill shall be possible only by operating the dedicated control for an LHS function, e.g. joysticks.		P
	<p>Means shall be provided to avoid any movement of a function of the LHS:</p> <ul style="list-style-type: none"> <li>— while switching on the system;</li> <li>— while starting the engine of an IC truck.</li> </ul> <p>After switching on the LHS control system and/or after starting the engine, initial activation of the LHS shall only be possible from the neutral position of the controls intended for LHS</p>		P
4.6.3	Monitoring of operating position		-
	<p>On sit-on and stand-on trucks a separate device (OPC) independent of the LHS controls shall automatically bring an active LHS to a safe state, as defined in 4.6.1, if the operator leaves the normal operating position. Nuisance deactivation of the OPC due to operating conditions, such as rough ground, shall be prevented. The safe state shall be initiated not later than 2,0 s after deactivation of the OPC. If the LHS function is electric/electronic controlled this time delay shall be reduced to maximum 0,2 s when the LHS control device is released. Powered LHS movement after the operator returns to</p>		P

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Items	Requirements	Result-Remark	Verdict
	<p>the normal operating position shall occur only when the LHS control device is activated from the neutral position.</p> <p>This safety function shall be in accordance with the PLr as defined in Table 3.</p> <p>Where separate LHS controls remote from the normal operating position are provided, separate device for detecting the normal operating position can be overridden when the remote controls are selected.</p>		
4.6.4	Deviation from setpoint		-
	<p>The LHS shall be so designed that deviation from operator setpoint, caused by an electrical fault, which could result in hazardous truck movement is prevented.</p> <p>The following behaviour is considered as hazardous:</p>		P
	<p>a) movement from standstill, longer than a time of 0,2 s, without activating LHS controls;</p> <p>b) unintended hazardous deviation from setpoint of an active LHS function. The level of deviation depends on the LHS function. Hazardous deviations are those deviations from setpoint that the operator is not able to control, and which lead to loss of load or stability.</p> <p>For specific applications a time less than 0,2 s can be required, e.g. electric/electronic controlled load clamp devices.</p> <p>These safety functions shall be in accordance with the PLr as defined in Table 3.</p>		P
4.6.5	Load clamp devices		-
	<p>Trucks equipped with attachments which hold the load by power (for instance, paper clamps) shall feature controls with a secondary action to prevent unintentional release of the load in accordance with EN ISO 3691-1:2015, 4.4.4.1.</p> <p>If the prevention of unintentional release is realized</p>		P

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Items	Requirements	Result-Remark	Verdict
	by an electric/electronic system this safety function shall be in accordance with the PLr as defined in Table 3.		
4.6.6	Limitation of load movement functions		-
	Electrical/electronic speed - and/or position - control and limitation systems shall be in accordance with the PLr shown in Table 3. For limitation of load movement as operator assistance see Annex E. An LHS limiting function shall be considered a safety function if it is required for passing the truck stability type tests, e.g. tilting angle limitation, maximum reach of the mast, limitation of the side shift displacement		P
4.7	Steering		-
4.7.1	General		-
	The hazards resulting from failures of electric or electric assisted steering systems are dependent on the type of the steering system. The following safety functions shall be applied to the corresponding steering system		P
4.7.2	Electrical/electronic steering		-
4.7.2.1	General		-
	Electrical/electronic steering control systems shall be designed to avoid hazardous deviations not controllable by the operator		P
4.7.2.2	Unintended steering movements		-
	A single electrical/electronic fault shall not lead to a risk of an unintended operation caused by the steering system.		P
	Within 0,1 s from the start of an unintended steering movement:		-
	a) on trucks not provided with backup steering, the fault shall be detected, the stop of the unintended steering operation and a controlled stop shall be initiated;		P

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Items	Requirements	Result-Remark	Verdict
	b) on trucks provided with backup steering, the fault shall be detected, the stop of the unintended steering operation shall be initiated, the backup steering system shall be activated automatically.		
4.7.2.3	Supervision of steering system		-
	An electrical/electronic fault potentially leading to loss of steering functions (for instance breakdown of steering controller or output stage, loss of power supply) shall on trucks:		P
	a) without a backup steering system initiate a controlled stop; or b) with backup (secondary) system initiate an automatic activation of the backup (secondary) system		P
4.7.2.4	Backup steering warning		-
	A single electrical/electronic fault as described in 4.7.2.2 and 4.7.2.3 on trucks provided with backup steering shall activate a warning to the operator.		P
4.7.2.5	Deviation from setpoint		-
	The steering control system shall detect potentially hazardous deviations between setpoint and actpoint. Hazardous deviations are those deviations from setpoint that the operator is not able to control. In case of hazardous deviations, one of the conditions defined in 4.5.1 shall be initiated within 0,1 s. This safety function shall be in accordance with PLr as defined in Table 4.		P
4.7.3	Electric powered assisted steering systems		-
	Any failure of the electrical part of an electric powered assisted steering system shall not prevent the truck from maintaining the path being steered. A failure of the electric powered assisted steering		P

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Items	Requirements	Result-Remark	Verdict
	system shall be signalled to the operator. This safety function shall be in accordance with the PLr as defined in Table 4.		
4.8	Software design		P
4.9	Other protective measures		P
4.10	Electrical verifications		P

## 2.5 EN ISO 3691-1:2015+AC:2016+A1:2020

Industrial trucks – Safety requirement and verification Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and

burden-carrier trucks

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
4	Safety requirements and/or protective measures		-
4.1	General		-
4.1.1	Overall requirements		P
4.1.2	Normal climatic conditions		P
4.1.3	Normal operating conditions		P
4.1.4	Electrical requirements		P
4.1.5	Edges or angles		P
4.1.6	Stored energy components		P
4.2	Starting/Moving		-
4.2.1	Unintended starting		P
4.2.2	Unintentional movement and inadvertent activation		P
4.2.2.1	Parking brake		P
4.2.2.2	Internal-combustion-engine powered trucks		N
4.2.2.3	Travel controls		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
4.2.2.4	Powered travel movement		P
4.2.2.5	Manual gearbox and manually operated clutch pedal		P
4.2.3	Travel speed		-
4.2.3.1	Pedestrian- controlled trucks		N
4.2.3.2	Stand-on trucks and Pedestrian- controlled trucks with foldable platform		N
4.2.3.3	Travel with mast raised		N
4.3	Brakes		-
4.3.1	All trucks shall be designed with service and parking brakes complying with ISO 6292		P
4.3.2	Failure of energy supply to service brake		P
4.3.3	Stand-on and pedestrian-controlled trucks		N
	Stand-on and pedestrian-controlled trucks shall be equipped with a brake system that will automatically engage upon release of the brake actuating control by the operator. This system may serve as the service and parking brake.		N
4.4	Manual control actuators		-
4.4.1	General		-
4.4.1.1	Consistency with the truck motions		P
4.4.1.2	Multiple operators		N
4.4.1.3	Multiple operating positions		N
4.4.2	Travel and braking controls		P
4.4.2.1	General The motion of the speed operating control shall be so designed that an increase in the movement of the control increases the travel speed. When the control is released, it shall return to the neutral position of the control actuator.		P
4.4.2.2	Sit-on trucks Trucks with pedal-operated travel and braking controls shall comply with ISO 21281.		P
4.4.2.3	Stand-on trucks		N
	The requirements for travel and braking controls for a stand-on truck are as follows. a) Travel control functions		N

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	<p>-- Where a tiller is used, it shall be fitted with control devices for travel direction and speed.</p> <p>-- Where a steering wheel or similar control is used, the controls for travel direction and speed shall be positioned in close proximity to the steering control.</p> <p>The service brake function shall be engaged</p> <p>-- automatically when the tiller is released, if operated by the tiller,</p> <p>-- automatically when the travel-control is released, if operated by the travel-control,</p> <p>-- automatically when releasing the pedal, if the brake function is foot-operated,</p> <p>-- when activating the hand actuator, if the brake function is hand-operated.</p>		N
	b) Trucks with elevating operator platform up to 1 200 mm		
4.4.2	Means shall be provided to prevent travel while the platform is elevated more than 500 mm, unless the controls are elevated with the platform.		
4.4.2.4	Pedestrian-controlled trucks		N
	<p>The requirements for pedestrian-controlled trucks are as follows.</p> <p>a) The tiller shall be fitted with control devices for</p>		N
	<p>travel direction and speed.</p> <p>b) When the tiller is released, it shall automatically return to its upper rest position, cut off traction power in the travel direction and engage the brake.</p> <p>c) When the tiller is in its lowered position, the traction power in the travel direction shall be cut off and the brake shall be engaged.</p> <p>d) The tiller shall be fitted with a device to energize the direction of travel away from the operator until pressure on the device is relieved, or that stops</p>		N

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	the truck by applying the brakes, if the head of the tiller in its operating position comes into contact with a solid body (e.g. the operator's body).		
4.4.2.5	Differential locking		P
	It shall be possible to unlock the differential when the truck is moving. For trucks fitted with a pedal-operated differential lock, depression of the pedal shall lock the differential and shall be released when releasing the pedal. Differential locking comply the requirement		P
4.4.2.6	Additional operation from outside the truck		N
4.4.2.7	Additional operation from alongside pedestrian controlled and stand-on trucks (coasting)		N
4.4.3	Steering controls		P
4.4.3.1	Steering direction		P
	a) For stand-on or sit-on trucks, when travelling in the forward direction, clockwise rotation of the steering wheel, or equivalent movement of the steering control, shall steer the truck to the right.		P
	b) For trucks with an operator control position rotatable by more than 90°, or having duplicated control positions, in order to facilitate the operator facing in the opposite direction, clockwise rotation of the steering wheel, or equivalent movement of the steering control, shall steer the truck to the right as viewed from the new position — i.e. the steering control sense is reversed beyond 90° to facilitate the operator facing in the opposite direction.		N
	c) Trucks with continuous 360° steering — i.e. the steering/drive wheel can move through 360° to propel the truck in the direction selected by the steering control — shall operate in the same sense as a), above, when travelling in the forward direction.		N

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	d) For pedestrian-operated trucks fitted with a tiller, when travelling in the forward direction, clockwise movement of the tiller shall steer the truck to the right.		
	e) Exceptionally, when requested by the user, end-control trucks may be equipped with “reverse steering” — i.e. clockwise rotation of the steering control will steer the truck to the left. Such trucks should be clearly identified.		N
4.4.3.2	Failure of power supply		P
4.4.4	Load handling controls		P
4.4.4.1	Controls shall return to the neutral position when released and stop the corresponding load movement. When single levers are used to control a function on trucks other than reach trucks with retractable mast or forks, the lever closest to the operator shall control lifting and lowering, the second closest lever should control the tilt function, the third closest lever should control the side shift and the fourth closest lever should be for auxiliary functions.		P
	When single levers are used to control a function on reach trucks with a retractable mast or forks, the lever closest to the operator shall control lifting and lowering, the second closest lever should control the displacement of the mast or forks, the third closest lever should control the tilt function, the fourth closest lever should control side shift and the fifth closest lever should be for auxiliary functions. Trucks equipped with attachments which hold the load by power (e.g. paper clamp) shall feature control(s) with a secondary action to prevent unintentional release of the load.		N
4.4.4.2	The hand power forces and the layout of controls of manually operated lifting systems shall comply with ISO		N

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	<b>3691-5</b>		
4.4.5	Multi-function controls		P
4.4.6	Controls for automated functions		N
4.4.7	Marking		P
4.5	Power systems and accessories		-
4.5.1	Exhaust and cooling system		
4.5.1.1	The exhaust system shall be designed in accordance with 4.7.6 and such that engine exhaust is directed away from the operator position. Materials used in the vicinity of exhaust systems shall be non-flammable and shall be chosen and protected such that they are not adversely affected by heat from the exhaust system.		N
4.5.1.2	The air flow through the cooling system shall be arranged so as to avoid discomfort to the operator		N
4.5.2	Fuel tank		N
4.5.2.1	If a fuel tank is within or adjacent to the engine compartment and excessively high temperatures can occur, the tank and/or filling arrangement shall be isolated from the electrical and exhaust systems by suitable protection, e.g. a separate enclosure or baffles. The tank location and facilities for filling shall be such that spillage or leakage will not drain into the engine or operator's compartment or onto electrical or exhaust system parts.		N
4.5.2.2	Fuel spillage shall not be possible under normal operating conditions.		N
4.5.3	Access to engine and other compartment		N
4.5.3.1	Engine covers Warning labels provided and fan was guarded.		N
4.5.3.2	The access covers shall be provided preventing unintentional closure		N
4.5.4	Liquefied petroleum gas (LPG)-powered trucks		N
4.5.4.1	Container		N

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	a) Permanently fixed on the truck or removable		N
	b) Removable containers shall be secured on the truck		N
	c) Pipe fittings and accessories on containers		N
	d) Containers shall be equipped with a device to prevent unintentional emission		N
	e) The fuel take-off on the container shall be equipped with a manually operated valve.		N
	f) The fuel take-off shall be in a liquid form unless the container and engine are specially equipped for a direct vapour withdrawal.		N
	g) Containers to be filled by the user, shall fitted: -A safety pressure relief valve -A fixed maximum level indicating device -Maximum level indicating devices which rely on bleeding to atmosphere -Maximum liquid level devices		N
	h) Ventilation openings at the bottom of compartments		N
	i) Fastenings of removable containers		N
	j) Removable containers which incorporate a safety pressure relief valve		N
	k) Additional container		N
	l) The position of containers		N
	m) Containers shall be fitted to prevent abrasion or shock or corrosive action of the product		N
	n) There are no projections outside the plan view outline of the truck		N
4.5.4.2	LPG piping		N
	a) Connecting piping and all associated parts		N
	b) Requirements of the support on pressure flexible hoses and rigid pipes		N
	c) The pressure that hoses, pipes shall withstand pressure		N
	d) Excessive pressure shall be avoided		N

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	e)Aluminium piping shall not be used in LPG lines		N
	f)Hose lengths shall be as short as practical.		N
	g) Pressure unions and joints above 1 bar		N
4.5.4.3	Equipment		N
	a)The supply of gas shall be automatically cut off when the engine stops b)Requirements for multi-fuel applications		N
	c)The truck is equipped with two or more containers to supply fuel		N
	d)Installation of safety pressure relief valves or liquid level indicators		N
	e)Corrosion resistant protective coating		N
	f)All fuel system components shall be firmly secured to the truck		N
	g)Pressure reducing valves		N
	h) The engine compartment shall be designed in accordance with 4.5.4.1 g), in order to avoid any LPG accumulation		N
4.5.4.4	LPG-powered trucks are subject to regional requirements, additional to the requirements of this part of ISO 3691. See ISO/TS 3691-8.		
4.6	Systems for lifting and tilting		-
4.6.1	Lift chains		P
4.6.2	Mechanical lifting system		N
4.6.2.1	Comply with the requirements of 5.6.3.3		N
4.6.2.2	Failure of the mechanism or its parts		N
4.6.2.3	The lowering speed		N
4.6.3	Hydraulic lifting and tilting system		P
4.6.3.1	Hydraulic lifting system		P
4.6.3.2	Lowering speed limitation		P
4.6.3.3	Limitation of stroke		P
4.6.3.4	Hydraulic tilting system		
4.6.3.5	Mast tilt and carriage isolation		
4.6.4	Hydraulic system		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	4.6.4.1 Hydraulic circuit		P
	4.6.4.2 Pressure control		P
4.6.4.3	Failure of energy supply to hydraulic circuit		P
4.6.4.4	Fluid purification		P
4.6.5	Load-handling and -stacking attachments		P
4.6.5.1	Unintentional displacement or detachment		P
4.6.5.2	Malfunction in the power supply system		N
4.6.5.3	Hydraulic system for attachment		N
4.6.5.4	Combined hydraulic systems		N
4.6.5.5	Attachments for lifting freight containers		N
4.6.5.6	Fork arms		P
4.6.5.6.1	Solid-section fork arms shall be manufactured and tested in accordance with ISO 2330, except with respect to safety factors. The safety factors are subject to regional requirements, additional to the requirements of this part of ISO 3691. See ISO/TS 3691-8		P
4.6.5.6.2	The total capacity of all fork arms fitted to a truck shall not be less than the actual capacity of the truck.		P
4.6.5.6.3	Means to prevent unintentional lateral displacement of the fork arms		P
4.6.5.6.4	Fork-arm extensions shall be designed to prevent accidental disengagement from the fork arms, and shall be in accordance with ISO 13284.		P
4.6.5.7	Fork carriers		N
4.7	Operator position		-
4.7.1	Dimensions		P
	4.7.2 Operator access and egress		P
	4.7.2.1 General		-
	Trucks shall be designed to permit safe and easy access and egress and to minimize the risk of slipping, falling and tripping. Steps, running boards and hand holds (grab handles, fixed parts of the truck structure, etc.) shall be provided		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	above a step height of 350 mm to give three-point contact at all heights (i.e. one hand and two feet or two hands and one foot). Step width, instep clearance and toe clearance shall comply with ISO 2867.		
4.7.2.2	<b>Steps</b>		P
	Steps shall have slip-resistant surfaces or covering (e.g. expanded metal, abrasive coating). The first step shall be not more than 550 mm from the ground and succeeding steps shall be 250 mm to 350 mm, preferably at equal intervals		P
4.7.2.3	<b>Compartment floors</b>		P
	The compartment floor frequented by the operator, steps and walkways shall be free of obstacles and shall have a slip-resistant surface, e.g. ribbed mats, abrasive coating, expanded metal.		P
4.7.2.4	<b>Walkways</b>		N
	Walkways more than 2 000 mm from the ground shall have guard rails. The guard rails shall have a height of 900 mm to 1 100 mm and shall be capable of withstanding, without permanent deformation, a force of 900 N applied in a horizontal direction from the inside to the outside.		N
4.7.2.5	<b>Hand holds</b>		P
	For access to, and egress from, the normal operating position with a floor height above 300 mm, hand hold(s) shall be provided; these may be part of the truck structure. The clearance dimension for a hand hold shall be at least of 45 mm width, 130 mm length and diameter of 15 mm (see Figure 3).		
4.7.3	<b>Platform</b>		N
4.7.3.1	<b>General</b>		N
	Operator stand-on platforms on pedestriancontrolled and stand-on end-controlled trucks shall be dimensioned in accordance with 4.7.1		N

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	and shall be capable of withstanding a compression force corresponding to 2,5 times the mass of the laden truck applied along the longitudinal axis of the truck with the outermost projection of the platform against a flat vertical surface. For the purpose of this requirement, the operator platform includes any surrounding reinforcement or parts of the truck which provide resistance to crushing of the platform, except for pedestrian-controlled stand-on trucks employing a tiller.		
4.7.3.2	Platforms overhanging the truck chassis		N
	Platforms overhanging the truck chassis on tilleroperated stand-on trucks, capable of travelling more than 6 km/h, shall, in addition to 4.7.3.1, be provided with a guard at either the sides or the front of the platform. The guards shall be capable of withstanding a horizontal force of 900 N acting from inside to outside applied in line with the centre of the operator's standing position without permanent deflection. The side guards shall be at a minimum height of 700 mm above the platform in its protective position.		N
4.7.3.3	Pedestrian-controlled trucks with foldable platforms		N
	Operator stand-on platforms that are fitted to pedestrian-controlled trucks and overhang the truck's chassis may be capable of being folded or pivoted to an upright position when the operator leaves the platform; this may be done automatically. For platforms which do not act automatically, devices shall be provided to prevent the truck manoeuvring or travelling unless the operator is standing on the platform or the platform is in its upper rest position. Travelling of more than 6 km/h shall only be possible when the platform is pivoted down and guards are in their protective position.		N

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
4.7.3.4	Stand-on platforms		N
	Operator stand-on platforms which are built within the plan view outline of pedestrian-controlled trucks, where the operator stands to the side of the motor housing, shall be equipped with an additional grab rail for operator stability when riding. This grab rail shall be capable of withstanding a horizontal force of 900 N applied in line with the operator's standing position, without permanent deformation. The requirements of 4.7.3.2 do not apply for this configuration of pedestrian-controlled truck.		N
4.7.3.5	Trucks with foldable platforms and foldable side guards		N
	On trucks with side guards and platforms of the folding or pivoting type as described in 4.7.3.2 and 4.7.3.3, travelling movement shall only be possible when the side guard or platform is in a protective position or an inactive rest position. No travelling movement is allowed with the platform or side guard in an intermediate position.		N
4.7.4	Operator's seat		P
	a)The seat has a facility allowing fore and aft adjustment without using tools		P
	b)The weight adjustable seat		N
	c)The seat has facility allowing it to swivel about a vertical axis		N
	d)The seat mounting		P
	e)Additional operator's seats		N
	f)Auxiliary seat on a stand-on industrial truck		N
	g) The seat anchorage to the battery cover or engine cover of sit-on counterbalanced trucks, as well as the latching method of the cover to the truck chassis, shall have sufficient strength in the event of a backwards tip-over of the truck from a loading dock. The seat anchorage shall be able to		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	withstand a force of 2 250 N at a 45°± 5° angle, as shown in Figure 4.		
4.7.5	Protection from road wheels and objects thrown up		P
4.7.5.1	Ride-on trucks		P
4.7.5.2	Pedestrian controlled trucks		N
4.7.6	Protection from burning		P
4.7.7	Protection against crushing, shearing and trapping points		P
4.7.7.1	General		P
4.7.7.2	Minimum distances		P
	<p>Parts which move relative to one another which are within the reach of the operator in the normal operating position shall be adequately guarded or be separated by the following minimum distance:</p> <ul style="list-style-type: none"> <li>- Places where the operators fingers can be trapped: min 25 mm</li> <li>- Places where the operators hands or feet can be trapped: min 50 mm</li> <li>- Places where the operators arms and legs can be trapped: min 100 mm</li> </ul> <p>Relative moving parts that need to contact or move in close proximity to one another shall be guarded to prevent access when the distance between those parts is more than 8 mm. If residual hazards exist, those shall be identified on the truck in accordance with 6.3.3.4.</p>		P
4.7.7.3	Attachments		P
	Crushing and shearing hazards to the operator in the normal operating position associated with attachments, except at the load supporting points, shall also meet the relevant requirements of 4.7.7.1. If such hazards still exist, they shall be identified according to 6.2 and on the attachment by a warning sign in accordance with 6.3.3.4.		P
4.7.7.4	Foot protection		N
	Trucks with side-facing seating or standing shall		N

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Items	Requirements	Result-Remark	Verdict
	be so built that when traveling, the operator cannot unintentionally keep his foot outside the confines of the truck or the truck shall be equipped with a traction cut out or signalling device which informs the operator if his foot is not in the safeguarded position.		
4.7.8	Operator restrain		P
4.7.9	Additional operator positions		N
4.8	Stability		-
4.8.1	In order to reduce the hazards of longitudinal and lateral tip-over in the operating conditions foreseen by the manufacturer, the trucks specified below shall comply with the stability requirements given in the applicable part of ISO 22915, without permanent deformation of the structure (see 5.2): --basic test criteria and requirements for all applicable truck types, ISO 22915-1; --counterbalanced trucks with mast, ISO 22915-2; ---reach and straddle trucks, ISO 22915-3; --pallet stackers, double stackers and orderpicking trucks with operator position elevating up to and including 1 200 mm lift height, ISO 22915- 4; --bidirectional and multidirectional trucks, ISO 22915 -7; ---industrial variable-reach trucks, ISO 22915-11; --- order-picking trucks with operator position elevating above 1 200 mm, ISO 22915-21.		P
4.8.2	Specific operating conditions		N
	For specific operating conditions foreseen by the manufacturer, additional stability tests shall be carried out in accordance with the following parts of ISO 22915, as applicable: -- trucks operating in the special condition of stacking with mast tilted forward and load elevated, ISO 22915-8;		N

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	<p>-- trucks operating in the special condition of stacking with load laterally displaced by powered devices, ISO 22915-10;</p> <p>-- trucks operating in the special condition of offset load, offset by utilization, ISO 22915-20.</p>		
4.8.3	Levelling indicator for rough-terrain trucks		N
4.9	Protective devices		-
4.9.1	Operators overhead guard		P
4.9.1.1	<p>Ride-on trucks with a maximum lift height of more than 1 800 mm above the floor shall be fitted with an overhead guard complying with ISO 6055 to protect the operator from falling objects.</p> <p>Trucks with an elevating operator position up to and including 1 200 mm that feature a lift height of the load of more than 1 800 mm above the operator platform shall be fitted with an overhead guard complying with ISO 6055 to protect the operator from falling objects.</p>		P
4.9.1.2	Additional fitting against falling small objects		P
	The overhead guard specified in 4.9.1.1 shall, when handling a load above 1 800 mm lift height, be constructed in such a manner that it can be provided with an additional fitting making it possible in those special cases to increase the protection of the operator against falling small objects		P
4.9.1.3	Pedestrian-controlled trucks with foldable platform		N
	Pedestrian-controlled trucks with a foldable platform as specified in 4.7.3.3 shall be provided with means to prevent lifting over 1 800 mm from the floor when the side guards are in their protective position. This does not apply if an overhead guard as specified in 4.9.1.1 is fitted on the truck.		N
4.9.2	Load backrest extension		P
4.9.2.1	Provision for load backrest extension		P

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Items	Requirements	Result-Remark	Verdict
	Trucks fitted with fork arms with a lift height of more than 1 800 mm shall be designed so that they can be fitted with a load backrest extension.		P
4.9.2.2	Size of openings		P
	Load backrest extensions, if provided, shall have height, width, and size openings sufficient to minimize the possibility of the load falling toward the mast when the mast is in a position of maximum rearward tilt. The size of openings in the load backrest extension, if provided, shall not exceed 150 mm in one of the two dimensions.		P
4.9.3	Warning device		P
	Trucks shall be equipped with an operatorcontrolled audible warning device.		P
4.9.4	Wheels with split wheel rims for inflatable tyres		P
	When split wheel rims are used with pneumatic tyres, the truck shall be provided with means to prevent the user from separating the halves of the wheel before removing it from the axle. Information on the proper means of removing the tyre from the wheel shall be provided in the instruction handbook (see 6.2).		P
4.9.5	Traction battery compartment		P
4.9.5.1	Unauthorized access		P
	On trucks with a nominal battery voltage exceeding 120 V d.c., if a lockable cover is not present on the battery enclosure, facilities shall be provided to enable the battery compartment to be secured so as to prevent unauthorized access to the battery.		N
4.9.5.2	Metal cover		P
	A metal cover for a battery compartment or battery enclosure shall have either a) sufficient strength and rigidity, in conjunction with an air spacing of at least 30 mm provided between it and the battery terminals, so that the		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	<p>battery terminals are not short-circuited when a 980 N force is applied to any area 300 mm -300 mm of the cover, or</p> <p>b) an air space reduced to a minimum of 10 mm, provided covers or live parts of the battery are insulated in such a way that disintegration and/or displacement of the insulation is prevented.</p>		
4.9.5.3	<b>Non-metallic cover</b>		<b>N</b>
	<p>For non-metallic covers of battery compartments, the following applies.</p> <p>a) The cover shall have a burn rating of V0 or V1 in accordance with IEC 60695-11-10.</p> <p>b) The cover shall comply with an impact test of 136 J, the impact being produced by dropping a steel sphere having a diameter of 100 mm and mass of 4,11 kg from a height of 3,3 m. If the battery is located under an overhead guard, the impact may be reduced to 68 J, produced by dropping a steel sphere having a diameter of 100 mm and mass of 4,11 kg from a height of 1,65 m. There shall be no live parts exposed or impact that causes physical damage to the battery.</p> <p>c) If metallic parts project into the battery compartment, then 4.9.5.2 applies.</p>		<b>N</b>
4.9.5.4	<b>Ventilation</b>		<b>P</b>
4.9.5.5	<b>Resistance to electrolyte</b>		<b>P</b>
4.9.6	<b>Battery-restraint devices</b>		<b>P</b>
4.9.7	<b>Starter battery requirements</b>		<b>P</b>
4.10	<b>Visibility/Lighting</b>		<b>-</b>
4.10.1	<p>Requirements for all-round visibility from unladen trucks up to and including 10 000 kg rated capacity shall be in accordance with ISO 13564-1. For visibility with load, see 6.2.2, considering that, if direct visibility is limited by the load, aids can be used. Visibility requirements are subject to regional</p>		<b>P</b>

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	requirements, additional to the requirements of this part of ISO 3691. See ISO/TS 3691-7:2011.		
4.10.2	Ride-on trucks shall be so designed that it is possible, referring to the manufacturer's instructions, to equip them with travel lights, working lights and signal lights.		P
4.11	Environmental conditions		-
4.11.1	Operator's cab		P
4.11.1.1	Cab is fitted in lieu of an overhead guard on an industrial truck, it shall comply with 4.9.1		P
4.11.1.2	The material of the cab and fixing devices		P
4.11.1.3	Efficient ventilation and environmental conditions for use		N
4.11.1.5	Wipers on the windscreen or rear window and safety glass		N
4.11.1.6	Emergency exit		P
4.11.1.7	The storage of the instruction handbook		P
4.11.1.8	Positions for additional operators		N
4.11.2	Noise emission		P
4.11.3	Vibration		P
4.11.4	Electromagnetic compatibility (EMC)		N
4.11.5	Transport		P
4.11.5.1	If the manufacturer specifies in the instruction handbook that a truck may be lifted without disassembling,		
4.11.5.2	locations for slinging points shall be provided		P
	Lifting points for the removal and transportation of individual assemblies of the truck, if required, shall be indicated on the assembly, or in the operating instructions.		P
4.11.5.3	Locations for slinging of removable attachments shall be provided as stated in the instruction handbook		P
4.11.6	Operation in potentially explosive atmospheres		N
	4.12 Devices for towing		P
5	VERIFICATION OF SAFETY REQUIREMENTS AND/IR		-

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	<b>MEASURES</b>		
5.1	General		-
5.2	Structural test		-
	<p>These tests are to be performed on a sample that is representative of series production. The structural components of the truck and its attachments shall carry static loads of 1,33 Q1 and 1,33 Q2 for 15 min each, where</p> <p>Q1 is the rated capacity at the standard lift height and standard load centre distance in accordance with the information on the capacity plate; Q2 is the actual capacity at maximum lift height in accordance with the information on the capacity plate. The truck shall be on substantially level ground with the mast in the substantially vertical position and may be anchored to prevent tip-over.</p> <p>The loads may be applied at the corresponding height by means independent of the truck. The test shall not result in any visual permanent deformation or damage.</p>		P
5.3	Functional verification		-
	<p>Functional verification shall be carried out on each truck to verify that it is able to perform the tasks for which it was designed. These tests shall be done according to the manufacturer's instructions. They shall be performed by trained persons either operating and testing the truck according to the manufacturer's instructions or simulating these tests by any method giving an equivalent effect and producing substantially the same result. Each truck shall be inspected to ensure that the travelling, braking, steering, load-handling controls and combined functions, if any, are appropriately identified and operate correctly. The correct operation of warning devices, safety devices and lighting, if any, shall also be checked.</p>		
6	<b>INFORMATION FOR USE</b>		-
6.1	General		-

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	<p>Each truck and removable attachment shall be supplied to the user with an instruction handbook(s), covering operating and regular servicing and addressing all identified hazards, printed in the language(s) of the country in which the truck is to be used, where required by national law. See also ISO 12100:2010, 6.4.5.</p> <p>There is no need for the workshop and parts handbooks intended for use by specialized personnel employed by the manufacturer or his authorized representative to be supplied with each truck, and these can be printed in the language of the country where the truck is to be used, as required by national law. In other cases, the instructions shall be in a language agreed between the truck supplier and purchaser.</p>		P
6.2 I	nstruction handbook		-
	These manuals shall include if applicable at least the following information:		-
6.2.1	Concerning the truck/attachment		P
	<ul style="list-style-type: none"> <li>- Name and address of the manufacturer or the authorized representative.</li> <li>- Designation of type.</li> <li>- Description of the truck and its accessories.</li> <li>- Attachments which are fitted to the truck and their assembly precautions.</li> <li>- Details of use of the load backrest.</li> <li>- Details for the installation of a fire extinguisher, if required by the application of the truck.</li> <li>- Admissible wheel rims and tyres with inflation pressures for pneumatic tyres.</li> <li>- Description of the safety devices and warning labels.</li> <li>- Details of the noise and vibration generated by the truck. (The noise declaration shall be made in accordance with prEN 12053)</li> </ul>		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	<ul style="list-style-type: none"> <li>- Overall dimensions, load capacity and performance details of the truck.</li> <li>- Visibility conditions when using remote controlled devices for the truck.</li> </ul>		
6.2.2	Operation of truck		-
	<ul style="list-style-type: none"> <li>a) intended uses of the truck and attachments, and examples of hazardous misuse;</li> <li>b) training requirements for the operator;</li> <li>c) function of operating controls and displays;</li> <li>d) pre-shift checks before the truck is put into operation;</li> <li>e) instructions for adjustment of the operator's seat;</li> <li>f) instructions for operation with/without cab, with/without doors;</li> <li>g) instructions for access and egress;</li> <li>h) instructions for safe handling by the operator, e.g. when changing attachments or moving fork arms;</li> <li>i) requirements of the ground/floor where the truck is to be used;</li> <li>j) instructions for starting, driving and stopping the truck;</li> <li>k) instructions for handling loads, warning about the hazards due to the action of wind forces;</li> <li>l) instructions when operating on a gradient;</li> <li>m) instructions for towing the truck;</li> <li>n) instructions for parking the truck;</li> <li>o) warning of risks during the use of the truck and its attachments, including crushing and shearing hazards;</li> <li>p) climatic conditions in which the truck is designed to operate;</li> <li>q) information about the direction of turning of the truck in relation to rotation of the steering wheel for</li> </ul>		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	<p>end-controlled trucks;</p> <p>r) information about operating the truck with loads causing insufficient visibility;</p> <p>s) information on the use of any visual aid that may be provided;</p> <p>t) information and conditions for the use of the drawbar;</p> <p>u) instructions when operating a rear touch device;</p> <p>v) information or instructions on action to be taken in the event of a malfunction;</p> <p>w) information for operation of the truck by a remote control device, e.g. visibility;</p> <p>x) the normal operating conditions as defined by the manufacturer, i.e. those for which the truck has been designed and the manner in which the truck will be used;</p> <p>y) instructions on the use of the operator-restraint device, system or enclosure, and guidance on the operator's behaviour in the event of a tip-over;</p> <p>z) information about lighting of the working area; aa) the procedure for movement of inoperative trucks;</p> <p>bb) instructions against operating truck with guarding removed;</p> <p>cc) lift height for travelling;</p> <p>dd) crushing and shearing hazards for the operator of pedestrian-controlled trucks featuring foldable platforms</p> <p>and reach trucks, between parts of the environment and the truck during travelling forward;</p> <p>ee) instructions to the operator of a stand-on endcontrol truck to step off and away from the truck in the event</p>		

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	of a tip-ove or off-dock accident; ff) information and instructions for using attachments, e.g. load bearing clamp.		
6.2.3	Details for battery powered trucks		-
	a) specification of approved batteries and onboard battery chargers; b) procedure for safe handling of batteries, including installation, removal and secure mounting on the truck; c) warning of risks of accumulation of hydrogen under covers; d) battery charging procedures and instructions; e) service mass of battery and ballast when required.		P
6.2.4	Details for internal-combustion-engine powered trucks		N
	a) approved fuels; b) procedure for safe handling of fuels; c) procedure for refuelling; d) warning of the effect of exhaust emissions in confined spaces; e) warning of the effect of exhaust emissions for the operator.		N
6.2.5	Service and maintenance		-
	a) training and qualifications needed for service and maintenance staff; b) safe procedure for the identification, detection and correction of faults; c) instructions for changing tyres or wheels; d) instructions for verification that markings, e.g. decals, are in place and legible; e) instructions for de-energizing of stored energy components; f) access to maintenance while working at height; g) servicing operations for which no specific skills are required;		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	<p>h) use of approved spare parts;</p> <p>i) drawings and diagrams necessary for truck service and maintenance;</p> <p>j) instructions for disposing of waste material (e.g. oils and battery);</p> <p>k) type and frequency of inspections and maintenance operations, with particular attention to the replacement and durability of wear and serviceable parts, emissions, and to the user's logbook (e.g. filter, brakes, chains, hydraulic hoses);</p> <p>l) instructions for removing and reattaching guarding;</p> <p>m) instructions for regular verification of seat belt related to</p> <ol style="list-style-type: none"> <li>1) cut or frayed straps,</li> <li>2) worn or damaged hardware, including anchor points,</li> <li>3) buckle or retractor malfunction,</li> <li>4) loose stitching.</li> </ol>		
6.2.6	Transportation, commissioning and storage		-
	<p>dismantled parts for transport, commissioning and storage;</p> <p>b) procedures for transporting, including loading and unloading;</p> <p>c) procedure for truck reassembly and mounting of attachments;</p> <p>d) functional tests on completion of commissioning;</p> <p>e) procedure for movement of inoperative trucks;</p> <p>f) procedure for prolonged shut down and storage of trucks.</p>		P
6.2.7	Truck modification		P
6.2.7.1	Unauthorized truck modification is not permitted. The text of 6.2.7.3 shall be included in the		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	instruction handbook and the workshop handbook.		
6.2.7.2	Except where provided in 6.2.7.3, no modifications or alterations to a powered industrial truck, which could affect, for example, capacity, stability or safety requirements of the truck, shall be made without the prior written approval of the original truck manufacturer, its authorized representative, or a successor thereof. This includes changes affecting, for example, braking, steering, visibility and the addition of removable attachments. When the manufacturer or his successor approves a modification or alteration, the manufacturer or successor shall also make and approve appropriate changes to the capacity plate, decals, tags and operation and maintenance handbooks.		P
6.2.7.3	Only in the event that the truck manufacturer is no longer in business and there is no successor in the interest to the business, may the user arrange for a modification or alteration to a powered industrial truck, provided, however, that the user		P
	<ul style="list-style-type: none"> <li>a) arranges for the modification or alteration to be designed, tested and implemented by an engineer(s) expert in industrial trucks and their safety,</li> <li>b) maintains a permanent record of the design, test(s) and implementation of the modification or alteration,</li> <li>c) approves and makes appropriate changes to the capacity plate(s), decals, tags and instruction handbook, and</li> <li>d) affixes a permanent and readily visible label to the truck stating the manner in which the truck has been modified or altered, together with the date of</li> </ul>		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	the modification or alteration and the name and address of the organization that accomplished those tasks.		
6.3	Marking		-
6.3.1	Information plates		P
6.3.1.1	Trucks		P
	<p>Trucks shall be marked legibly and indelibly (e.g. weather-proofed, profiled letters) with at least the following details:</p> <p>a) name and address of the manufacturer or his authorized representative;</p> <p>b) designation of series or type and compliance with the requirements of this part of ISO 3691;</p> <p>c) serial number and year of manufacture;</p> <p>d) unladen mass of the truck in working order and without removable attachments, and without battery in the case of battery-powered trucks, but with fork arms or integral attachments, the actual mass being permitted to vary from the stated mass by up to 5 % or 1 000 kg, whichever is the lower of the two;</p> <p>e) actual capacity at maximum lift height with load centre distance; where a secondary lift is fitted to a truck, the capacity at maximum lift shall be determined with the secondary mast fully elevated;</p> <p>f) actual capacities at other lift heights and load centre distances, if applicable;</p> <p>g) actual capacity with each removable attachment fitted at the manufacturer's authorized lift height(s) and load centre(s), these actual capacities being easily readable by the operator in the normal operating position;</p> <p>h) on battery-powered trucks, the authorized maximum and minimum battery mass and the system voltage;</p>		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	<p>i) if fitted, the maximum supporting force on the towing point connection, in newtons;</p> <p>j) if fitted, the drawbar pull on the towing point connection, in newtons;</p> <p>k) the nominal power in kilowatts, e.g. marked on the engine or electric motor.</p>		
6.3.1.2	<b>Removable attachment</b>		<b>N</b>
	<p>Removable attachments shall be marked legibly and indelibly (e.g. weather-proofed, profiled letters) with at least the following details:</p> <p>a) name and address of the attachment manufacturer or his authorized representative;</p> <p>b) model or type;</p> <p>c) serial number and year of manufacture;</p> <p>d) mass of attachment, which may vary from the stated figure by up to 5 % or 200 kg, whichever is the lower of the two;</p> <p>e) distance of the centre of gravity of the attachment from its mounting face on the truck;</p> <p>f) rated capacity;</p> <p>g) in the case of hydraulically or pneumatically operated attachments, the maximum operating pressure recommended by the attachment manufacturer;</p> <p>h) load centre, if applicable;</p> <p>i) lost load centre distance;</p> <p>j) the instruction "The capacity of the truck and attachment combination shall be complied with".</p>		<b>N</b>
6.3.1.3	<b>Tractors</b>		<b>N</b>
	<p>Tractors shall be marked legibly and indelibly (e.g. weather-proofed, profiled letters) with at least the following details:</p> <p>a) name and address of the manufacturer or the authorized representative;</p> <p>b) designation of series or type;</p> <p>c) unladen mass of the tractor in working order</p>		<b>N</b>

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
	<p>without battery for battery-powered tractors; the mass may vary from the figure shown by up to 5 % or 1 000 kg, whichever is the lower;</p> <p>d) serial number and year of manufacture;</p> <p>e) on battery-powered tractors, the authorized minimum and maximum battery mass and the system of voltage;</p> <p>f) the nominal power in kilowatts, e.g. marked on the engine or electric motor;</p> <p>g) the maximum supporting force on the tow-hook, in newtons;</p> <p>h) the drawbar pull, in newtons, and the period of time during which this pull can be exerted</p>		
6.3.1.4	Marking of controls		P
	Controls shall be legibly and indelibly marked (e.g. weather-proofed, profiled letters) with graphic symbols indicating the function(s), except where these are obvious, e.g. accelerator pedal. Each symbol shall be affixed on, or in close proximity to, the control to which it applies. Control symbols shall comply with ISO 3287, for existing symbols.		P
6.3.2	Information plate for trucks operating in special conditions		N
	If a truck is designed to operate in special conditions (see 4.1.1. and 4.8.2), the manufacturer shall provide, where appropriate, and in addition to the information provided in the instruction handbook, an information plate on the truck identifying those special conditions of use, including capacity if different from the capacity during normal operation (see 4.1.2).		N
6.3.3	Other information		-
6.3.3.1	Marking for slinging of trucks		P
6.3.3.2	Pneumatic tyre inflation pressure		P
6.3.3.3	Filling points		P
6.3.3.4	Warning signs		P

EN ISO 3691-1:2015+AC:2016+A1:2020			
Items	Requirements	Result-Remark	Verdict
6.3.4	Languages English		P
6.3.5	Operator restraint		P
ANNEX A	Determination of driving direction and rated capacity		P
ANNEX B	List of significant hazards		P

2.6 EN 16307-1:2020 Industrial trucks - Safety requirements and verification - Part

1: Supplementary requirements for self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks

EN 16307-1:2020			
Items	Requirements	Result-Remark	Verdict
4	Safety requirements and/or protective measures		-
4.1	General		-
	Machinery shall comply with the safety requirements and/or protective measures of 4.2 to 4.16. In addition, the machine shall be designed according to the principles of EN ISO 12100:2010 for relevant but not significant hazards which are not dealt with by this document. The following applies to the self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks, dealt with in EN ISO 3691-1:2015. These are additional to the requirements of EN ISO 3691-1:2015 and, in certain instances, replace them		P
4.2	Electrical requirements		-
	Electrical systems and equipment shall be in accordance with the relevant part(s) of EN 1175:1998+A1:2010.		P
4.3	Travel speed		-
	The requirements of EN ISO 3691-1:2015, 4.2.3 shall apply, except the reference to ISO/TS 3691-8, with the following addition:		-
	The travel speed of variable-speed pedestrian-controlled trucks operating on level ground shall not exceed 6 km/h.		P
	The maximum speed on level ground of stand-on trucks and pedestrian-controlled trucks fitted with a foldable platform when the operator is on the platform shall not exceed 16 km/h		P
4.4	Brakes		-
	The requirements of EN ISO 3691-1:2015, 4.3.1 shall apply, except the reference to ISO/TS 3691-8, with		-

EN 16307-1:2020			
Items	Requirements	Result-Remark	Verdict
	the following addition:		
	The parking and service brakes of trucks that can travel with an elevated operator position and/or elevated load above 500 mm, and up to and including 1 200 mm, are subject to the following requirements:		-
	— for travel speeds up to and including 9 km/h, parking brakes shall be in accordance with ISO 6292:2020, 6.2.2 a), and service brakes shall comply with the specifications of ISO 6292:2020, Table 2, Group C;		P
	— for travel speeds above 9 km/h, parking brakes shall be in accordance with ISO 6292:2020, 6.2.2 b) and service brakes shall comply with the specifications of ISO 6292:2020, Table 2, Group A1.		P
4.5	Travel and braking controls - additional operation from alongside pedestriancontrolled and stand-on trucks		-
	The requirements of EN ISO 3691-1:2015, 4.4.2.7 shall apply, except the reference to ISO/TS 3691-8, with the following addition:		-
	Low-lift order-picking trucks provided with a system that allows operating while walking alongside the truck are subject to the following requirements:		-
	— activation of the travel control device from outside of the truck shall only be possible when the truck is stationary;		P
	— the travel control shall be a hold-to-run control and the speed shall not exceed 4 km/h while operating the travel control from outside of the truck		P
	— braking function shall be automatically applied when travel control device is released.		P
4.6	Lift chains		-
	The requirements of EN ISO 3691-1:2015, 4.6.1 shall apply, except the reference to ISO/TS 3691-8, with the following addition:		-
	The minimum safety factor of the lifting mechanism, K1, shall be as follows:		-

EN 16307-1:2020			
Items	Requirements	Result-Remark	Verdict
	<p>— for trucks <math>\leq 10\ 000</math> kg rated capacity: <math>K1 \geq 5</math></p> <p>— for trucks <math>&gt; 10\ 000</math> kg rated capacity: <math>K1 \geq 5 - 0,2(Q' - 10)</math>, but not less than 4</p> <p>where <math>Q'</math> is the rated capacity of the truck, in tonnes.</p>		P
4.7	Mast tilt and carriage isolation		-
	<p>The requirements of EN ISO 3691-1:2015, 4.6.3.5 shall apply, with the following addition:</p> <p>For ride-on trucks, the movement of powered attachments shall not be possible through operation of the control when the operator is not in the normal operating position.</p>		P
4.8	Operator's seat		-
	<p>The requirements of EN ISO 3691-1:2015, 4.7.4 shall apply with the following addition:</p> <p>The operator's seat shall be specified and marked in accordance with EN 13490:2001+A1:2008</p>		P
4.9	Protection against crushing, shearing and trapping		-
4.9.1	General		-
	<p>The requirements of EN ISO 3691-1:2015, 4.7.7.1 shall apply with the following addition:</p> <p>Where fixed and/or removable guard systems are needed, the requirements of EN ISO 14120:2015 shall be met.</p> <p>When a fixed guard is removed, its fixing system shall remain on the guard or on the truck. This requirement applies to any fixed guards that are liable to be removed by the user with a risk of loss of the fixings, e.g. fixed guards that are liable to be removed during routine maintenance or setting operations carried out at the place of use.</p>		P
4.9.2	Pedestrian and stand-on end-controlled trucks with mast		-
	<p>The mast shall be guarded at the side facing the operating controls, e.g. by a transparent cover. The guard shall, as a minimum, cover the whole width of the hazardous zone and the full length of the nonelevated</p>		P

EN 16307-1:2020			
Items	Requirements	Result-Remark	Verdict
	mast, or up to 2,2 m from the ground, whichever is less.		
4.10	Loading control		-
	The manufacturer shall give information regarding the residual risk of overloading and overturning in the instruction handbook, see 6.1.1.		P
4.11	Lateral stability		P
	The requirements of EN ISO 3691-1:2015, 4.8.1 shall apply. In addition, counterbalanced lift trucks other than rough terrain counterbalanced trucks, that have a centre control, sit down, non-elevating operator, with a rated capacity up to and including 5 000 kg shall comply with EN 16203:2014.		P
4.12	Visibility		-
	The requirements of EN ISO 3691-1:2015, 4.10.1 shall apply except the reference to ISO 13564-1 and with the following modification		P
	The requirements of EN 16842 shall apply. EN 16842-1:2018 defining the basic test criteria and requirements for all applicable truck types shall be applied in conjunction with the truck type specific part of EN 16842:		-
	<ul style="list-style-type: none"> <li>— sit-on counterbalance trucks and rough terrain masted trucks up to and including 10 000 kg capacity: EN 16842-2:2018;</li> <li>— reach trucks up to and including 10 000 kg: EN 16842-3:2018;</li> <li>— sit-on counterbalance trucks and rough terrain masted trucks greater than 10 000 kg capacity: EN 16842-6:2018;</li> <li>— masted container trucks handling freight containers of 6 m (20 ft) length and longer: EN 16842-7:2018.</li> </ul>		P
4.13	Reduction of noise by design		-
4.13.1	General		-
	Industrial trucks shall be designed and constructed		P

EN 16307-1:2020			
Items	Requirements	Result-Remark	Verdict
	such that risks resulting from the emission of airborne noise are reduced according the state of the art. When noise is a significant hazard, there is need for a low-noise design. In this case, the methodology for low-noise design given in EN ISO 11688-1:2009 shall be considered.		
4.13.2	<b>Main source of noise</b>		-
	On industrial trucks, the main sources of noise are components, such as the following, in a high-speed operation mode:		-
	— combustion engines, including air intake, cooling fan and exhaust system; — hydraulic pumps/motors.		P
4.13.3	<b>Measures to reduce noise at the operator's position</b>		-
	Typical measures to reduce noise include:		-
	— selection of low-noise components; — use of elastic mountings that prevent the transmission of structure born noise from the components to the structures; — the use of improved noise insulation in the cabin, if fitted. These and other measures of identical or better efficiency may be used.		P
4.13.4	<b>Determination of noise emission values</b>		-
	The value of noise emission shall be measured using the test method given in EN 12053:2001+A1:2008.		P
4.14	<b>Vibration</b>		-
	Whole body vibration shall be measured using the test method given in EN 13059:2002+A1:2008.		P
4.15	<b>Electromagnetic radiation</b>		
4.15.1	<b>Non-ionising radiation</b>		-
	Where trucks are fitted with functional related		P

EN 16307-1:2020			
Items	Requirements	Result-Remark	Verdict
	<p>non-ionising radiation devices, the radiation shall be minimised with consideration to the influence to persons, in particular with active or non-active implantable medical devices.</p> <p>Electromagnetic emission of trucks shall comply with EN 12895:2015+A1:2019, 4.1, 5.1 and 5.2.</p>		
4.15.2	External radiation		-
	Electromagnetic immunity of trucks shall comply with EN 12895:2015+A1:2019, 4.2, 5.1 and 5.3.		P
4.16	Operator restraint system		-
	Whenever the truck is switched-on and in drive mode, a visual warning shall indicate to the operator that the restraint system as required in EN ISO 3691-1:2015, 4.7.8, is not engaged (e.g. seat belt not buckled, door bar or cabin door not closed).		P
	When the restraint device is engaged, the visual warning shall be switched-off.		P
	When the restraint device is not engaged, and the truck speed is greater than 4 km/h an audible warning shall be given to the operator. If it is not possible to determine the speed of the truck, an audible warning shall be given after a reasonable time after switch-on of the truck, latest 30 s after switch-on of the truck or detection of the operator by the operator control (e. g. seat switch) when the restraint device is not engaged.		P
	When the truck is equipped with more than one operator restraint, it is sufficient if one of these devices is engaged.		P
	When the truck is equipped with a driving system that is not able to accelerate the truck to a speed of more than 4 km/h if the restraint system is not engaged, an audible warning is not required.		P
5	Verification of safety requirements and/or protective measures		P

EN 16307-1:2020			
Items	Requirements	Result-Remark	Verdict
6	Information for use		P

Annex : Technical Information

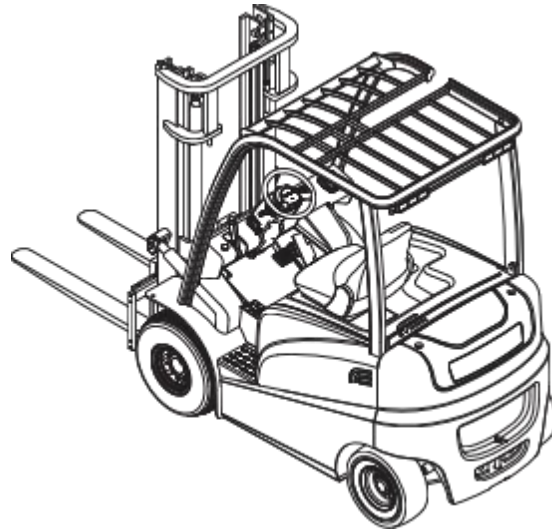
A.1 Instruction manual



(Electric four-wheel Forklift Truck)

CPD10/15/18/20/25/30-A  
CPD10/15/18/20/25/30/35-AC3  
CPD10/15/18/20/25/30/35-AC3F  
CPD10/15/18/20/25/30/35-AC4  
CPD10/15/18/20/25/30/35-AC4F  
CPD10/15/18/20/25/30/35-AD2 CPD25-  
ALC3 CPD25-ALC3F  
CPD25-ALC4 CPD25-ALC4F  
CPD25-ALD2

**OPERATION AND MAINTENANCE MANUAL**



original Instruction

## FOREWORD

Thanks for you purchasing our A series electric four-wheel forklift truck.

A series electric four-wheel forklift truck is our company's new product. It has the character of small turning radius, beautiful shape, small dimensions, low gravity, good stability, superior performance.

This operation manual is the explanations that how to use 1.0t~3.5t A series electric four-wheel forklift truck correctly. It will instruct you how to operate safety and precautionary maintenance. To ensure safety and exert the truck's potential, all the personnel that in charge of operation, maintenance and management must read this manual thoroughly before starting work with the forklift.

As the improvements of products of our company, maybe there are some differs between this operation manual with your forklift truck.

If you have any questions please keep touches with .sales department or let the agents know.

<b>A SeriesS four-wheel forklift truck</b>	<b>Driven controller</b>	<b>pump controller</b>	<b>Rated capacity(t)/ Load center(mm)</b>
CPD10~30-A	Curtis1244	Curtis1253	1.0 / 500, 1.5 / 500, 1.75 / 500 2.0 / 500, 2.5 / 500, 3.0 / 500
CPD10~18-AC3(F)	Curtis 1234	Curtis 1253	1.0 / 500, 1.5 / 500, 1.75 / 500
CPD20~30-AC3(F)	Curtis 1236	Curtis 1253	2.0 / 500, 2.5 / 500, 3.0 / 500
CPD35-AC3(F)	Curtis 1238	Curtis 1253	3.5 / 500
CPD10~18-AC4(F)	Curtis 1234	Curtis 1234	1.0 / 500, 1.5 / 500, 1.75 / 500
CPD20~25-AC4(F)	Curtis 1236	Curtis 1234	2.0 / 500, 2.5 / 500
CPD30-AC4(F)	Curtis 1236	Curtis 1236	3.0 / 500
CPD10~18-AD2	Kollmorgen ACS48S-35P	Kollmorgen ACS48S-23P	1.0 / 500, 1.5 / 500, 1.75 / 500
CPD20~25-AD2	Kollmorgen ACS48M-35P	Kollmorgen ACS48M-23P	2.0 / 500, 2.5 / 500
CPD30~35-AD2	Kollmorgen ACS80M-35P	Kollmorgen ACS80M-23P	3.0 / 500, 3.5 / 500
CPD25-ALC3(F)	Curtis 1236	Curtis 1253	2.5 / 500
CPD25-ALC4(F)	Curtis 1236	Curtis 1236	2.5 / 500
CPD25-ALD2	Kollmorgen ACS80M-35P	Kollmorgen ACS80M-23P	2.5 / 500

## CoNTENT

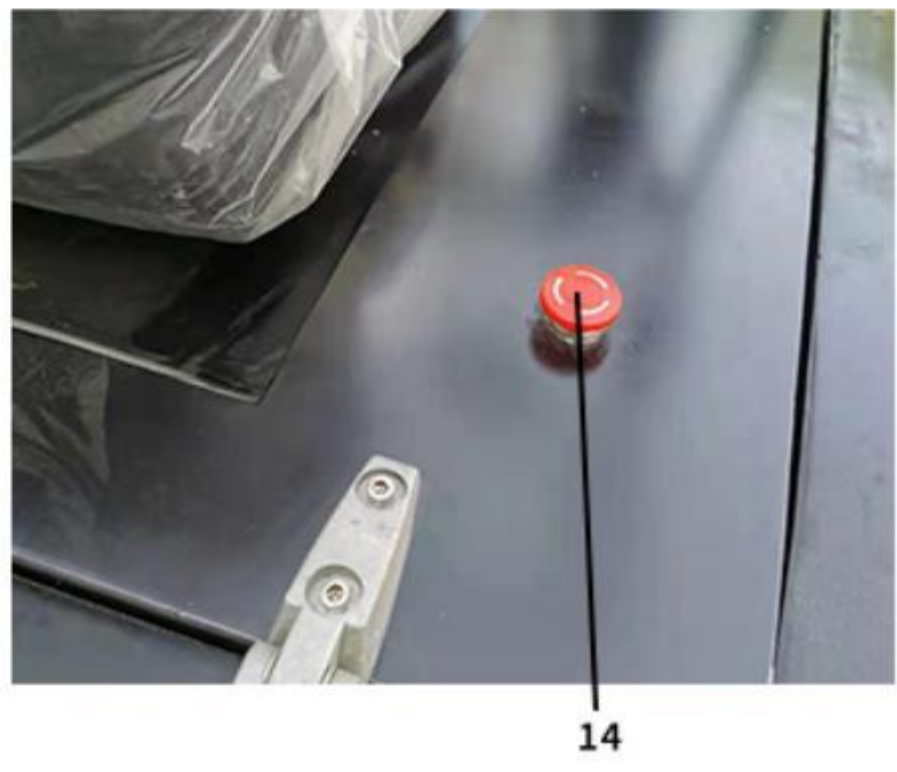
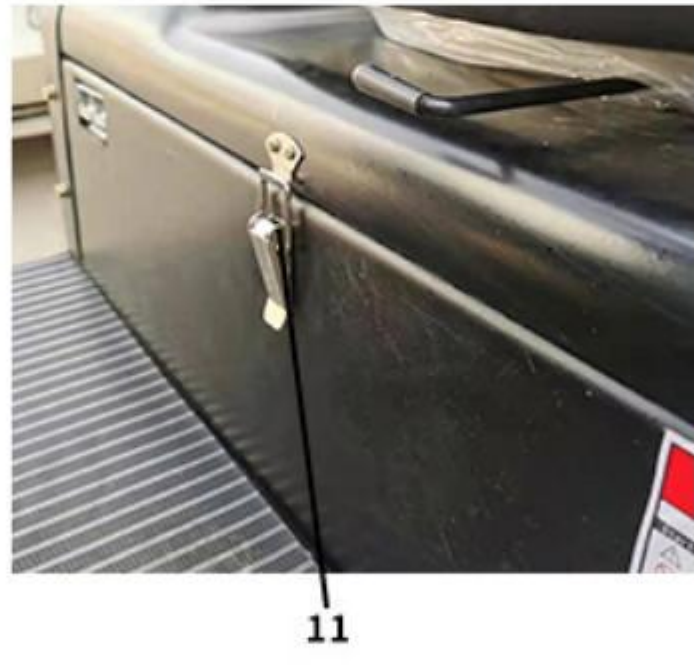
### Foreword

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## 1. Appearance and the main components

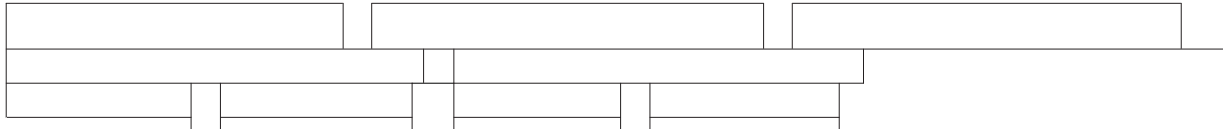
Item	Description
1	Fork
2	Load backrest
3	Mast
4	Rearview mirror
5	overhead guard
6	Driver's seat
7	counterweight cover
8	counterweight
9	Towing pin
10	Rear wheel
11	Battery behind cover hood
12	Front wheel

2. Displays and controls



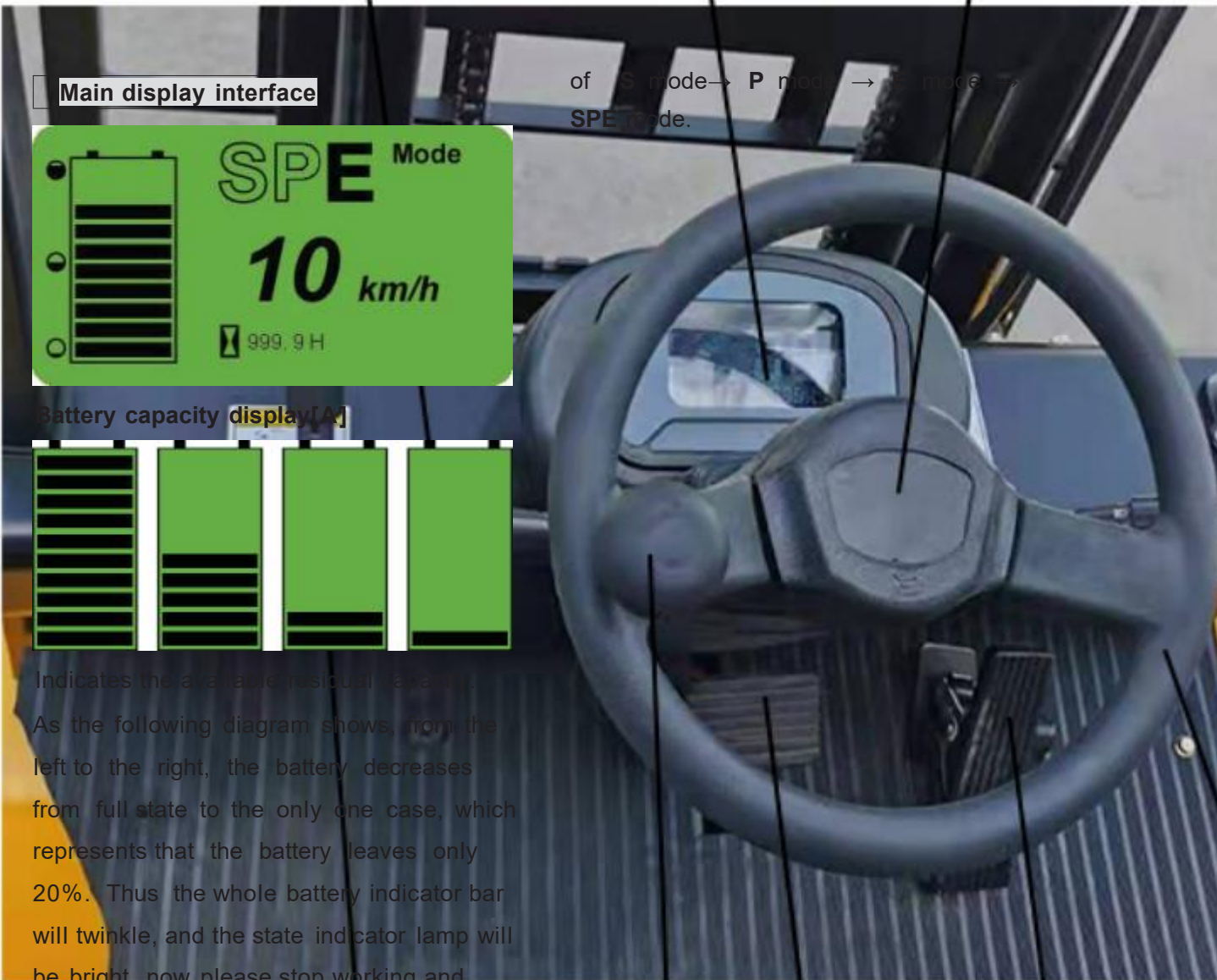
<b>Item</b>	<b>control / Display</b>
13	Travel direction switch
14	Multi-function display
15	Horn
16	combination light switch
17	Lifting lever
18	Tilting lever
19	Emergency disconnect switch
20	parking brake lever
21	warning light switch
22	steering column positioning device
23	Brake pedal
24	Accelerator pedal
25	steering wheel
26	key switch
27	Locker of battery cover hood
28	Locking bolt of battery side plate
29	Air spring
30	Fuse box
31	Fork stopper

## MULTI-fUNCTION display



The multi-function display shows the battery capacity, the service hours, the operating mode, the travel speed and fault code information. Graphic illustrations on the multi-function display act as warning indicators. Through the multi-function display on the right button can also check fault code and parameter setting.

Item	Display
A	Battery capacity display
B	service hours display
C	operating mode display
D	Travel speed or fault code display
F	crawl speed indicator
G	Fault indicator
H	Battery low capacity indicator
I	Lifting low speed indicator
J	seat switch indicator
K	parking brake applied indicator
L	Mode settings or direction choosing button
M	Menu button



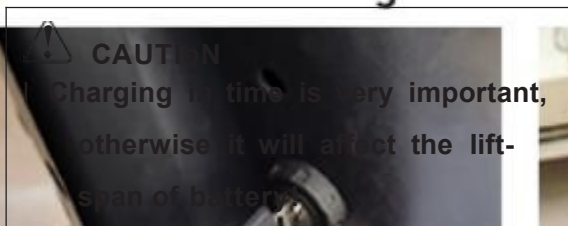
**Main display interface**

of S mode → P mode → R mode → SPE mode.

**Battery capacity display[A]**



Indicates the available residual capacity. As the following diagram shows, from the left to the right, the battery decreases from full state to the only one case, which represents that the battery leaves only 20%. Thus the whole battery indicator bar will twinkle, and the state indicator lamp will be bright, now please stop working and charge immediately.



**Service hours display[B]**

999.9 H

Hourglass icon indicates a timing function. when you turn off the key switch, the hour meter will works and the minimum unit is 0.1 hour.

**operating mode display[C]**



As the diagram shows, the pictures from the left to the right represent the mode




**S mode** is super mode, thus the truck's acceleration, deceleration rate, max climbing gradient and so on is much higher. It is applied for transporting mass of good in short time and climbing big gradient slop , but it costs more energy , so the mode will not be used in normal state except emergency.

**P mode** is power mode. All kinds of index are lower than that of super mode. It is applied for the case of long distance transporting and needing higher power or speed.

**E mode** is economical mode. All the parameters are optimized. working in this mode can save power so it is applied for a long time work after charging, and it is suggested to work in this mode in normal work-time.

**SPE mode** is safe mode. Thus the max vehicle speed is limited to about 7km/h. It is applied for working in busy storage and cabined room.

**SPE mode:** The truck is in safety Mode. In this mode, maximum traveling speed is limited to 7km/h. it is very good for working in a crowd warehouse or other compact space. In this mode, the slow indicator[F]  will be on.



**CAUTION**

**| The default mode is mode E. after power cutting every time, the work mode resets to mode E no matter which mode it is before power cutting, but the switch key is still in the mode before turn off.**

**Travel speed or fault code display[D]**

**Travel speed display**

**10 km/h**

Normal work, display the truck travel speed.

### Fault code display

TRA: 4,7  
HYD: OK

Failure occurs, display the controller's fault code.

**Note:** "TRA" means the traction controller, "HYD" means the pump controller.

### Indicator light



#### crawl speed indicator[F](Green)



when the truck in SPE mode, the crawl speed indicator light up.

#### Fault indicator[G](Red)



The light up when the controller is wrong or operation mistake, and the fault code shows in the main display screen.

#### Battery low capacity indicator[H](Red)



when there is only one line for the power, the indicator will be on to remind the user to charge the battery.

#### Lifting low speed indicator[I](Red)



when there is 10% power, the indicator is on, and the mast lifting speed drops, to remind user to charge the battery as soon as possible.

#### seat switch indicator[J](Red)



when operator leaves the seat, the light will be on, and the truck will be unable to travel

or lift. This function needs the seat to equip with seat

switch (optional).

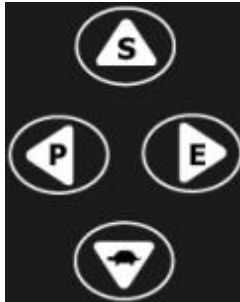
### Parking brake applied indicator[k]







when parking brake applied, the light up.


### Button

### Mode settings or direction choosing button[L]







### Mode settings

In the main display interface, the button  、  
 、  、  , corresponding s mode 、 P  
mode 、 E mode 、 sPE mode.

**For example:** In the main display interface,  
press the button  , the screen shows as  
follows:




### Direction choosing

In the menu interface, the button  、  、  
 、  , corresponding up 、 left 、 right 、 down  
four direction choosing button keys.


### Menu button[M]



(1) In the main display interface, press the

button , and then enter the fault code interface. The fault code shows as follow:



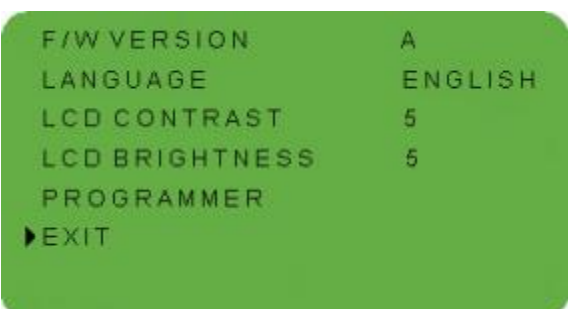
(2) In the main display interface, press the button  over 2 seconds, and then enter the main menu .

The main menu includes: operation menu, advanced settings and exit.



### OPERATION MENU

The operation menu includes : software version information, language settings, LCD contrast settings, LCD brightness settings, programmer settings and exit.




### ADVANCED SETTINGS

This menu needs password.





Through the example below shows how to use the button settings parameter .


**For example:** The language from english switch to chinese.

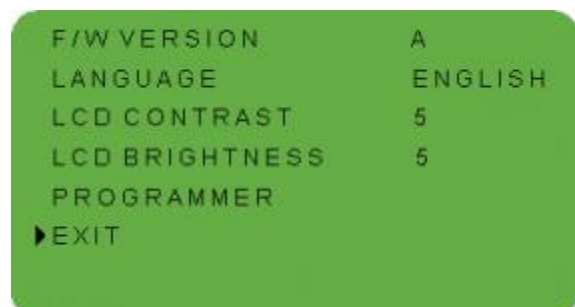
① In the main display interface, press the **menu button** () over 2 seconds, and then enter the main menu .



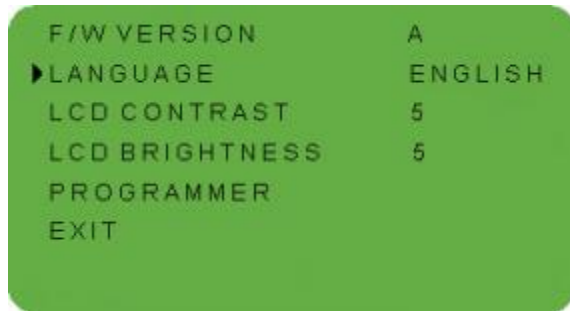
② select the “OPERATION MENU” through **up button** () or **down button** () .



③ Press the **menu button** () , enter the operation menu.



④ select the “LANGUAGE” through up button(▲) or down button(▼) .



⑤ Enter the language setting state through left button(←) or right button(→).



⑥ Through the up button(▲) or down button(▼), select the chinese language.

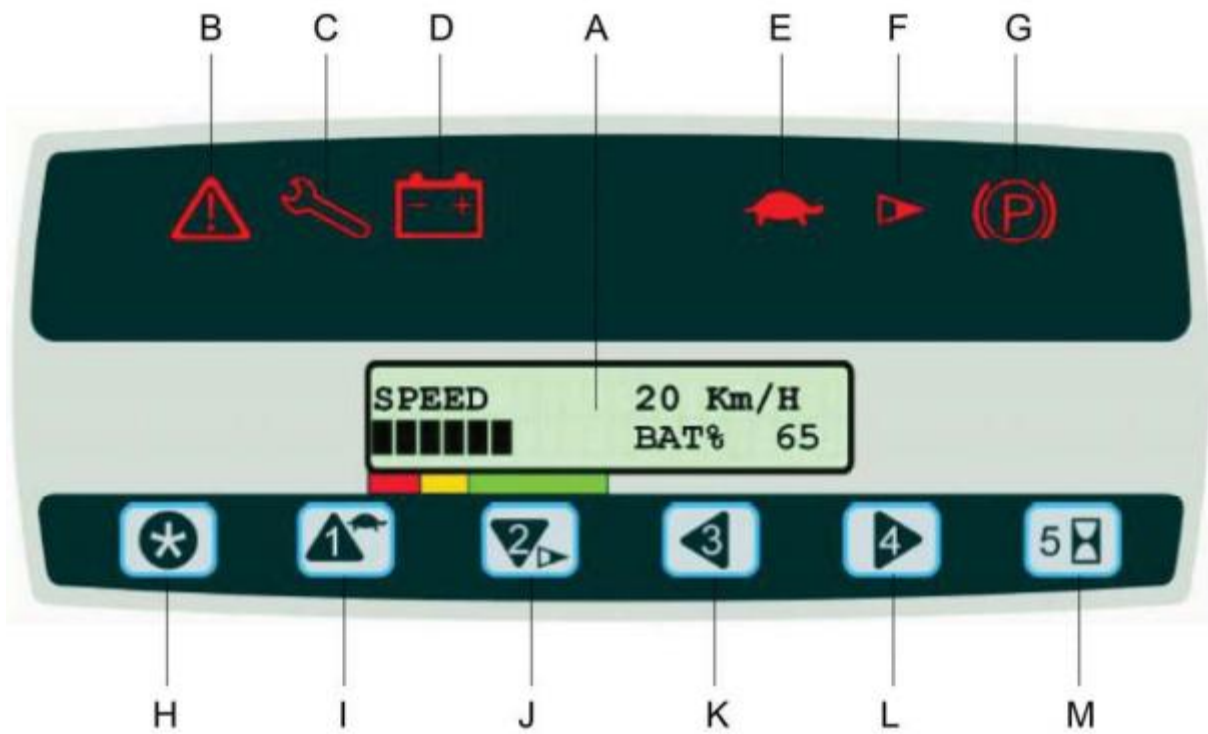


⑦ Refer the steps ⑤ ④ ③ ② ①, return the main display interface.  
The language has been set up .

**Note:** this instrument supports two languages of chinese and English, it will set to your wanted language and if you want to switch the language, please refer to the above example for operation.

CPD10/15/18/20/25/30/35-AD2

CPD25-ALD2



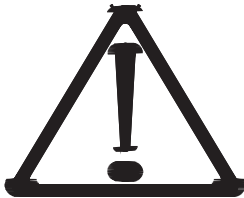
Item	Display
A	Dashboard display LcD
B	communicate indicator
C	Error indicator
D	Low battery warning
E	speed limited indicator
F	Accelerate indicator
G	parking brake indicator
H	Entrance button
I	speed limited button
J	Accelerator limited button
K	Backup button
L	Backup button
M	switch button of hour indication

### Dashboard display LCD [A]



when turn on the key switch, the system will self-diagnose, the lamp will lights on one by one. After self-diagnose, LCD will display truck speed and battery capacity. You can know your truck's working condition through the LCD dashboard.

### communicate indicator [B]



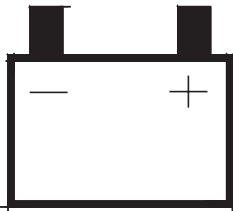
only lights on when record program, usually it is no use.

### Error indicator [c]



when operation is wrong or the truck is in trouble, error code will display on the dashboard. The error indicator lights on.

### Low battery warning [D]



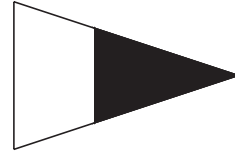
when battery quantity is lower than 20% of maximum capacity, the indicator lights are on, at the same time, buzzer beep. when LED shows no power, please charge battery as

### speed limited indicator [E]



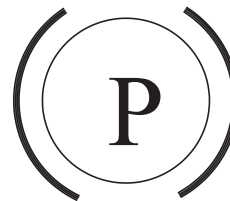
when this lamp lights, it meanings the truck working at low speed mode. The maximum speed of truck decreased. press button 1, you can switch the high speed and low speed mode.

### Accelerate indicator [F]



when this lamp lights on, it means the truck working at low acceleration mode. The maximum acceleration decreased. press button 2, you can switch the high acceleration and low acceleration mode.

### parking brake indicator [G]



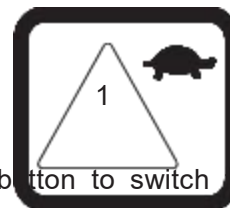
when pulling on the parking brake lever, this lamp lights on.

### Entrance button [H]



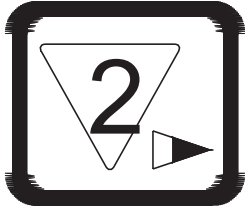
This button is no use for operator.

### speed limited button [I]



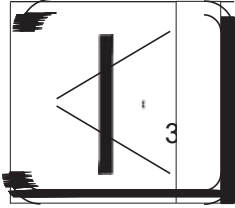
press this button to switch the high speed and low speed.

### Accelerator limited button [J]

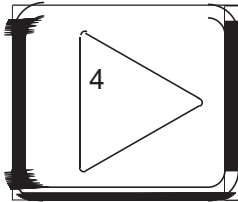


press this button to switch the high acceleration and low acceleration.

**Backup button [k]**



This button is no use for operator. **Backup button [L]**



This button is no use for operator **switch button of hour indication [M]**



push this button, it will display the total hours of truck, as follow figure:



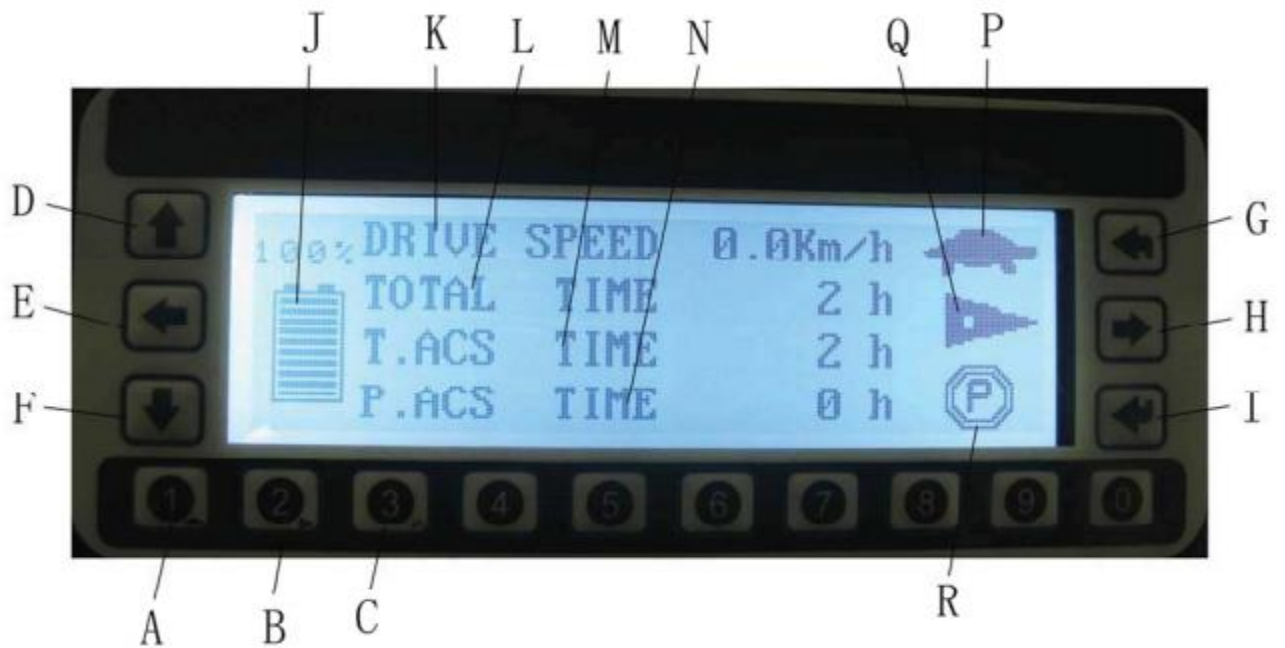
push again, it switch to the total traction hour.



push the button once again, it switch to speed display mode.

CPD10/15/18/20/25/30/35-AD2



CPD25-ALD2






No.	Name/ symbol	No.	Name/ symbol
A	Turtle speed Button	J	Battery Level Display
B	Acceleration Button	K	Traveling speed Display
C	window-switch Button	L	Total time Display
D	Up Button	M	Traction ACs Time Display
E	Left Button	N	pump ACs Time Display
F	Down Button	p	Turtle speed symbol
G	Back Button	Q	HalfAcceleration symbol
H	Right Button	R	parking Brake symbol
I	Confirm Button	Digital Button	Number 0~9

## Up Button [D]




### Turtle speed Button [A]

	
Turtle speed Button	Turtle speed symbol


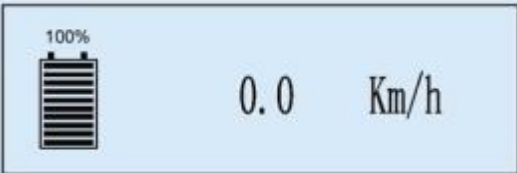
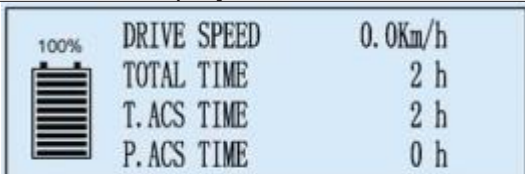
Turtle speed mode can be open and closed by pressing the Turtle speed Button . when open, it is in slow traveling speed and only takes half of the normal traveling speed. Meanwhile the Turtle speed symbol  would appear in the upper right corner of the instrument. when closed, the traveling speed turns back to normal and the window of Turtle speed symbol  would disappear.


### Acceleration Button [B]

	
Acceleration Button	Half Acceleration symbol



Traveling acceleration speed can be switched between the normal speed and slow speed by pressing the Acceleration Button  (Accelerated speed is half of the normal speed). when acceleration speed is in half, Half Acceleration symbol  would appear on the right side of the window. when it's turned back to normal acceleration speed, window of Half Acceleration symbol  would disappear.

### window-switch Button [c]

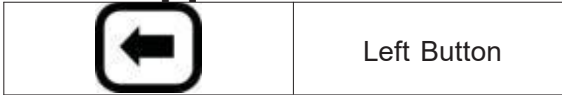
	window-switch Button
	
<p>only traveling speed and battery level can be displayed in this window</p>	
	
<p>Driving status of the forklift is shown in this window.</p>	




It can be switched to the speed and battery level window and forklift driving status window by pressing the window-switch Button .



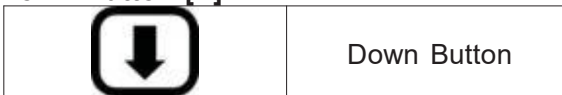
By pressing the Up Button , the cursor can be moved up by one step or the number be added by one. when the cursor reaches on “+” or “-”, the two symbols can be switched by pressing the Up Button .



#### Left Button [E]



The cursor can be moved to left side by pressing the Left Button . If the cursor reaches on the “cancel” button on the parameter modification window, it can be removed to “confirm” button by pressing the Left Button . Meanwhile if the cursor reaches on the “confirm” button, by pressing the Left Button , it can be removed to parameter number at far-right side.


#### Down Button [F]



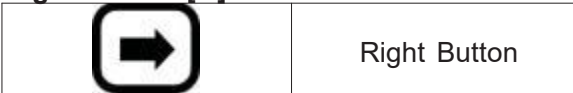
By pressing the Down Button , the cursor can be moved down by one step or the number be decreased by one. when the cursor reaches on “+” or “-”, the two symbols can be switched by pressing Down Button .



#### Back Button [G]



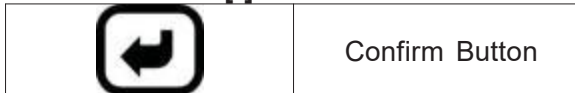
It plays different functions by pressing the Back Button  when in different windows. Basically speaking, it can function as follow, No.1: to have the window turn back the menu interface or back to the home page. No.2: to delete the numbers. No.3: to move the cursor the cancel button.


#### Right Button [H]

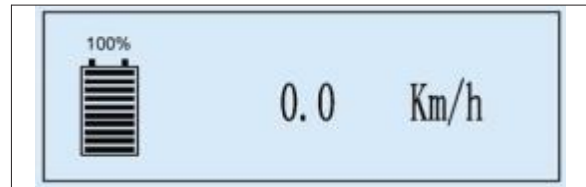


By pressing the Right Button , the cursor can be moved to the right by one step. when the cursor reaches on “confirm” or “cancel” in the parameter modification window, the cursor can be remove to the parameter number at far-left side or “+” or “-” next to the number by pressing the Right Button .

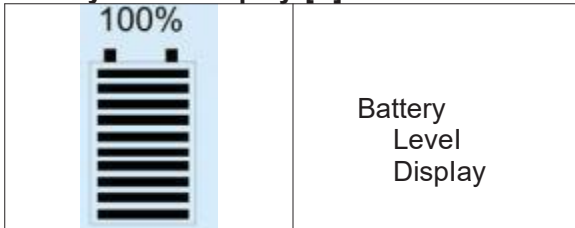
### Confirm Button [I]



It plays different functions by pressing the Confirm Button  when in different windows. Basically speaking, it can function as follow: No.1: to enter the submenu page. No.2: to confirm the modification. No.3: to switch the password entrance window.



### Battery Level Display [J]



This symbol demonstrates the battery level. The more of the lines in the figure, there will be more remaining battery and the higher of the remaining battery percent there will be.

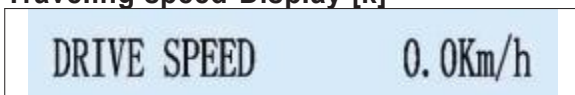
when the remaining battery drops to a certain value, there will be flashing light if the battery percentage drops to 25% which is set as the default values to flash. If it drops to 15%, not only there will be flash, but also with the fault code out of the instrument window and alarm as well. To modify the battery percentage to flash, go to "6.BDI sET" → "6.2 BDI LED %"; To modify the battery percentage to alarm, go to "6.B DI sET" → "6.3 BDI sLOW %".




#### Caution:

- | It's suggested to charge when the remaining battery percent is less than about 30% so as to postpone the life cycle of the battery.
- | To charge the battery monthly for trucks are parking for a prolonged period. Take out the plug when finished.

### Traveling speed Display [k]






Driving speed can be shown when the forklift is running. To take a glance at the driving speed, the window can be switched to the following by pressing the window-switch Button , see the window switch as follow.





**Total time Display[L]、Traction ACs Time Display[M]、pump ACs Time Display[N]**





TOTAL TIME	2 h
T. ACS TIME	2 h
P. ACS TIME	0 h



Total time Display、Traction ACs Time Display and pump ACs Time Display can be shown in the menu interface. Total time Display is used to remind the operator or administrator to inspect and maintain the forklift timely.

**Turtle speed symbol[p]、Half Acceleration symbol[Q]、parking Brake symbol [R]**

	Turtle speed symbol
	HalfAcceleration symbol
	parking Brake symbol



By pressing the Turtle speed Button  , the forklift drives in a slowing speed and meanwhile the Turtle speed symbol  would appear in the window. If the Turtle speed Button  is pressed again, the window of Turtle speed symbol  would disappear and the traveling speed turns to the normal.

By pressing the Acceleration Button  , the acceleration speed is decreased to a half and the Half Acceleration symbol  would appear in the window. If the Acceleration Button  is pressed again, the window of Half Acceleration symbol  would disappear and the traveling speed turns to the normal.

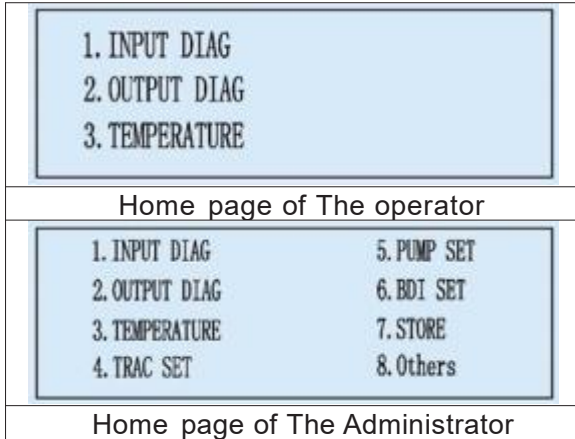
If parking Brake symbol  appears on the window, it means the forklift is in a parking brake status. To press the hand braking button and pull the brake forward, if the parking Brake symbol  disappears in the window, it can be safely concluded that the parking brake is released.

**Digital Button 0 to 9**



Type the right number, Digital Button 0 to 9, in the password entry window or password modification window. Type the wanted number to the parameter on the parameter modification window. For instance, in the following two windows, by removing the cursor to the Up Button  or Down Button  or typing the corresponding number, to select the

wanted items, both can function well.



**system password**

Turn the key and start the instrument. Enter the system password window. The initial password is 00000.



**Caution:**

- If the three wheel counterweight truck is equipped with turning sensor, press button in the home page, the window can be switched to turning sensor display.
- If the window shows up fault code when the truck is started, do not operate the truck until the fault is corrected. If window shows up the fault code when in the process of operation, stop the truck immediately and correct the fault before restart the truck. It's prohibited to operate a truck with faults.

**steps to view the parameter of the forklift— for operator**

1. open the password entry window by pressing the confirm Button , see the figure below.



button and pressing the confirm Button , the operator can leave the password entry window. By pressing the Back Button twice, it's also useful to leave the window.

**Caution:**

- The original password is 99966. To reset the password, the operator needs to enter the administrator home page→8. others→8.1 set operater password.
- To view the forklift parameter is allowed in the operator home page but it's forbidden to modify the parameter.

2. The operator can log in the operator home page window through typing the password by pressing the digital numbers 0 to 9, see as follow.



3. The operator can remove the cursor to the target items by pressing the Up Button or Down Button . It is also accessible to remove the cursor to the target items by typing the corresponding number and pressing the confirm Button to enter the submenu interface. operator is only allowed to view the parameter and he is not authorized to modify the parameter. Here below can manifest the windows of input diag., output diag. and temperature. The parameter of the above windows varies from other each as the configuration and the use of the truck differs.



**Input Diag. submenu Interface window**

1. To remove the cursor to "INpUT DIAG".



2. Enter the Input Diag. submenu Interface window by pressing the confirm Button . windows can be switched directly by pressing the Up Button or Down Button .



By pressing the Left Button  or  
Right Button , removing the cursor to the  
“cancel”

1.5 PARKING SWITCH	1	↑
1.6 PUMP SWITCH 1	0	
1.7 PUMP SWITCH 2	0	
1.8 PUMP SWITCH 3	0	↓


  

1.9 PUMP SWITCH 4	0	↑
1.10 ACCEL SWITCH	1	
1.11 ACCELERATION	222	
1.12 PUMP POT	385	

### output Diag. submenu Interface window

1. To remove the cursor to "OUTPUT DIAG".

1. INPUT DIAG
<b>2. OUTPUT DIAG</b>
3. TEMPERATURE


2. Enter the output Diag. submenu Interface window by pressing the confirm Button .

2.1 MAIN CONTACTOR	1
--------------------	---

### Temperature Diag. submenu Interface window


1. To remove the cursor to "TEMPERATURE".

1. INPUT DIAG
2. OUTPUT DIAG
<b>3. TEMPERATURE</b>





2. Enter the Temperature Diag. submenu Interface window by pressing the confirm Button .

3.1 TRACT MOTOR TEMP	29
3.2 PUMP MOTOR TEMP	0
3.3 TRACT ACS TEMP	28
3.4 PUMP ACS TEMP	0

### steps to view the parameter of the forklift— for Administrator




1. open the password entry window by pressing the confirm Button , the initial password for the administrator is 55577. see as follow.

PLEASE ENTER PASSWORD	
*****	
[CONFIRM]	[CANCLE]

By pressing the Left Button  or Right Button , removing the cursor to the "cancel" button and pressing the confirm Button , the administrator can leave the password entry window. By pressing the Back Button  twice, it's also useful to leave the window.

2. The administrator can log in the administrator home page window through typing the password by pressing the digital numbers 0 to 9. see as follow.




1. INPUT DIAG	5. PUMP SET
2. OUTPUT DIAG	6. BDI SET
3. TEMPERATURE	7. STORE
4. TRAC SET	8. Others

3. The administrator can remove the cursor to the target items by pressing the Up Button  or Down Button . It is also accessible to remove the cursor to the target items by typing the corresponding number and pressing the confirm Button  to enter the submenu interface. The administrator is not only allowed to view the parameter but also permitted to modify the parameter on the basis that the he can assure the modified parameter is accurate. Generally, it is not permitted to modify the parameter. Here below can manifest the eight submenu interface windows. The parameter of the above windows varies from other each as the configuration and the use of the truck differs.

### 1. Input Diag. submenu Interface window

1) To remove the cursor to "INPUT DIAG".

<b>1. INPUT DIAG</b>	5. PUMP SET
2. OUTPUT DIAG	6. BDI SET
3. TEMPERATURE	7. STORE
4. TRAC SET	8. Others

2) Enter the Input Diag. submenu Interface window by pressing the confirm Button . windows can be switched directly by pressing the Up Button  or Down Button .

1.1 SEAT SWITCH	1
1.2 FORWARD SWITCH	0
1.3 REVERSE SWITCH	0
1.4 PEDAL SWITCH	0 ↓


1.5 PARKING SWITCH	1	↑
1.6 PUMP SWITCH 1	0	
1.7 PUMP SWITCH 2	0	
1.8 PUMP SWITCH 3	0	↓

1.9 PUMP SWITCH 4	0	↑
1.10 ACCEL SWITCH	1	
1.11 ACCELERATION	222	
1.12 PUMP POT	385	

## 2. output Diag. submenu Interface window

1) To remove the cursor to "OUTPUT DIAG".

1. INPUT DIAG	5. PUMP SET
<b>2. OUTPUT DIAG</b>	6. BDI SET
3. TEMPERATURE	7. STORE
4. TRAC SET	8. Others


2) Enter the Output Diag. Submenu Interface window by pressing the confirm Button .

2.1 MAIN CONTACTOR	1
--------------------	---

## 3. Temperature Diag. submenu Interface window

1) To remove the cursor to "TEMPERATURE".

1. INPUT DIAG	5. PUMP SET
2. OUTPUT DIAG	6. BDI SET
<b>3. TEMPERATURE</b>	7. STORE
4. TRAC SET	8. Others


2) Enter the Temperature Diag. Submenu Interface window by pressing the confirm Button .



3.1 TRACT MOTOR TEMP	29
3.2 PUMP MOTOR TEMP	0
3.3 TRACT ACS TEMP	28
3.4 PUMP ACS TEMP	0

## 4. Traction set submenu Interface window

1) To remove the cursor to "TRAc SET".

1. INPUT DIAG	5. PUMP SET
2. OUTPUT DIAG	6. BDI SET
3. TEMPERATURE	7. STORE
<b>4. TRAC SET</b>	8. Others

2) Enter the Traction Set Submenu Interface window by pressing the confirm Button .

The cursor can be moved to up and down line by line by pressing the Up Button  or Down Button .

4.1 T. MAX SPEED	3300	
4.2 T. MAX ACCEL	15	
4.3 T. NEUTRAL BRAKE	20	
4.4 T. REVERSE BRAKE	30	↓

4.5 T. PEDAL BRAKE	20	↑
4.6 T. TURTLE VALUE	1900	
4.7 T. POWER VALUE	5	
4.8 T. SPEED PRECISION	0	↓




when "4.8 T.SPEED PRECISION" value is 1, the speed display is accurate to one decimal place. when "4.8 T.SPEED PRECISION"

value is 0, the speed display is accurate to integer value.

## 5. pump set submenu Interface window

1) To remove the cursor to "PUMP SET".

1. INPUT DIAG	<b>5. PUMP SET</b>
2. OUTPUT DIAG	6. BDI SET
3. TEMPERATURE	7. STORE
4. TRAC SET	8. Others

2) Enter the Pump Set Submenu Interface window by pressing the confirm Button . The cursor can be moved to up and down line by line by pressing the Up Button  or Down Button .


5.1 P. MAX SPEED	3500	
5.2 P. LIFT ACCEL	50	
5.3 P. LIFT SPEED	3300	
5.4 P. CREEP SPEED	400	↓

5.5 P. MOTOR SPEED 1	500	↑
5.6 P. MOTOR SPEED 2	1500	
5.7 P. MOTOR SPEED 3	1500	
5.8 P. MOTOR SPEED 4	1300	

## 6. BDI set submenu Interface window

1) To remove the cursor to "BDI SET".

1. INPUT DIAG	5. PUMP SET
2. OUTPUT DIAG	<b>6. BDI SET</b>
3. TEMPERATURE	7. STORE
4. TRAC SET	8. Others


2) Enter the BDI Set Submenu Interface window by pressing the confirm Button .

6.1 MIN VOLT SETTING	5
6.2 BDI LED %	25
6.3 BDI SLOW %	15

### 7. store submenu Interface window

1) To remove the cursor to "STORE".

1. INPUT DIAG	5. PUMP SET
2. OUTPUT DIAG	6. BDI SET
3. TEMPERATURE	7. STORE
4. TRAC SET	8. Others




2) Enter the Store Submenu Interface Window by pressing the confirm Button .

7.1 STORE PARAMETERS	0
7.2 RESTORE	0

### 8. others submenu Interface window

1) To remove the cursor to "Others".

1. INPUT DIAG	5. PUMP SET
2. OUTPUT DIAG	6. BDI SET
3. TEMPERATURE	7. STORE
4. TRAC SET	8. Others

2) Enter the Others Submenu Interface Window by pressing the confirm Button . The cursor can be moved to up and down line by line by pressing the Up Button  or Down Button .

8.1 SET OPERATER PASSWORD
8.2 SET ADMIN PASSWORD
8.3 SET STARTUP PASSWORD
8.4 LANGUAGES SETTING

#### steps to set the password

1. Remove the cursor to the line of "SET OPERATER PASSWORD", "SET ADMIN PASSWORD" or "SET STARTUP PASSWORD" when the password needs to be revised.

8.1 SET OPERATER PASSWORD
8.2 SET ADMIN PASSWORD
8.3 SET STARTUP PASSWORD
8.4 LANGUAGES SETTING


Remove the cursor to this line when operator password needs to be revised.

8.1 SET OPERATER PASSWORD
8.2 SET ADMIN PASSWORD
8.3 SET STARTUP PASSWORD
8.4 LANGUAGES SETTING




Remove the cursor to this line when administrator password needs to be revised.

8.1 SET OPERATER PASSWORD
8.2 SET ADMIN PASSWORD
8.3 SET STARTUP PASSWORD
8.4 LANGUAGES SETTING


Remove the cursor to this line when startup password needs to be revised.





2. Enter the submenu interface window of "SET OPERATER PASSWORD", "SET ADMIN PASSWORD" or "SET STARTUP PASSWORD" by pressing the confirm Button .


PLEASE ENTER OLD PASSWORD
*****
[CONFIRM] [CANCLE]

3. Enter the old password by pressing the Left Button  or Right Button  and remove the cursor to "cONFIRM" and pressing the confirm Button . A new window would pop up to request the new password. See as follow.

PLEASE ENTER NEW PASSWORD
*****
[CONFIRM] [CANCLE]


If new password happens to enter incorrectly during the process of entering the new password, the incorrect password can be deleted one by one by pressing the Back Button .

There are two ways to leave the password window. The first one is to delete the password one by one by pressing the Back Button  and press it double times at last. The second one is to remove the cursor to "cANcLE" by pressing the Left Button  or Right Button  and then press the confirm Button .

4. After entering the new password, remove the cursor to "cONFIRM" and press the confirm Button . Enter the password again.

## steps to modify the parameter for administrator



5. After entering the password again, remove the cursor to "cONFIRM" and press the confirm Button . window shows the new password is set successfully and it will return to the last interface window.




### caution

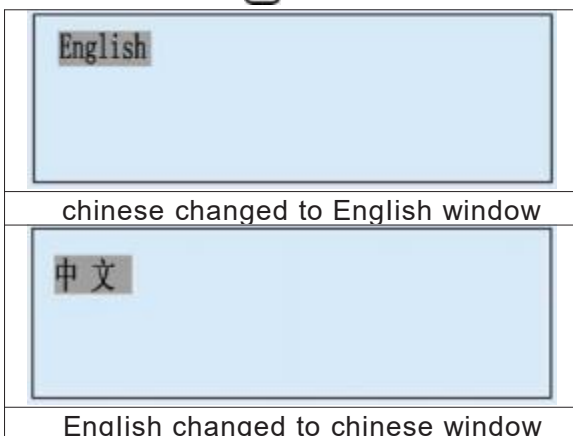
1 The password is composed of 5 digital numbers. The passwords of operator, administrator or startup the system should be remembered. The administrator password should be kept safely and it's prohibited to expose to others.



## steps to set languages for administrator

1. Remove the cursor to the line of "LANGUAGES SETTING".



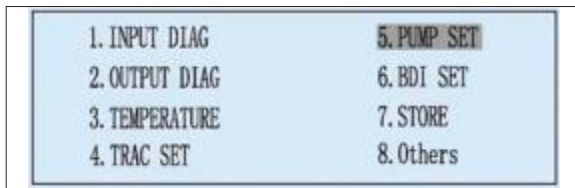
2. Enter the submenu interface window of "LANGUAGES SETTING" by pressing the confirm Button .



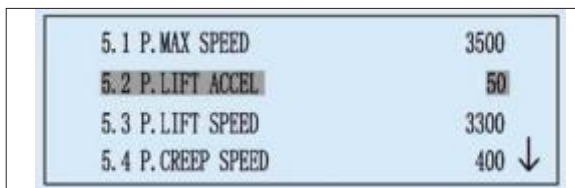
3. when the cursor reaches on "English", language will be turn to English by pressing the confirm Button . when the cursor reaches on "chinese", language will be turn to chinese by pressing the confirm Button .

The interface window of traction set, pump set, BDI set, store and others in the administrator home page can be revised. we will take the modification of “PUMP SET” → “P. LIFT AccEL” as an example. Other parameter modification should be similar to this one.

1. Remove the cursor to the line of “PUMP SET”.



2. Enter the Pump Set submenu interface window by pressing the confirm Button . Remove the cursor to “P. LIFT AccEL” by pressing the Up Button or Down Button .

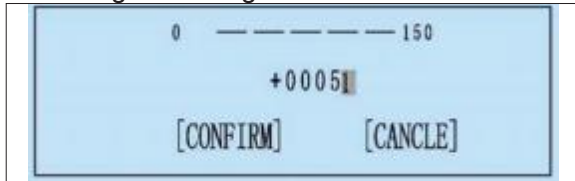


3. Enter the parameter modification window by pressing the confirm Button .



4. Modify the parameter.



when the cursor reaches on the digital number, the number can be added or decreased by pressing the Up Button or Down Button . It's also accessible to type the number directly according to the digital button 0 to 9.

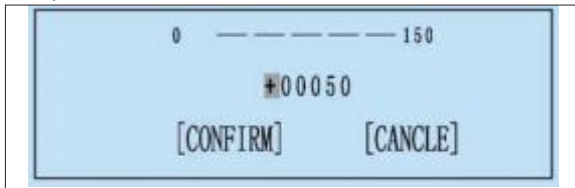




when the cursor does not point to the parameter which needs to be modified, it is necessary to press the Left Button or Right Button and remove the cursor to the position where needs modification.

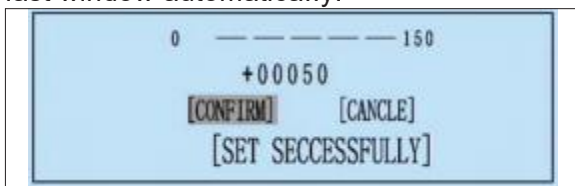




If the parameter of “+” or “-” needs to be modified, remove the cursor to the far left of




the parameter and press the Up Button  or Down Button . It can be used to switch “+” / “-”.





when the parameter is modified correctly, press the Confirm Button  and remove the cursor to “CONFIRM” and press the Confirm Button . The window will show “SET SECCUSSFULLY” and return to the last window automatically.



when the cursor reaches on “CONFIRM”, remove it up to the parameter line and press the Right Button , the cursor would moves to the “+” or “-” or the parameter number at far left side. By pressing the Left Button , the cursor can remove to the parameter number at far right side.

when the cursor reaches on “CANCEL”, there are two ways to remove it to the parameter line. The first one is to press the Left Button , remove the cursor to “CONFIRM” and press the Left Button  again and then remove the cursor to the parameter line. The second way is to press the Right Button  and remove the cursor to the “+”/“-” at the parameter line or remove the cursor to the position at far left side.

when need to cancel the password setting and leave the window, press the Back Button , remove the cursor to “CANCEL” and press the Confirm Button , the window has returned to the last menu interface window.

**⚠ Caution:**

- | To revise the parameter calls for prudence.
- | The revised parameter can only be effective when the truck is power on. If the parameter is revised when the truck is power off, the effective parameter restored to the original one when truck is restarted.
- | The revised parameter is still effective when truck is power off and restarted


as long as the parameter is saved in the parameter store controller.

#### 5. Parameter Store Controller


Only the parameter is stored in the controller that the parameter can be effective when the truck is power off and restarted.

1) Remove the cursor to the line of "STORE".


1. INPUT DIAG	5. PUMP SET
2. OUTPUT DIAG	6. BDI SET
3. TEMPERATURE	7. STORE
4. TRAC SET	8. Others

2) Enter the submenu interface window of "STORE" by pressing the Confirm Button . Remove the cursor to the line of "STORE PARAMETERS"

7.1 STORE PARAMETERS	0
7.2 RESTORE	0

3) Enter the interface window of parameter modification by pressing the Confirm Button .

0	-----	1
+00000		
[CONFIRM]		[CANCLE]


4) Modify the parameter to "1" and remove the cursor to the line of "CONFIRM" and press the Confirm Button .

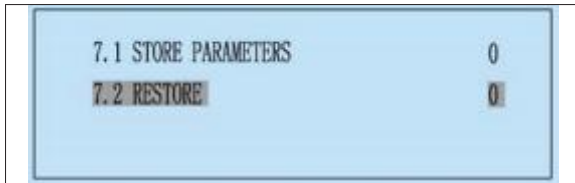
0	-----	1
+00001		
[CONFIRM]		[CANCLE]


#### Restore Factory setting

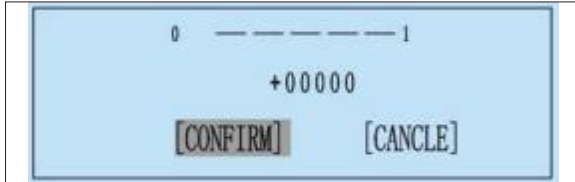
1. Remove the cursor to the line of "RESTORE".


1. INPUT DIAG	5. PUMP SET
2. OUTPUT DIAG	6. BDI SET
3. TEMPERATURE	7. STORE
4. TRAC SET	8. Others

2. Enter the submenu interface window of "STORE" by pressing the Confirm Button . Remove the cursor to the line of "RESTORE".



3. Enter the interface window of parameter modification by pressing the Confirm Button .

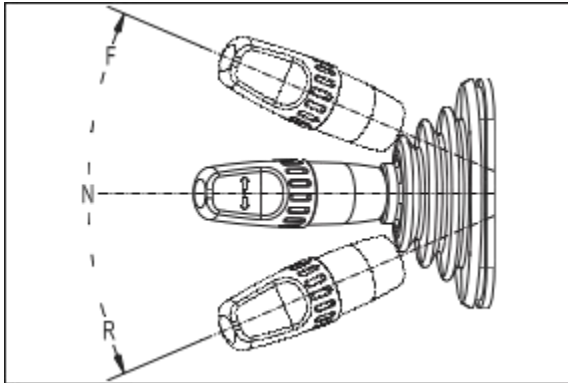


4. Modify the parameter to "1" and remove the cursor to the line of "CONFIRM" and press the Confirm Button . If "SET SECCUSSFULLY" shows in the window, the factory settings are well restored.



## Controls

### Travel direction switch [13]



sets the required travel direction.

The travel direction switch is used for switching between forward and backward moves. when the travel direction switch is pushed forward and accelerator pedal pressed, the forklift trucks moved forward. when the travel direction switch is pushed backward, the forklift trucks moved backward.



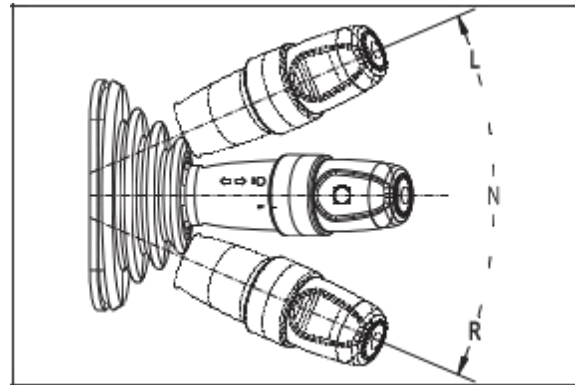
#### CAUTION

While traveling, if change the travel direction switch, electric braking will operate, speed will lower until stop, then travel to the opposite direction.



#### WARNING

Turning the key switch “on” does not make the forklift truck move, if the travel direction switch is not in the neutral position or the accelerator pedal is being pressed. In this case, the travel direction switch should be returned to neutral and move you foot from the accelerator pedal. Then the truck can be



control the turn signal lights, headlights and front small lights working condition.

This combined light switch is composed of turning light switch and big/small lamp switch. Turning light indicates the traveling direction. when turn on the switch, the lamp flashes.

The light switch has two shifts. First shift small lights on; second shift headlights and small lights both up.

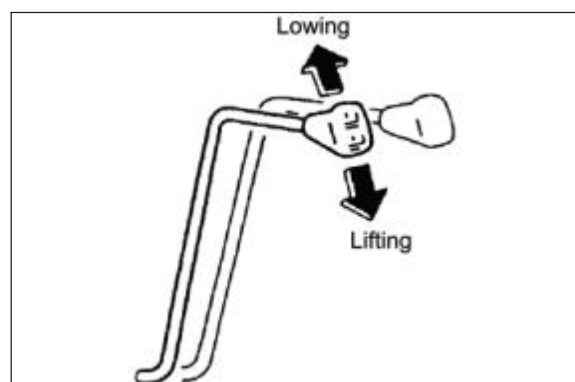
Forward	Left turning lamp flashes
Neutral	Lamp goes off
Backward	Right turning lamp flashes



#### CAUTION

- The turn signal switch does not automatically return to the neutral position. Reset it by your hand.

### Lifting lever [17]



Lifts / lowers the forks.

The forks can be raised or fell by pulling backwards or pushing the lever. Lifting speed

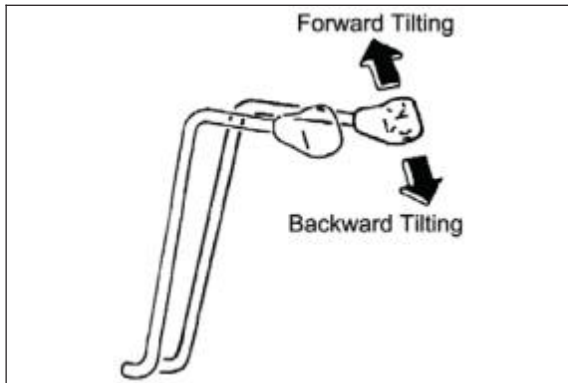
**operated.**

**Combined light switch [16]**

can be controlled by tilt backwards angle of lever and the lowering speed can be controlled by tilt forwards angle of the lever.

secures the truck when stationary.

### Tilting lever [18]



Tilts the forks forward / backward.

The forks can be tilted by operation of this tilt lever. Pulling on this lever backwards will tilt the forks backwards, and pushing it forwards will tilt the forks forwards. The tilt speed can be controlled by tilt angle of the lever.



#### **CAUTION**

**| The tilt lock mechanism built in the hydraulic control valve does not allow the mast to tilt forwards while the electricity is being shut down even if the tilt lever is pushed forwards.**

### Emergency disconnect switch [19]

switches power supply on and off.

when happen emergency, presses down the emergency disconnect switch, and then the main power of the truck will be cut off, the truck stops working.



#### **CAUTION**

**| Please don't use the emergency disconnect switch to substitute the function of key switch.**

### Parking brake lever [20]

use this parking brake lever to park the lift truck. And the parking brakes are applied on the front two wheels by pulling up on this lever. To release the parking brakes, move the lever forwards.

There is a micro switch at the left side of the parking brake lever, tense the lever makes running invalid.

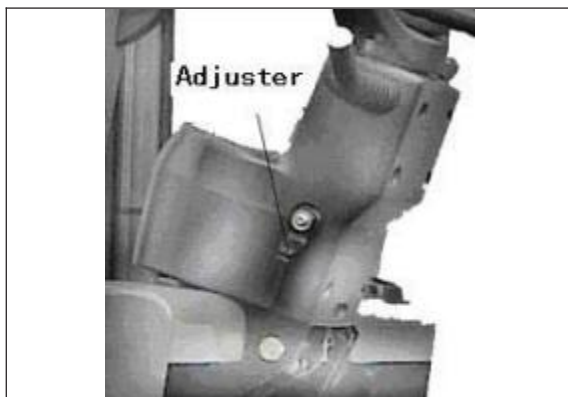
For the truck of CE: if you leave the seat without tensing the lever, it will warn and remind you to tense the lever.



**WARNING**

**| If parking on a grade is unavoidable, be sure to block the wheel.**

**steering column positioning device [22]**



Adjusts and fixes the steering column to the required distance.

The tilting angle of the steering column is adjustable to suit individual operators. Turn the hand lever upward to release the steering column and locked by turning it downward.

**Brake pedal [23]**

Decelerates the truck.

Press this pedal to slow or stop the truck. At the same time, the brake light comes on.



**CAUTION**

**| No permitted to press the brake pedal and the accelerator pedal at same time, otherwise, it is harmful**

**to the traveling motor.**

#### **Accelerator pedal [24]**

provides infinitely variable control travel speed.

As the accelerator pedal is slowly pressed, the drive motor start turning and the forklift truck will start to move. According to the force applied to the pedal, the speed is adjusted with not steps.



#### **CAUTION**

**| Loosen the accelerator pedal when truck is working, truck can make soft brake.**



#### **WARNING**

**| Before open the key switch to press the accelerator pedal, the more function digital indicator shall show alarm information. Then you must release the accelerator pedal.**



#### **WARNING**

**| This truck is provided with the power steering, so heavy hand-wheel operation is caused when the steering motor comes to a stall. To put the power steering in operation again, restart the steering**

#### **steering wheel [25]**

It's can control the forklift steering.

The steering hand-wheel is operated in the conventional manner, that is, when the wheel is turn right, the truck will turn to the right; when the wheel is turn left, the truck will turn to the left. The steer wheels are located at the rear of the truck. These cause the rear of the truck to swing out when a turn is made.

**motor without delay.**

### **key switch [26]**

switches control current on and off. Removing the key prevents the truck from being switched on by unauthorised personnel.

The key switch has two “on/ off” position, you should push the Direction switch lever to neutral and loose the accelerator pedal, then turning the key switch to “on” position clockwise.



#### **CAUTION**

- | **Turning the key switch “on” does not make the forklift truck move, if the Direction switch lever is not in the neutral position or the accelerator pedal is pushing.**
- | **Error code maybe appear, don't worry about it.**
- | **The Direction switch lever should be returned to neutral and move you foot from the accelerator pedal. Then the truck can be operated.**
- | **Then the error code should be disappeared.**

### **Locker of battery cover hood [27]**

Fixed the battery cover.

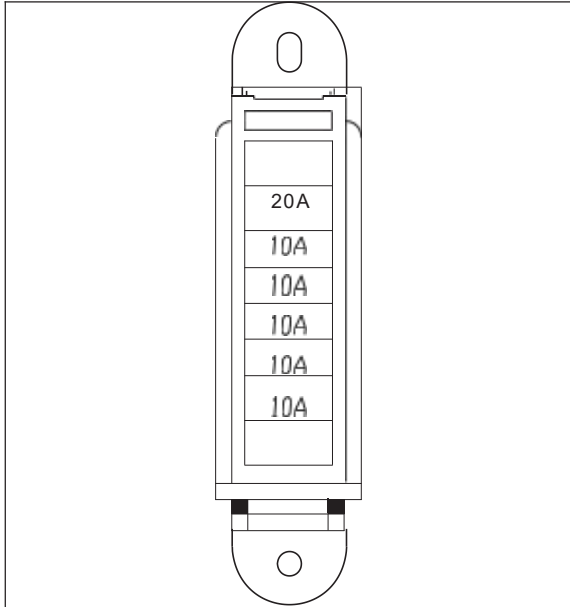
### **Locking bolt of battery side plate [28]**

Locking the side plates on both of the battery box.

### **Air spring of battery cover [29]**

when the battery cover hood opened, to support the cover hood. when closed the cover hood, press the red button, at the same time hard to press the cover hood.

### **Fuse box [30]**



beam. It is used to attach goods.

- | It is forbidden to lock the fork on the gap position, to prevent the fork fall off from the gap.
- | In the middle of the above beam, a bolt used to prevent fork works here. Please change the bolt as soon as it is damaged.

**CAUTION**

- | When replace a new fuse, please choose the same capacity fuse of the old one.

**Change fork**

Take down the old fork: FirstLY, locate the fork to the middle, decline it to the ground and make the mast forward, then operate the truck traveling backward, the fork will be taken down.

change new fork: FirstLY, make the fork dead against the truck and forklift's mast to the bottom, then operate the truck traveling forward, aim at the two gaps and beams, and raise the mast. Adjust the position of the fork.

**Fork stopper [31]**



**Battery cover hood**

The cover hood can be swung up fully to provide easY examining and maintenance of the storage batteries.

You can lift up the cover hood with little effort with an aid of cover hood damper. To lock the cover hood, push down on the front of cover hood until it covered.

Fork stoppers are locked the forks in position. To adjust fork spacing, pull up fork stoppers, turn 90 ° and shift the forks to the desired position. The fork spacing should be adjusting according to loads to be handled.

**CAUTION**

- | Be careful do not to catch you fingers in the cover hood when closing it.
- | Depress the spring insurance before you close the cover hood, then press the head of the cover hood.

**WARNING**

- | The forks should be set symmetrically to machine centerline and fork stoppers should always be locked again.
- | There are one gap on the below

**overhead guard**

The overhead guard used is strong enough to

meet safety standard, and protects the operator from falling materials. The top gap is used to lift the batteries. It is forbidden for use a truck that does not with safeguard.

### **L.H. & R.H. battery side plate**

The battery is covered hood, one left and one right. when you want to take off the hood, you should take off the locking bolts at first.

### **safety step and safety grip**

The safely steps are provided on both side of the truck body. The safely grip is provided on the front left pillar of the overhead guard. use the safely step and safely grip when mounting and dismounting the truck.

### **Brake fluid reservoir cup**

The brake fluid reservoir cup is located at the meter board.



#### **CAUTION**

**| The brake fluid is poisonous, be careful do not drop down. when add brake fluid, be careful do not let dirt and other thing drop into reservoir cup.**

### **Hydraulic oil reservoir cap**

The hydraulic oil reservoir cap is located at the right rear end, below the battery hood; open the right side battery hood when adding oil. After fill in clean hydraulic fluid, tighten lock the cap.

### **Air leakage plug**

There is an air leakage plug on the oil tank to let air in the tank goes out. You'd better often check the plug and see whether been jammed.

### **Head lights and combination lights**

Two headlights and combination lights (turn signal, show width lamp) are installed at the front side of the truck. Take care of the lights, and wipe dirt, if any, and replace any damaged

light immediately.

### Rear combination lights

The combination lights at the rear side serve as turn signal, show width lamp, brake lamp, and back-up lamp. pay attention to keep them from being damaged or covered with dust, if any, clean or replace immediately.

### Rear big lamp [For CE or option]

The rear big lamp is set on the safeguard. If it is broken, please replace a new one at once.

### Rear big lamp switch [optional]

Rear big lamp switch (push\pull) has only one shift.

x—Means connected

connecto r position	Battery	Far light
0	x	
1	x	x



#### CAUTION

**| This light does not relate to key switch position, so please don't forget to turn off the rear big lamp when you leave the truck.**

## seat

Desigend maximum comfort, this seat can be adjusted as follows.



### Adjusting the seat to the driver's weight:

To achieve optimal seat cushioning the driver's seat must be adapted to the driver's weight.

- sit on the driver's seat. when the correct weight adjustment has been made, the weight adjustment lever should be aimed at the driver's weight. If the weight adjustment lever ① is facing too far to the left or right, the seat must be adjusted to the driver's weight.
- To set the seat to a lesser weight, push the weight adjustment lever ① left.
- To set the seat to a greater weight, push the weight adjustment lever ① right. **To adjust the seat position:**

- Pull up the longitudinal adjuster ② and push the driver's seat forwards or backwards to the desired position.
- Engage the longitudinal adjuster ② in position again.

### **⚠ WARNING**

**| The longitudinal adjuster must be securely located in the desired position.  
The driver's seat setting must not be changed during travel.**

### To adjust the backrest:

- sit on the driver's seat.
- Press down the backrest adjustment button ③ and adjust the backrest tilt.
- Release the backrest adjustment button ③ to lock the backrest in position.

## **safe belt**

put on the seat belt④ each time before starting the truck. The belt protects against serious injury. protect the belt from contamination and clean it regularly.

### **correct use the safe belt:**

- sit correctly on the seat.
- check that seat belt is not twisted.
- place the seat belt at hip level.
- Attach the seat belt and check that it locks.
- Adjust the seat belt to your body shape without squeezing your hip and without over-slack. **Regular verification of seat belt related to:**

- cut or frayed straps.
- worn or damaged hardware, including anchor points.
- Buckle or retractor malfunction.
- Loose stitching.



### **WARNING**

- | **In no event should the lift truck be used if the seat belt is defective (fixing, locking, cuts, tears, etc.). Repair or replace the seat belt immediately.**
- | **Do not alter the belt setting. Always replace the seat belt after an accident.**

### How to act in unusual situations

- Fasten seat belt, stay in seat.
- Do not jump !
- Lean forward, hold on tight steering wheel, brace feet.
- Lean your body away from impact.



#### **WARNING**

- | **If the truck is about to tip over, never undo the restraint belt and try to jump out.  
This will only increase the risk of serious injury or death !**

### **seat Aware system(For cE)**



### **vehicle Forward/Reverse control**

when the vehicle is in static starting state, the driver sits incorrectly, there is no seat pressure switch input, travel selector switch hangs in the forward or reverse gear, there is no corresponding forward or reverse signal output, meanwhile, the alerting signal outputs, buzzer and indicator lights are on, the park brake hangs or the driver sits correctly, then exits the alerting condition; if the driver sits correctly and relieve the park brake, there is seat pressure switch input, travel selector switch hangs in the forward or reverse gear, there is corresponding forward or reverse signal output, the vehicle can travel forward or reverse. The driver leaves the seat (there is no seat pressure switch input) over 1 second, control state is the same with the driver sitting incorrectly.

when the vehicle is traveling forward or reverse, the driver leaves the seat (there is no seat pressure switch input) over 1 second, there is no corresponding forward or reverse signal output, the vehicle forward and reverse power is cut off, meanwhile, the alerting signal outputs, buzzer and indicator lights are on; when the park brake hangs or the driver sits correctly, it exits the alerting condition, the driver sits down again, travel selector switch hangs in the forward or reverse gear, the vehicle forward and reverse power recovers.

### **Forklift working Device control**

when the vehicle starting in static condition or no starting in static condition (when it is in no starting static condition, key switch should be in travel gear), the driver sits incorrectly or falling signal switch is open, there is no seat pressure switch input, no working device pressure or falling signal output, working device is locked; if the driver sits correctly, there is seat pressure switch input and falling signal switch is closed, working device pressure and falling signal output, working device can be operated normally. The driver leaves the seat

(there is no seat pressure switch input) over 1 second, control state is the same with that the driver sits incorrectly.

when the vehicle is traveling forward or reverse, the driver leaves the seat (there is no seat

pressure switch input) over 1 seconds, there is no working device pressure or falling signal output, working device is locked; when the driver sit down again, there is seat pressure switch input, and falling signal switch is closed ,working device pressure and falling signal output, working device can be operated normally.

**Attention: seat aware system including single locked and double locked:**

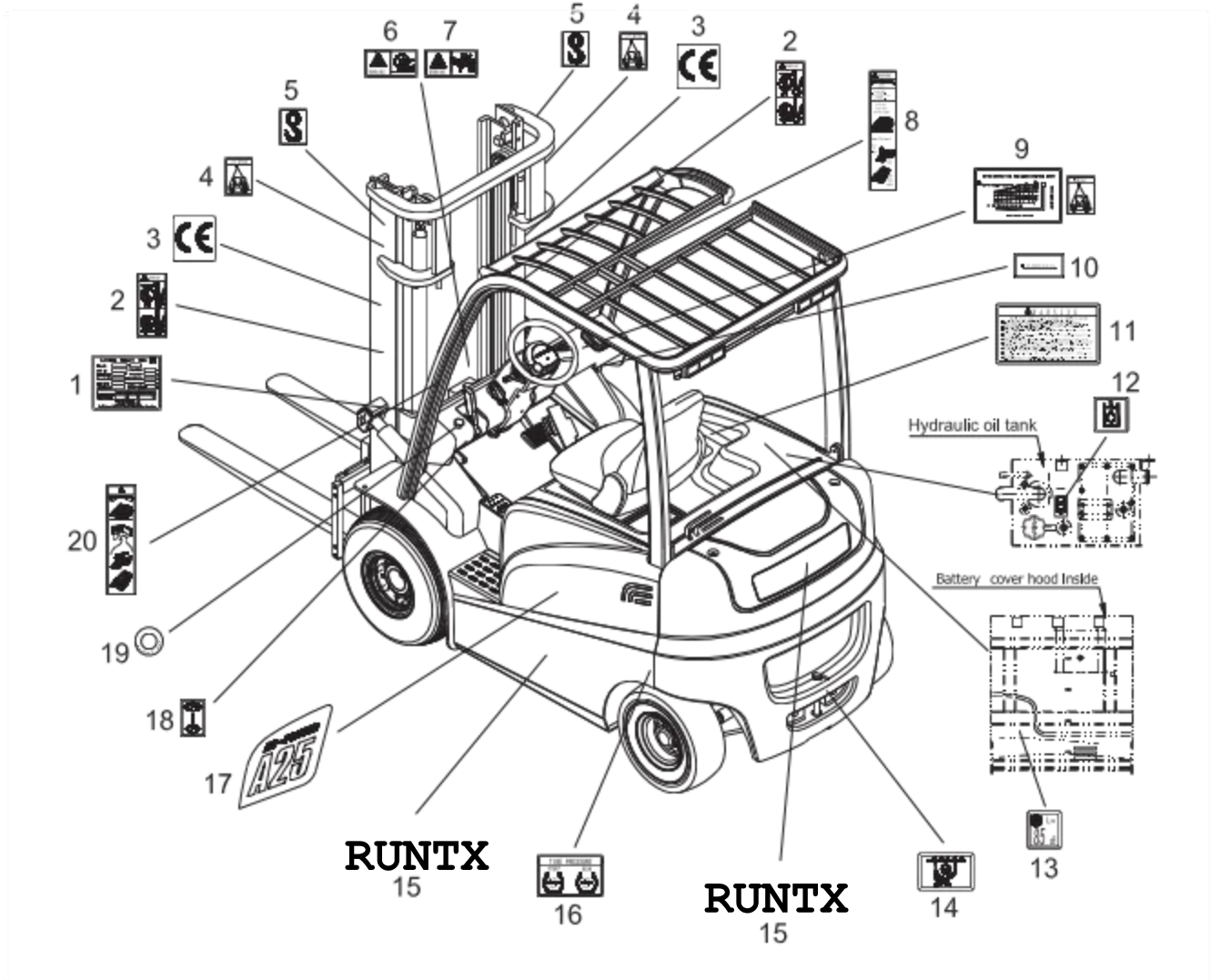
- single locked: it is said that the sYstem limits the forklift's travel ,when the driver leaves the seat, the traction motor will not work and the vehicle will stop.
- Double locked: it is said that the sYstem limits the forklift's travel and mutil-waY valve's work, the masts will not lift or down.

**Forklift parking Brake control**

In anY vehicle state, when the driver sits incorrectlY, there is no seat pressure switch input, meanwhile, do not pull the parking brake, there is alerting signal output, pull the parking brake or the driver sits correctlY, it can exit the alerting condition. The driver leaves the seat (there is no seat pressure switch input) over 1 seconds, control state is the same with that the driver sits incorrectlY.

### 3. Nameplate and safety Labels

warnings and notices such as Rated capacities and load centers graph, warning label and name plate must be legible at all times. Replace if necessary.



No.	Description
1	Nameplate
2	warning label: Do not step onto or beneath the load
3	CE label: For CE
4	Lift method
5	strap points for crane lifting: For CE
6	warning label: No climbing

No.	Description
7	warning label: Risk of trapping with moving mast
8	warning label(stick in the R.H. leg): procedure when truck in danger of tipover notice
9	Rated capacities and load centers graph
10	use specified fuses only : For CE
11	warning label: Please abide by the operation instructions
12	Hydraulic label: Adding hydraulic oil For CE
13	Noise label
14	Tight point label: For CE
15	HANGCHA black decal
16	Tire pressure: For CE
17	series and tonnage label
18	Hand brake label: For CE
19	Emergency stop
20	warning label(stick in the L.H. leg): procedure when truck in danger of tipover notice

#### 4. Technical Specifications

1.0 t / 1.5 t

No.	Item		CPD10-AC3 AC3E	CPD10-AC4 AC4E	CPD10-AD2	CPD15-A	CPD15-AC3 AC3E	CPD15-AC4 AC4E	CPD15-AD2
1	Rated lifting capacity	kg	1000	1000	1000	1500	1500	1500	1500
2	Load center distance	mm	500	500	500	500	500	500	500
3	standard mast lift height	mm	3000	3000	3000	3000	3000	3000	3000
4	Free lift height	mm	145	135	135	135	145	135	135
5	Mast Tilt angle (front/back)	( ° )	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10
6	Maximum travel speed(full load/no load)	km/h	14/14	14/14	14/14	14/14	14/14	14/14	14/14
7	Maximum lifting speed (full load/no load)	mm/s	290 / 440	290 / 440	290 / 440	290 / 440	290 / 440	290 / 440	290 / 440
8	Maximum grade ability (full load/no load)	%	15 / 16	15 / 16	15 / 16	15 / 16	15 / 16	15 / 16	15 / 16
9	Minimum outside turning radius	mm	1900	1900	1900	1900	1900	1900	1900
10	Minimum ground clearance	mm	110	110	110	110	110	110	110
11	Maximum braking distance	m	2.5	2.5	2.5	2.5	2.5	2.5	2.5
12	Dimensions	Length(t o face) fork mm	2098	2098	2098	2098	2098	2098	2098
		width mm	1120	1120	1120	1120	1120	1120	1120
		Height to overhead guard mm	2050	2050	2050	2050	2050	2050	2050
13	service weight	Include battery box	kg	2940	2940	2940	2940	2940	2940
14	Battery	standard V/Ah	48 / 420	48 / 420	48 / 420	48 / 420	48 / 420	48 / 420	48 / 420
15	Motor	Driven Motor kw	8.0 AC	8.0 AC	8.0 AC	5.0 DC	8.0 AC	8.0 AC	8.0 AC
		pump Motor kw	8.2 DC	8.6 AC	8.6 AC	8.2 DC	8.2 DC	8.6 AC	8.6 AC
16	Tire	Front×2	6.00-9	6.00-9	6.00-9	6.00-9/2	6.00-9	6.00-9	6.00-9
		Rear×2	5.00-8	5.00-8	5.00-8	5.00-8/2	5.00-8	5.00-8	5.00-8

1.8 t / 2.0 t

No.	Item		CPD18-AC3 CPD18- AC3E	CPD18-AC4 CPD18- AC4E	CPD18-AD2	CPD20-A	CPD20-AC3 CPD20- AC3E	CPD20-AC4 CPD20- AC4E	CPD20-AD2
1	Rated lifting capacity	kg	1750	1750	1750	2000	2000	2000	2000
2	Load center distance	mm	500	500	500	500	500	500	500
3	standard mast lift height	mm	3000	3000	3000	3000	3000	3000	3000
4	Free lift height	mm	145	135	135	140	140	140	140
5	Mast Tilt angle (front/back)	( ° )	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10
6	Maximum travel speed(full load/no load)	km/h	13.5 /14	13.5 /14	13.5 /14	14/14	14/14	14/14	14/14
7	Maximum lifting speed (full load/no load)	mm/s	285/440	285/440	285/440	280/440	280/440	280/440	280/440
8	Maximum grade ability (full load/no load)	%	15 / 16	15 / 16	15 / 16	13/14	13/14	13/14	13/14
9	Minimum outside turning radius	mm	1900	1900	1900	2090	2090	2090	2090
10	Minimum ground clearance	mm	110	110	110	120	120	120	120
11	Maximum braking distance	m	2.5	2.5	2.5	2.5	2.5	2.5	2.5
12	Dimensions	Length(t o face) fork mm	2098	2098	2098	2342	2342	2342	2342
		width mm	1138	1138	1138	1265	1265	1265	1265
		Height to overhead guard mm	2050	2050	2050	2075	2075	2075	2075
13	service weight	Include battery box kg	3090	3090	3090	3700	3700	3700	3700
14	Battery	standard V/Ah	48 / 420	48 / 420	48 / 420	48 / 630	48 / 630	48 / 630	48 / 630
15	Motor	Driven Motor kw	8.0 AC	8.0 AC	8.0 AC	7.0 DC	11 AC	11 AC	11 AC
		pump Motor kw	8.2 DC	8.6 AC	8.6 AC	8.6 DC	8.6 DC	8.6 AC	8.6 AC
16	Tire	Front×2	21×8-9	21×8-9	21×8-9	23×9-10	23×9-10	23×9-10	23×9-10
		Rear×2	5.00-8	5.00-8	5.00-8	18×7-8	18×7-8	18×7-8	18×7-8

2.5 t

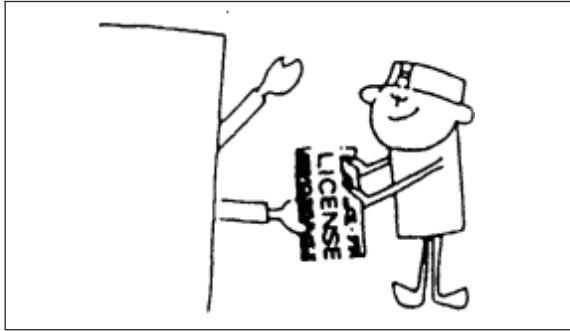
No.	Item	CPD25-A	CPD25-AC3 CPD25-AC3F	CPD25-AC4 CPD25-AC4F	CPD25-AD2	CPD25-ALC3 CPD25-ALC3F	CPD25-ALC4 CPD25-ALC4F	CPD25-ALD2	
1	Rated lifting capacity kg	2500	2500	2500	2500	2500	2500	2500	
2	Load center distance mm	500	500	500	500	500	500	500	
3	standard mast lift height mm	3000	3000	3000	3000	3000	3000	3000	
4	Free lift height mm	140	140	140	140	140	140	140	
5	Mast Tilt angle (front/back) (°)	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	
6	Maximum travel speed(full load/no load) km/h	14/14	14/14	14/14	14/14	14/14	14/14	14/14	
7	Maximum lifting speed (full load/no load) mm/s	230/430	230/430	230/430	230/430	230/430	230/430	230/430	
8	Maximum grade ability (full load/no load) %	13/14	13/14	13/14	13/14	13/14	13/14	13/14	
9	Minimum outside turning radius mm	2090	2090	2090	2090	2230	2230	2230	
10	Minimum ground clearance mm	120	120	120	120	125	125	125	
11	Maximum braking distance m	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
12	Dimensions	Length(t o face) fork mm	2342	2342	2342	2342	2482	2482	2482
		width mm	1265	1265	1265	1265	1265	1265	1265
		Height to overhead guard mm	2075	2075	2075	2075	2110	2110	2110
13	service weight Include battery box kg	4180	4180	4180	4180	4580	4580	4580	
14	Battery standard V/Ah	48 / 630	48 / 630	48 / 630	48 / 630	80/500	80/500	80/500	
15	Motor	Driven Motor kw	7.0 DC	11 AC	11 AC	11 AC	15.0 AC	15.0 AC	15.0 AC
		pump Motor kw	8.6 DC	8.6 DC	8.6 AC	8.6 AC	10 .0DC	10 .0AC	10 .0AC
16	Tire	Front×2	23×9- 10	23×9- 10	23×9- 10	23×9- 10	23×9-10 /2	23×9-10 /2	23×9-10 /2
		Rear×2	18×7-8	18×7-8	18×7-8	18×7-8	18×7-8 /2	18×7-8 /2	18×7-8 /2

3.0 t / 3.5 t

No.	Item	CPD30-A	CPD30-AC3	CPD30-AC4	CPD30-AD2	CPD35-AC3	CPD35-AC4	CPD35-AD2	
1	Rated lifting capacity kg	3000	3000	3000	3000	3500	3500	3500	
2	Load center distance mm	500	500	500	500	500	500	500	
3	standard mast lift height mm	3000	3000	3000	3000	3000	3000	3000	
4	Free lift height mm	145	145	145	145	145	145	145	
5	Mast Tilt angle (front/back) ( ° )	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	
6	Maximum travel speed(full load/no load) km/ h	14/14	14/14	14/14	14/14	12/13	12/13	12/13	
7	Maximum lifting speed (full load/no load) mm/ s	250/400	250/400	250/400	250/400	210/400	210/400	210/400	
8	Maximum grade ability (full load/no load) %	13/14	13/14	13/14	13/14	13/14	13/14	13/14	
9	Minimum outside turning radius mm	2230	2230	2230	2230	2310	2310	2310	
10	Minimum ground clearance mm	125	125	125	125	125	125	125	
11	Maximum braking distance m	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
12	Dimensions	Length(t fork to face) mm	2502	2502	2502	2502	2582	2582	2582
		width mm	1265	1265	1265	1265	1302	1302	1302
		Height overhead mm	2110	2110	2110	2110	2110	2110	2110
13	service weight	Include battery box kg	5050	5050	5050	5050	5450	5450	5450
14	Battery	standard V/Ah	80 / 500	80 / 500	80 / 500	80 / 500	80 / 500	80 / 500	80 / 500
15	Motor	Driven Motor kw	10.2 DC	15 AC	15 AC	15 AC	15 AC	15 AC	15 AC
		pump Motor kw	10.0 DC	10 DC	10 AC	10 AC	10 DC	10 AC	10 AC
16	Tire	Front×2	23×9- 10	23×9- 10	23×9- 10	23×9- 10	23×10- 12	23×10- 12	23×10- 12
		Rear×2	18×7-8	18×7-8	18×7-8	18×7-8	200/50- 10	200/50- 10	200/50- 10

## 5. safety Instructions

1. only trained and authorized operator shall be permitted to operate the truck.



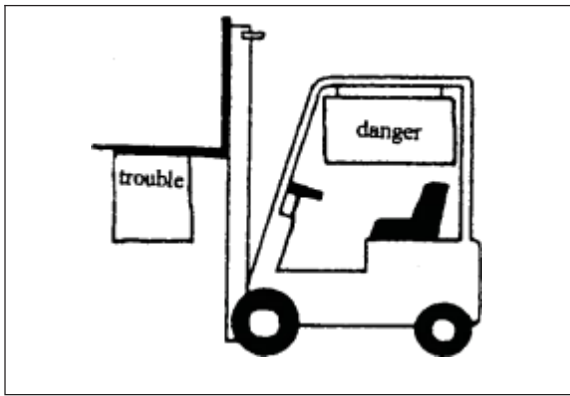
2. Inspect the truck at periodic intervals for oil or water leak, deformation, lousiness, etc. If neglected, short life of components will be caused and in the worst case a fatal accident would occur.

- Make sure having replaced good parts during periodic check.
- wipe off oil, grease or water from the floor board and foot and hand controls, if any.
- strictly prohibit smoking and spark nearby the storage battery when checking it.
- If maintenance on high position, such as mast, front and rear lamp, please be careful to prevent fall down or be clamped.
- Be careful do not be scalded when inspect the motor, controller and etc.

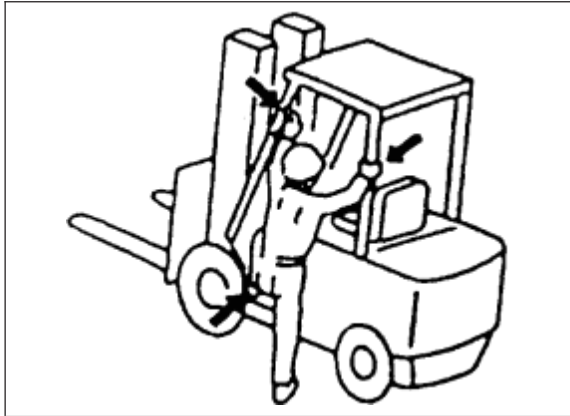
3. whatsoever in trouble, you must stop the forklift, hang a mark of "danger" or "trouble" and take off the key, at the same time inform the manager. only after the trouble is removed, you may use the forklift.

- If trouble occurs when lifting cargo, to Climb or descend, or the storage battery electrolyte, the hydraulic fluid, the brake fluid has the revelation,

please organizes the personnel to repair immediately.



4. operator must wear helmet, safety shoes and work clothes.
5. Because there will bring exploding gas in the bosom of the battery, prohibit any flame nearby it absolutely.
  - Do not let any tools close the two terminal of the battery to avoid spark or short circuit.
6. The movement road of forklift should be solid and smooth coagulation road or similar to the road suitable for vehicle. Recheck the state of working ground.
  - The considered climatic conditions when the forklift designs are: Temperature - 20°C-50°C; the wind speed does not surpass 5m/s; the air relative humidity is not bigger than 90% (temperature 20°C).
  - The forklift is not suitable in the flammable explosive working conditions.
  - Altitude: No more than 2000 meters.
7. Never mount or dismount the moving truck. use the safety step(s) and safety grip facing the truck when mounting or dismounting the truck.



since the wire rope may slide off.  
If needed, a

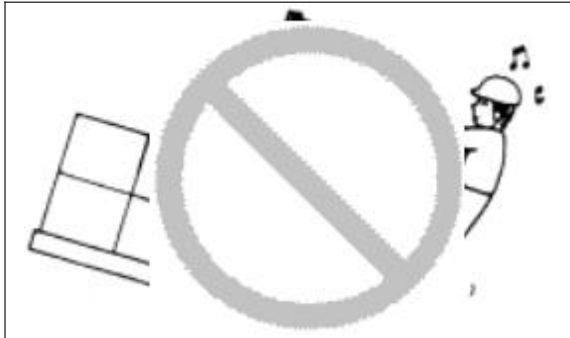
- 8.** Never attempt to work the controls unless properly seated.
  - Before starting, adjust the seat so you can get easy access to all hand and foot control.
- 9.** Before starting up, make sure that:
  - Please fasten seat bolts.
  - The parking brake lever is applied securely.
  - The forward-reverse lever is in neutral.
  - Before starting, make sure no one is under, on and close to the truck.
  - Don't step the accelerate pedal or control the lifting lever or tilting lever before turning on power.
- 10.** operate the controls smoothly. Avoid sudden stops or turns.
  - It is dangerous to make a sharp brake. otherwise the truck has the possibility of overturn.
- 11.** Pay attention to the route of the truck; be sure to make a wide sight.
- 12.** Never allow other person(s) to ride on the forks, pallets or on the truck.
- 13.** Taking account of the shape and material of loads to be handled, use a proper attachment and tools.
  - Avoid hoisting the load, with wire rope hung on the forks or attachment,

qualified personnel for slinging operation should perform, making use of a hook or crane arm attachment.

- Take care not to protrude the forks out of the load. The protruded fork tips may damage or turn over the adjacent load.

**14.** know the rated capacity of your lift truck and its attachment, if any, and never exceed it.

- Do not use a man as an additional counterweight. It's quite dangerous.



**15.** keep your mind on your work.

**16.** keep your head, hands, arms, feet and legs within the confines of the operator's compartment. Never stretch out for any reason.



**17.** The pallet and skid used should be strong enough to endure the load. Never use damaged or deformed ones.

**18.** we afford all type of attachment, such as rotating roll clamp, bale clamp, side shifter, and crane jib etc. You should refit the truck under ours license if you want. It is forbidden to refit it by yourself.

**19.** Safeguard protect you do not be hurt by the goods fallen. Load bracket protect you load goods smoothly. It is forbidden to use truck without safeguard or load bracket.

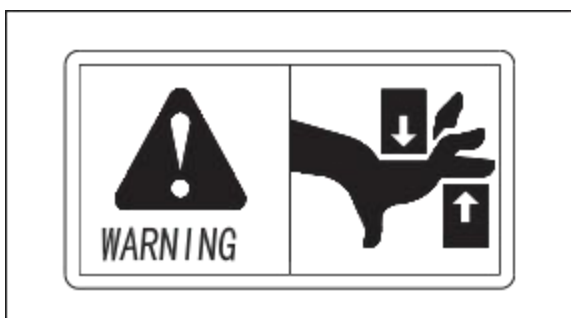
**20.** It is forbidden to walk down the fork or the attachment.

- It is forbidden to walk up the fork or stand on the fork.



**21.** It is forbidden to put your hands, arms or head stretch between the mast and safeguard. once clamped, the life has danger.

- It is forbidden to put your hands in inner and outer mast.



**22.** The goods is liable to drop turning or passing rough road when it departures the center. And the forklift may turn over more probably.

**23.** Don't stack loads on forks in such a way that the top of loads exceeds the load backrest height. If unavoidable, make sure the load is

restrict your vision operate the truck in reverse or have a guide. when lead by a guide, make sure you understand hand, flag, whistle or other signals. when handling long loads such as pipe, lumber etc or in the case of the Large-sized model, or operate with long attachment, be extremely careful of load end swing at corners or in narrow aisles. Be alert for others.

**24.** use minimum forward and reverse tilt when stacking and un-stacking loads. Never tilt forward unless load is over stack or at low lift height.

- when stacking loads on a high place, once make the mast vertical at a height of 15 to 20 cm above the ground and then lift the load farther. Never attempt to tilt the mast beyond vertical when the load is raised high.
- To un-stack loads from a high place, insert forks into the pallet and drive backwards, then lower the load. Tilt the mast backwards after lowering. Never attempt to tilt the mast with the load raised high.

**25.** It is dangerous to travel with forks higher than appropriate position regardless of whether loaded or not. keep the good traveling posture. (when traveling, the forks should be 15 to 30 cm above the ground or floor and the mast tilted backward)

- Do not operate the side shift mechanism, if equipped, when the forks are raised and loaded, since this will cause the truck to be unbalanced.

**26.** watch for branches, cables, doorways, or overhangs. pay caution when working in congested areas.

- Slow down and sound horn at cross aisles

and other locations where vision is restricted.

- when make a turn, be sure the speed of the truck is lower than the 1/3 max. of allowable speed.

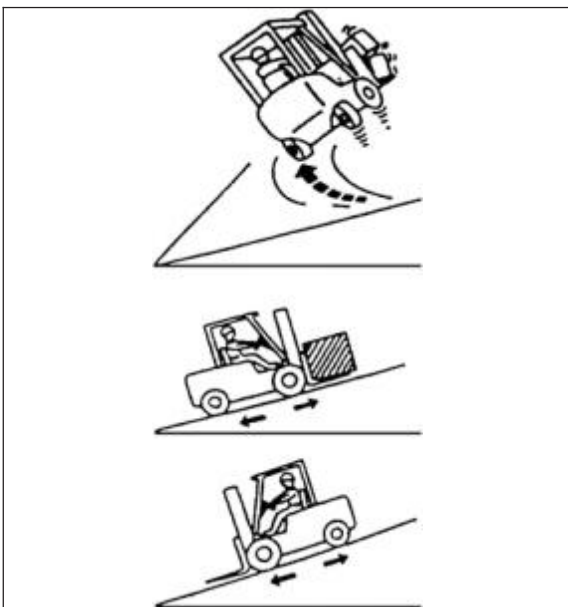


27. Affirm keeping some distance from roadside and flat roof.

28. Before driving over a dock-board or bridge-plate, be sure that it is properly secured and strong enough to sustain the weigh.

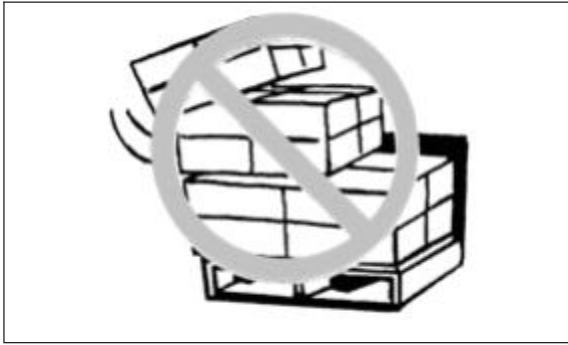
29. when operating loaded truck, have the rear end of your machine pointed downhill.

- when operating unloaded truck, have the rear end of your machine pointed upgrade.
- Do not make a turn on the grade, in order to avoid overturn.



30. the goods is liable to drop turning or passing rough road when it departures the

center. And the forklift may turn over more probably.



**31.** Never lift loads with the truck inclined. Avoid loading work on a grade.

**32.** Never permit anyone to stand or walk under upraised forks or other attachments if machine is so equipped. If unavoidable, use a safety stand or block to prevent a possibility of fork attachments falling down or moving unexpectedly.

**33.** Inspect the surface over which you will run. Look for holes, drop-offs, obstacles, and look for rough spots. Look for anything that might cause you to lose control, bog down or upset.

- Clear away trash and debris. pick up anything that might puncture a tire or let the load lose balance.
- Slow down for wet and slippery roads. Stay away from the edge of the road. If unavoidable, pay more attention.
- Do not operate the truck when the weather is execrable, such as windy, thunder storm, snow and etc. Especially when wind speed is higher than 5m/s, don't operate the truck outside.

**34.** An accumulator is required for controller. Forbid to touch within B+ and B- to prevent from wounding by electricity. Before checking or cleaning, please connect loads (contactor circuit or horn for example) between B+ and B-

first to discharge for capacitor of controller.

the reason is brake or turn system, move it by a suitable

**35.** Pulling the hand brake when parking on flat. If necessarily parking on ramp, you should place the wedges under wheels.

- Descending the fork to the ground and keeping a little forward tilting, shut off key switch and take off key.
- Pull out the battery plug.
- The parking place must be far away from fireworks.

**36.** You can tow the forklift to the safe place with towing pin when the forklift can't run.

- Don't tow the truck which steering system or brake system has been damaged.

**37.** There is operating method and warning label on the truck. Please operate the truck obey the rules on the label and this manual. often inspect the nameplate, when damaged or lost please replace it.

**38.** Fire extinguisher must be prepared at working place. users can select fire extinguisher along with truck, and it usually is fixed on rear supported leg of safety shelf, it is easy to pick.

- Driver and manager should be familiar with the position and operation of fire extinguisher.

**39.** Please use stock when conveying little goods, it is forbidden to use fork directly.

**40.** The work road surface for forklift should be stability and unknit, cement, blacktop or beton. If there are snow, ice, water or other eyewinker, bar. Eliminate all, then work. otherwise the truck will be out of control and lead the safety accident.

**41.** Move the truck to the place which respects traffic when it anchors. If

truck (Reference the part of truck move); other reasons, use a suitable truck to traipse, tie the cord outside of truck. Please abide by the traffic regulations when traipse the truck on calzada.

**42.** After take-down the hood, water tank cover board, overhead, backrest of mast, unallowed to operate the truck or load cargo.

**43.** There are enough light at truck work ground. At night, open the head lamp to collocate enough lamp-house.

**44.** only in the event that the truck manufacturer is no longer in business and there is no successor in the interest to the business, the user may arrange for a modification or alteration to a powered industrial truck provided, however, that the user shall:

- Arrange for the modification or alteration to be designed, tested and implemented by an engineer(s) expert in industrial trucks and their safety;
- Maintain a permanent record of the design, test(s) and implementation of the modification or alteration;
- Approve and make appropriate changes to the capacity plate(s), decals, tags and instruction handbook;
- Affix a permanent and readily visible label to the truck stating the manner in which the truck has been modified or altered together with the date of the modification or alteration, and the name and address of the organisation that accomplished the tasks.

**45.** when the view is obstructed, use the rear-view mirror, adjust it to the right angle to facilitate observation of rear vision.

**46.** Except where provided in 44, no modifications or alterations to a powered industrial truck, which could affect, for example, capacity, stability or safety requirements of the truck, shall be made without the prior written approval of the original truck manufacturer, its authorized representative, or a successor thereof. This includes changes affecting, for example, braking, steering, visibility and the addition of removable attachments. when the manufacturer or his successor approves a modification or alteration, the manufacturer or successor shall also make and approve appropriate changes to the capacity plate, decals, tags and operation and maintenance handbooks.

**47.** If fork arms/locking pins joint imperfectly, unexpected drop may occur.

**48.** only in the event that the truck manufacturer is no longer in business and there is no successor in the interest to the business, may the user arrange for a modification or alteration to a powered industrial truck, provided, however, that the user.

- a) Arranges for the modification or alteration to be designed, tested and implemented by an engineer(s) expert in industrial trucks and their safety,
- b) Maintains a permanent record of the design, test(s) and implementation of the modification or alteration,
- c) Approves and makes appropriate changes to the capacity

plate(s), decals, tags and instruction handbook, and

- d) Affixes a permanent and readily visible label to the truck stating the manner in which the truck has been modified or

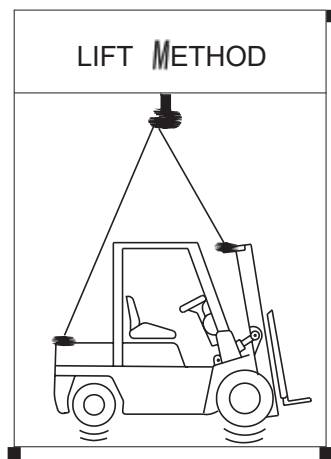
altered, together with the date of the modification or alteration and the name and address of the organization that accomplished those tasks.

## 6. Forklift Transport, Lifting & Towing

### Transport

- The Fork Lift Truck is designed for material handling only, It is inappropriate for long-distance transportation. If needed, the Fork Lift Truck must be transported by ship, train or lorry, of 5T loading. use a lifting pallet to hoist the truck.
- use the steel Wire ropes to tie the holes in the tWo side of the outside mast's beam and the rear of truck's body, and then use the lifting device to hoist the truck.

### Lifting



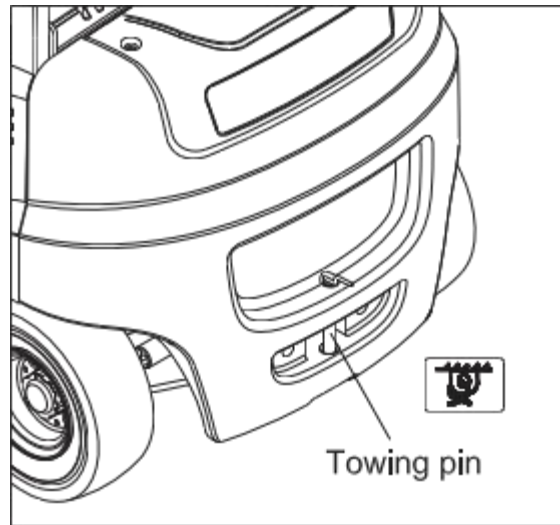
use the steel Wire ropes to tie the holes in the tWo side of the outside mast's beam and the hook of the counter balance, and then use the lifting device to hoist the truck. The steel Wire rope attach to the counterWeight should through the safeguard gap, and make the safeguard not be distorted.



#### **wARNING**

- | when hoist the truck, don't coil the overhead guard with the steel wire.
- | The steel wire ropes and the lifting device must be very firm to support the truck because the truck is very heavy.
- | Don't lift the truck by hoist the overhead guard.
- | when lifting the truck, don't take yourself below the truck.

## ToWing




- The towing rod on the bottom of the counter balance is used to Pull and drag the truck.
- Turn off key and Pull out Power switch.
- Loosen the brake lever.
- set switch lever to neutral Position.

### **WARNING**

- | Don't tie the steel Wire ropes on the unfixed position.
- | Don't carry a load to steel Wire ropes suddenly.
- | The truck Would be damaged if you toW it With the electric lock Working.


## 7. The structure and stability of Truck

prevent the forklift to turn over! It is very important for operator to know the truck's structure and relationship between load and stability.


 <b>CAUTION</b>	<b>structure</b>
--	------------------

The basic structure of the truck is mast (include mast and forks) and body (include tire).

The lift truck keeps the balance of weight between the truck body and the load on the forks with the center of the front wheels as a fulcrum when the rated capacity load is placed in position.

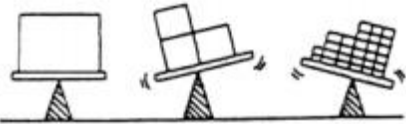



Due care should be paid to the gravity center of loads and forklift to maintain the stability of the truck.








 <b>CAUTION</b>	<b>Load center</b>
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There is difference in gravity because of the loads' shape,

such as box, board and large roller. It is very important to distinguish the difference of the gravity center of loads for evaluating the truck's stability.



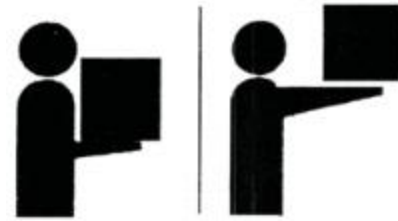
 <b>WARNING</b>	<p>If the truck will turn over, do not attempt to get out of the truck because the speed of overturn is much faster than your speed. You should hold the steering wheel handle, stretch your feet, and this practice will let you in the seats. operator fastens the safety belt please.</p>
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 <b>WARNING</b>	 Fasten Seatbelt	 TRUCK CAN TIP OVER! Risk of serious INJURY or DEATH!	 If Truck Tips Over Do Not Jump!	 Lean Forward Hold on Tight	 Brace Feet	 Lean Away From Impact
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 <b>CAUTION</b>	<b>The max. load and load center</b>
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The load center distance is defined that: the distance between the load center and the fork carriage or the front of the fork carriage. The max. load means the maximum load the truck can charge at the normal load center distance. The relation between the max. load and load

center distance shows on the capacity chart. You should reduce the weight of load if the load center distance inclines to the fork carriage.





**CAUTION**

**Gravity center and stability**

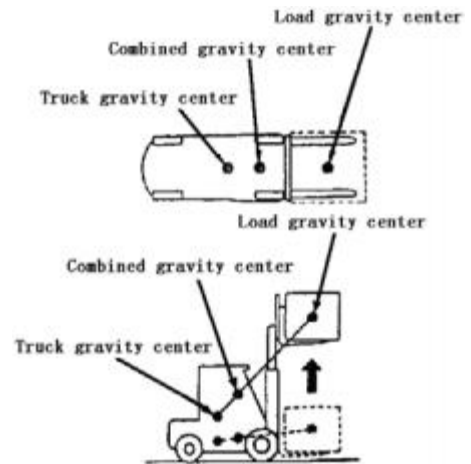
The combined gravity center that is composed of the forklift center and the load gravity center determine the stability of lift trucks.

when unloaded, the barycenter does not change; when loaded, the barycenter is determined by the truck and the load's center.

The barycenter is also determined by the tilting and lifting of the mast.

The combined center is determined by these factors:

- Load's size, weight and shape
- The lifting height
- The tilting angle
- The acceleration
- The radius of turning
- The road and grade's angle
- The attachments

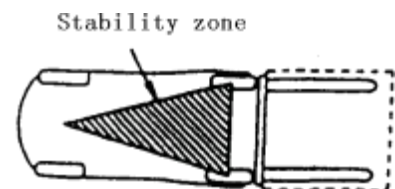


**CAUTION**

**The stable region of the load center**

In order to make the truck stable, the combined center must be in the triangle which is made up of two points that the two front wheels attach ground and the midpoint of the back axle.

If the combined center is in the front driving axle, the two front wheels become two fulcrums, the truck will overturn. If the combined center departs the triangle, the trucks shall overturn in the corresponding direction.

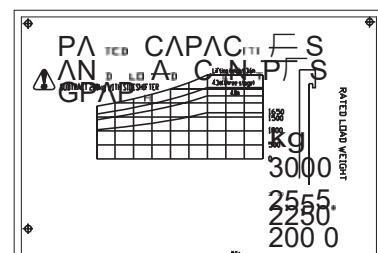


**CAUTION**

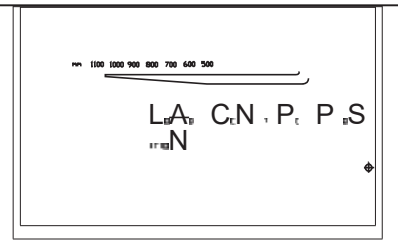
**Capacity chart**

The chart given shows the relation between the load center and the weight of loads.

Before loading, make sure that the load and the load center distance in the range of capacity chart. If the load's shape is complex, put the most weightily part on the middle of the forks, and close to



the fork carriage.





**CAUTION**

**velocity and acceleration**

one object will keep quiescence until force works on it. Also, a moving object will keep moving until force works on it .This is just inertia.

According to inertia, when truck starts moving, one force works backwards, and when truck stops moving, one force works forwards. So, it's dangerous to brake suddenly, because it causes one large force works forwards, and it's easy to cause truck overturn or load slide off.

when the forklift makes a turn, will exert a centrifugal force outward from the curve center. This strength pushes forklift outwards and causes it to turn over. About stability region is very small, so decelerate when turning. If the cargo transported at the high position, it's easier to turn over.

## **8. Running-in of the new truck**

we recommended operating the machine under light load conditions for the first stage of operation to get the most from it. Especially the requirements given below should be observed while the machine is in a stage of 100 hours of operation.

- Must prevent the new battery from over discharging when early used. usually should recharge when discharging down to 20%.
- perform specified preventive maintenance services carefully and completely.
- Avoid sudden stop, starts or turns.
- oil changes and lubrication are recommended to do earlier than specified.
- Limited load is 70%~80% of the rated load.

## 9. Daily Maintenance

The earnest complete maintenance, can keep the forklift to be at the good status. And the safety of the truck is related with your job and your life.



### **WARNING**

- | **Except checking lights and operating capability, you should shut off the key switch and pull out the plug before checking electric system.**
- | **prohibit operate forklift with trouble.**
- | **Little trouble brings big accident.**

### **1. Inspect oil leakage: include hydraulic oil, electrolyte and brake fluid**

Inspect connector of the oil pipe and storage battery to see whether there is any leakage. use your hand or eyes to inspect, Forbid to use a flame.

### **2. Inspect tire**

Turn the tire valve cap counter clock-wise and move it. using a tire pressure gauge, measure the inflation pressure, and adjusting it to the specified pressure, if needed. After making sure there is no air leakage from the tire valve, reinstall the cap. check that each tire does not get damaged at the tread surface or side face. Make sure the wheel felloe is not bended.



### **WARNING**

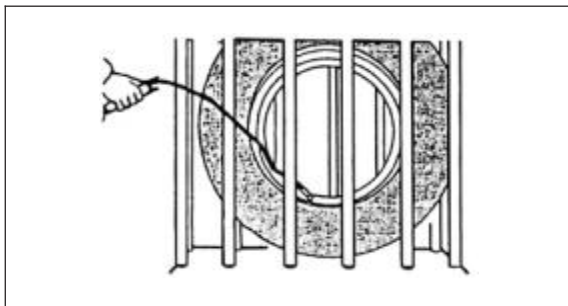
- | **since the tires of forklift truck need have a high inflation pressure to carry heavy loads, even a small bending of rims or a little damage at the tread surface could cause an accident.**
- | **When using an air compressor, at**

first, adjust the air pressure of the compressor. otherwise it will cause a serious accident, since the maximum pressure of compressor higher than the pressure tire can bear.

### Tire pressure

only for the pneumatic-tire(GB/T2982-2001)

Model	Front wheel	Rear wheel
1.0t~1.8t	0.79 Mpa	1.0 Mpa
2.0t~3.5t	0.9 Mpa	0.8 Mpa



### **⚠ WARNING**

| All bolts and nuts should be screw tight to the stipulation torque after the tire and the wheel felloe was assembled, then charge is allowed. Types have expansion energy after changing, so the tire pressure does not surpass the rating.

| please put the tire in a protection frame or tie it with a iron chain when charging to prevent accident happening.

### Replace tire

when the tire is damaged, you should replace it in time. use a jack to make the tire just beyond ground, then put a wood block under the chassis. Loosen nut , replace a new tire.

Tighten the nut crosswIse and sYmmetrically.

### 3. checking the wheel attachments.

- parking the truck securely.
- Tighten the wheel nuts crosswise with a torque wrench.

Bolt tightening torque:

Model	Front wheel nut	Rear wheel nut
1.0t~1.8t	157-176 N.m	76-107 N.m
2.0t~3.5t	441-588 N.m	157-176 N.m



### 4. check brake pedal

- step the brake pedal, check it for slowness or block .
- The proper brake distance is 2.5m when free load .
- Adjust the height of pedal to 115~125mm .
- Adjust brake booster push rod clearance to 1-3mm .
- The brake lamp should be lighted when the brake pedal steps on 10-20mm .

### 5. check the parking brake lever

The force of hand brake lever is adjusted bY the bolt on the top of lever.

The force increases clock-wise screwing, and decreases counter lock-wise screw.



#### **cAUTION**

**| To step the brake pedal is helpful to tighten or loose the hand brake lever.**

### 6. check accelerate pedal

The acceleration changes as the stroke changes.

### 7. Brake fluid level check

open the brake lubricated cap cover. check the fluid level in the range allowed. If lack, please add, and check if there is air mix into the pipe.

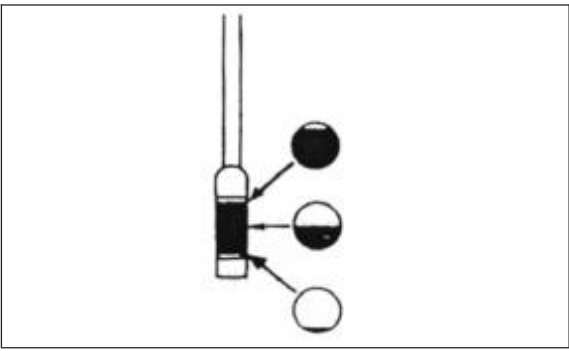


#### **cAUTION**

- | Please use brake fluid with one type, do not mix.**
- | Dont spatter the brake oil onto the surface of paint otherwise the paint will be damaged.**
- | when adding fluid, due should be taken to prevent dirt or water from entering the reservoir.**

### 8. check hydraulic oil

Loose the cap of hYdraulic oil inside of right frame, pull out dipstick and check it if the oil level is between the scales. Add oil when lack.



- check the terminal for loose or damage. otherwise it will be adjust or replace.

## **9. Replace hydraulic oil**

Replace hydraulic oil once half year on schedule.

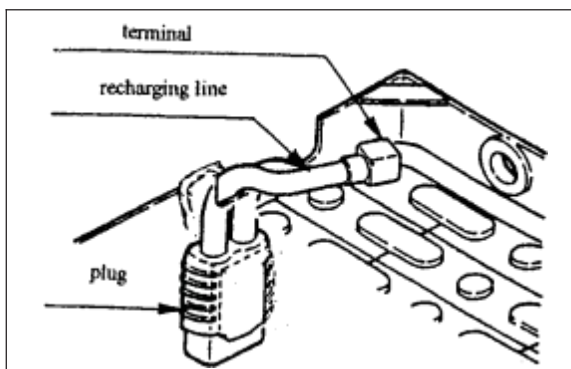
- stop the truck on smooth ground.
- Turn steering wheel right to the bottom, and enable the fuel drain plug to have the enough space.
- Tilt mast backwards to the bottom, and fall the forks to the ground.
- Pull on the hand brake.
- Loose the cap of hydraulic oil, pull out dipstick.
- set a plate under the chassis, then loose the fuel drain plug, and put the old oil.
- Dispose the old oil according to local environmental protection laws.
- Twist the fuel drain plug, join the new hydraulic fluid, and inspect whether have a leakage.
- start the truck, lifting for 3-5 times, and tilting for 3-5 times.
- Add hydraulic oil to required scale.

## **10. Drivers seat adjustment**

Make sure the driver's seat is properly located. If not properly, shift the adjusting lever to the right and move the driver's seat to a position which provides easy access to all foot and hand controls. After adjustment, shake the driver's seat a little to be sure that it is securely locked. Adjust the weight.

## **11. check battery**

- check the battery whether be installed firmly.
- check proportion of electrolyte. Refer to "Battery" section.



**Pull in the plug and close the hood**

**Turn on the key switch**

## **12. Instrument check (include battery capacity and error diagnose)**

Refer to instrument section.

## **13. Lifting lever, tilting lever, attachment lever**

check the lifting lever, tilting lever and attachment lever for looseness. Return position well.

## **14. Mast**

check the mast and the forks to insure that:

- The fork does not have crack and distortion.  
Forks were installed firmly and correctly.
- check the oil cylinder, oil pipes for leakage.
- check the rotation of idler wheel
- check the mast for crack or distortion
- Lifting lever, tilting lever, attachment lever
- check the mast whether works normally, whether have unusual sounds.

## **15. Mast lubrication**

You should grease lubrication to the orbit of mast on schedule base on requirement.

Adjust the lubricate schedule according to your working condition. Add times when busy.

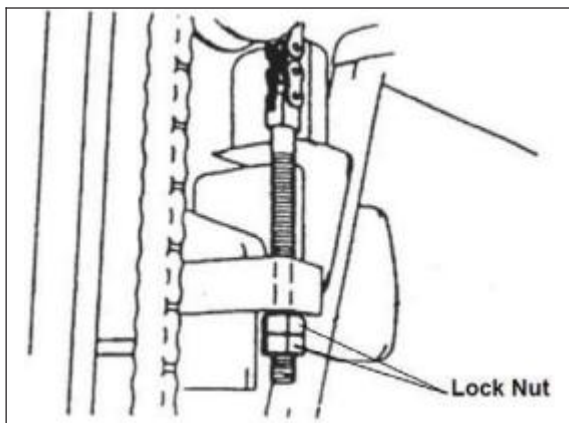
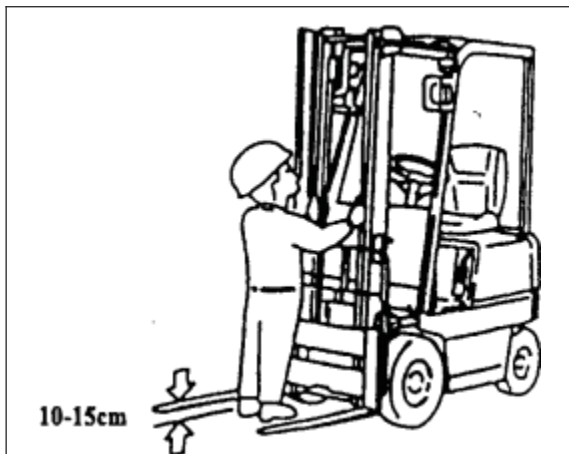
To coordinate forklift's operation, grease lubrication to the guide pulley and in outer upright mounting.

## **16. Lift chain tension check**

- Raise the fork about 10-15 cm above the

ground vertically.

- push the middle of the chain with the thumb. Make sure the tension for the right and left chains are equal.
- Adjust the chain tension: loosen the lock nut and adjust the chain by nut, then locked nut .



### 17. check steering system

Turn the wheel right and left separately to check steering system.

### 18. Turn signal, horn and other lamp check

Make sure that the turn signal operates properly by pull/push turn signal switch.

Make sure that the sound of horn is properly by press the horn button check the other lamp and back-up buzzer.

### 19. Battery maintenance

Refer to battery section.

### 20. other

For instance, pay attention to abnormal noise.

## 10. Driving and operation

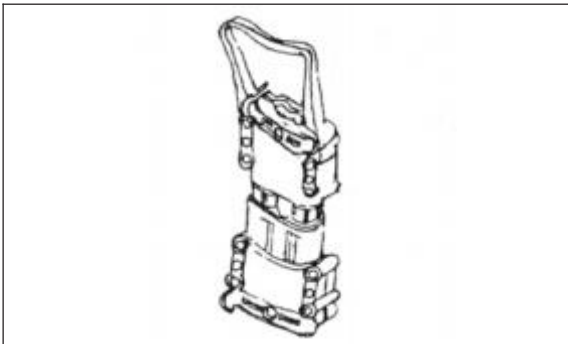


### **WARNING**

- | **Before operating the truck, check all controls and warning devices for proper operation. If any damage or fault is found, don't operate truck until corrected.**

### **Driving**

- open the cap, and insert the storage battery plug, then close the cap.



- set the direction switch to neutral position .
- Turn on key switch .
- Hold the steering wheel with left hand and turn on the key switch with right hand.
- Tilt back the mast
- control the lifting lever to set the bottom of the fork 150-200mm above the ground. control the tilting lever to fully tilt back the mast.
- control direction lever.
- Forward: Push the direction lever forward.
- Backward : Pull the direction lever backward.
- Loosen the hand brake lever
- step the brake pedal and push the hand brake lever to the front position.
- Hold the steering wheel with your left hand and attach your right hand.

### **Traveling**

step the accelerate pedal slowly, the truck will travel forward or backward.

### **Decrease speed**

Loosen the accelerate pedal slowly, the truck will decelerate.



### **CAUTION**

**Decelerate the truck in the situations following:**

- | **Turning;**
- | **Close the goods or pallet;**
- | **Close the deposit area;**
- | **Enter a narrow passage;**
- | **The condition of road surface is bad.**



### **WARNING**

- | **Don't step the accelerate pedal and brake pedal at the same time.**

### **Turning**

unlike general passenger-cars, the turning wheels are located at the rear of the truck. This cause the counterbalance swing out when turning.

slow down the truck and turn the steering wheel toward the side which you are turning. The steering wheel should be turned a bit earlier than as with the front wheel steering car.



### **CAUTION**

- | **Drive the truck slowly and control the steering wheel carefully, assure there is enough space to steer.**

### **stopping or parking**

- slow down and press the brake pedal to

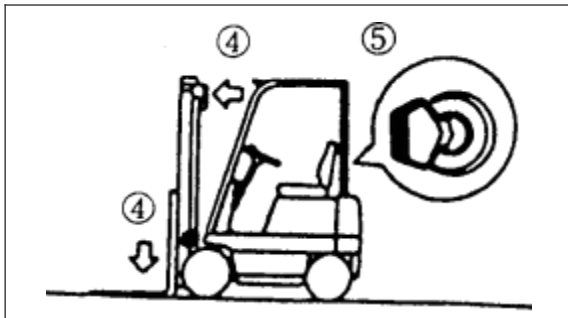
- stop the truck.
- Place the shift lever in neutral.
- Pull up the parking brake lever.
- Down the forks on the ground, tilt mast forwards fully.
- Place the key switch in "OFF" to shut off the battery. Remove the key and keep it.

- when handling bulky loads which restrict your vision, operate the truck in reverse



#### **CAUTION**

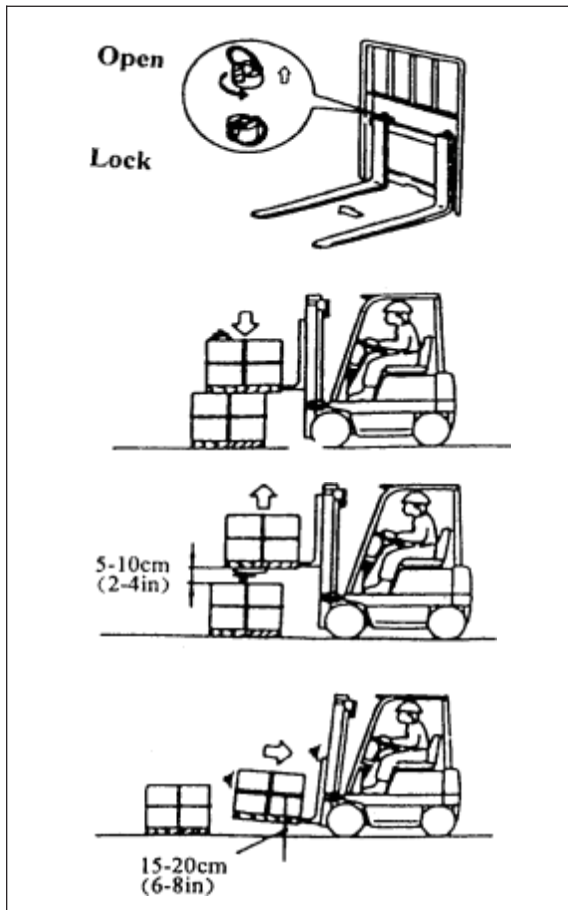
- | **Don't** dismount from the moving truck, never jump from the truck.
- | **Don't** parking the truck on the working road.



#### **Loading**

- The forks should be adjusted properly to maintain the balance of load.
- Place the truck right in front of the load to be handled.
- The pallet should be evenly positioned across both forks.
- Insert forks into the pallet as far as possible.
- To raise loads from the ground:
- Firstly, lift the forks 5 to 10 cm off the ground or floor and make sure loads lay stably.
- Then tilt the mast backwards fully and lift forks up to 15 to 20 cm off ground then start running.

except when climbing grades.



### stacking load

- when approaching the deposit area slow down your truck.
- Stop the truck right 30 cm far away from the position where your load is to be deposited.
- check the condition of the deposit area.
- Tilt the mast forward until forks become to horizontal. Raise forks until they are a little higher than the deposit position.
- Move forward to place the load directly over the desired area and stop the truck.
- Make sure your load is just over the desired area. Slowly lower the load into position. Make sure the load is securely stacked.
- Do necessary lift-tilt operations and then back away to make the forks leave loads.

- After making sure the forks leave the load, lower the forks to the basic position (15 to 20 cm off the ground).
- Tilt the mast backwards.

**forks. Raise the forks 5 to**



**CAUTION**

**Decelerate the truck in the situations following:**

- | Turning;
- | Close the goods or pallet;
- | Close the deposit area;
- | Enter a narrow passage;
- | The condition of road surface is bad.



**WARNING**

- | Never tilt the mast with loads upraised 2m or more.
- | Don't leave or dismount from the truck when the load is raised high.

**Un-stacking load**

- when approaching the area where the load is to be retrieved, slow down your truck.
- stop the truck 30 cm far from the load.
- check the condition of the load.
- Tilt the mast forward until forks become horizontal. Elevate forks up to the position of the pallet.
- Make sure forks are positioned properly to the pallet. Move forward slowly to insert forks into the pallet as far as possible.



**CAUTION**

- | If the forks are hard to be fully inserted, use the following procedure: Move forward and insert 3/4 of the

**10 cm and move backward 10 to 20 cm with the pallet on the forks, and then fall the pallet to the stack.**

**| Move forward again to insert the forks fully.**

- Raise the forks 5 to 10 cm off the stack
- check all around the truck to insure that the path of travel is unobstructed and back away slowly.
- Lower forks to a height of 15 to 20 cm above the ground. Tilt the mast backward fully and move to the desired area.

### **Check after operation**

clean and check the truck after operation:

- Damage or leakage.
- Add grease if necessarily.
- check the tire if it is damaged or inset with foreign body.
- check the wheel hub nut if it is loose.
- check the height of electrolyte surface.
- If you haven't lift the fork to the max. height in the day, you should lift it to the max. height 2~3 times.



### **CAUTION**

**| If You find anY trouble, must repair it in time.**

**| prohibit operate the forklift before repairing it completelY.**

## 11. Deposit

### Daily Depositing

- Park your truck at the area appointed, and block the wheels to prevent accidental roll.
- Make sure the shift lever on neutral position.
- Pull up the hand brake lever.
- shut off key switch and operate the lift and tilt lever several times so that the inner pressure in the hydraulic tube will decrease.
- cramp out the electrical outlet.
- Take out the key and deposit it in a safe position.

### Deposit the truck for a long time

on the basic of the "daily depositing" you should do these checks and maintenance additional:

- Take out plug to prevent discharge and place in shade.
- Brush antirust oil on those parts which is exposed such as piston rod and axle easy-rusted.
- cover breather hole and so on which humidity easy to enter.
- cover the whole truck with mantle
- All lubrication points add the oil (grease).
- Fill up the truck body and counter weight with stow-wood to reduce bearing of the two rear wheels.
- operate the forklift once a week, and be required to lift the forks to its max. height many times .
- check the proportion and the level of electrolyte once a month.
- charge the battery equally once a month.

### WARNING

- | **The stow-wood must be single and hard enough to support the truck.**
- | **Don't use a stow-wood higher than 300mm (11.81 inch) .**
- | **Lift the truck to the height of placing on the stow-wood.**
- | **Place two same size stow-woods under the left and right sides of the truck.**
- | **After supporting the truck with stow-wood, swings the truck forward, backward, left and right, check its safety.**

### Working after long deposit

- Get rid of antirust oil.
- Discharge the gear oil from driving axle, decelerator box, and clean up the internal of them. Add new oil.
- charge the battery then install it to truck, and do not forget to connect the down-lead.
- check carefully before starting, include start, advance, and back off, turning, lift, fall, tilt and so on.

## 12. Battery

### Attention for using battery:

#### 1. No firing

The gases produced during charging can cause explosions. This gas mixture is highly explosive and must not be ignited .

Explosive gas , smoking , flame and sparkle easily give off in the battery, each can cause battery explosion.



#### 2. Protection against electric shock

##### **! WARNING**

- | Battery has high voltage and energy.
- | Do not bring short circuit.
- | Do not approach tools to the two poles of the battery , which can cause the sparkle.

#### 3. correct wire connection

Not allowing instead anode of cathode , otherwise , resulting in sparkle or burning or explosion.

#### 4. Do not over-discharge

If you use the energy of battery till the forklift can't move, you will shorten its working hours. when the display of battery shows low capacity, please charge it quickly.

#### 5. Inspection for electrolyte

Forbidden to use the truck when the electrolyte is shortage.

Inspection for electrolyte level every week. when electrolyte level is low , you must add distilled water to the level appointed.

##### **! WARNING**

- | The shortage of the electrolyte will cause the storage battery overheated, even cause the system part of storage battery and electric combustion.
- | vitriol include in the electrolyte can create burns, see doctor for emergency treatment quickly if touch it un-carefully.
- | Splashing to the skin or eyes: wash with water 15~20 minutes;
- | Splashing to the clothes: take it off immediately.
- | careless drinking: Instead of plenty of water and milk.
- | Wearing glasses 、 rubber overshoes and rubber glove.

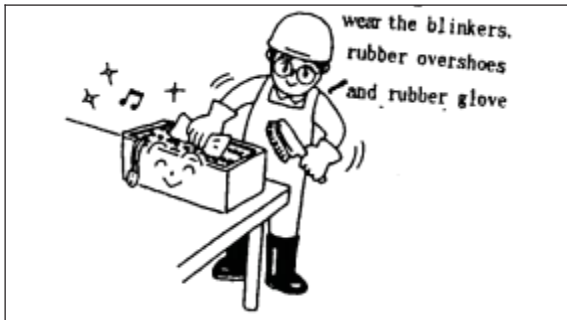
#### Remaining clean battery

keep dryness and cleanness on the surface of battery .the poles for connection are also dry and clean. operator must screw down the vent-cover of battery.

##### **! WARNING**

- | Do not use dry cloth or fiber cloth to clean the battery , avoiding static to cause the explosion.
- | Pull out battery plug.
- | cleaning with wet cloth.
- | Wearing glasses 、 rubber overshoes and rubber glove.

- when wire or electrical outlet was damaged , please do not charge.



### Measure in summer

In summer , water in the electrolyte is easy to evaporate , therefore , electrolyte must often be inspected if electrolyte is low , you must add distilled water to the level appointed.



#### **WARNING**

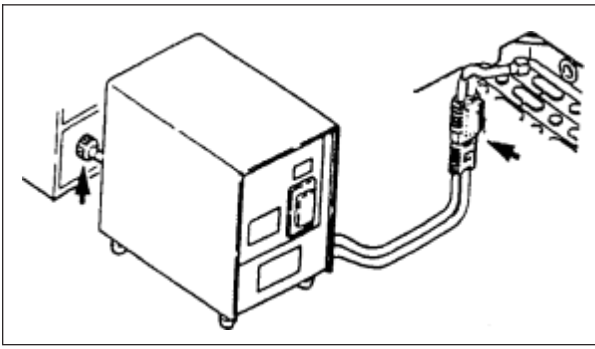
**| Filling with distilled water beyond the regulated range, spilt electrolyte will cause corrosion and electricity leakage.**

### Measure in winter

- keep effective and good surrounding for charging.
- To prevent discharging , when it is cold ,pull out the battery pin.
- Take measures , such as , covering battery for warmth.
- Charge in time after work.

### Attentions for charging

- Please charge in the well-ventilated and appointed site.
- Mark 'no smoking' when charging.
- Inspect wire and electrical outlet.
- Before charging , please examine wire and electrical outlet whether been damaged.
- Check connections whether there is loosen, fasten if any.



from destroy caused by high temperature. stop the

- open forklift cover and battery lid when charging , in order to release the explosive gas .
- In the progress of charging , electrical source switch and battery pin are not to pull out , otherwise will destroy pin and electrical units. The normal procedure is that: press down the stopping button firstly , and then pick out the pin..

#### **charger**

- The battery group is equipped with JCD-35A-24 type automatic high frequency computer to charge. The input power supply is AC single-phase with 220v, input current is not lower than 15A. The output voltage is DC36v and its max. charge current is 35A. The charging process is automatic, the detail of using method please refer to the charger operate manual.
- Connect with earth wire when the charge is used.
- To replace fuse , make sure that the input and output circuits are disconnected.
- only professional person is allowed to disassemble the cover to check and repair.
- Do not rebuild or disassemble charger.
- In high temperature season, pay attention to prevent the charge

- charge in short time when it is necessary.
- If a non-automatic charger is used, the charge voltage, current and charge time should be adjusted, and check the rate of battery electrolyte timely, so as to make sure that the charge of battery group is in good condition. The adjust parameters please refer to “battery charging” in the follow.
  - Do not continuously charge.
  - continuously charge several batteries will cause charger overheat even be damaged. You can use the charger again after it has been rested for an hour.
  - select the charger according to battery’s voltage and capacity (refer to parameter table).

	GB4554-84 or special for battery
--	----------------------------------

**specification for distilled water:**

Ingredient	Index
Appearance	No color crystal

**Battery charging**

There are two charge mode can be adopted, including intelligent charging and constant current charging. For the first charging, adopt the constant current charging.

All the batteries of the new truck are not added electrolyte.

**Electrolyte confect**

Parameter Name		Type	
		D-420	D-500 D-630B
specific gravity of acid		1.265g/c m <sup>3</sup>	1.275g/c m <sup>3</sup>
water and vitriol	volume ratio	3.1:1	2.6:1
	Quality Ratio	1.7:1	1.65:1
vitriol Ratio		1.835g/cm <sup>3</sup>	
vitriol standard		suitable for	

Dry residue	%	≤0.005
Resistivity(25 <sup>0</sup> c) Ω.cm		≥7×10 <sup>4</sup>
Fe	%	≤0.0004
Cl	%	≤0.0005
Mn	%	≤0.00002
organic compound (calculating oxygen)	%	≤0.0002
Magnesium oxide+calcium oxide	%	≤0.005
Ammonium	%	≤0.0008
Nitrate or nitrite	%	≤0.0005

be

### Confect course

- wear the blinkers, rubber overshoes and rubber glove.
- Please pay attention to add the acid to water slowly, churning up at the same time, make it mix equality.



#### CAUTION

**I Don't pour the water to the acid, in order to avoid the temperature of liquid surface turning high suddenly to cause boiling and splashing out to hurt someone.**

- when the electrolyte is cooled to 30°C, pour it into battery. It is proper to pour the electrolyte 15-20mm above the protection piece (without a dobber) or 1mm distance between dobber and cover (with a dobber).
- only when the temperature of the electrolyte is below 35°C (after about 3-5 hours), can be first charged.



#### CAUTION

**I The time that is from pouring the electrolyte into the battery to starting first charging can't**

**exceeded 12 hours.**

- The specific charging cable should be connected to charging machine.



**CAUTION**

**| Be sure to notice that the polarity sign on the plug must keep comfortably to the out specific charging end node.**

**| when the charging cable is connected to the storage batteries, please pay attention to keeping comfortably on the polarity sign. otherwise maybe you will damage your battery.**

- Inspect

The voltage value that the power needed is the number of the serial battery three times.

Inspect the charging machine.

Inspect every battery's polarity.

Truck type	Battery	Battery voltage (V)
1.0t~1.8t	D-420	48
2.0t~2.5t	D-630B	48
3.0t~3.5t	D-500	80

- charging ways : (time, current as the form) .

- 1<sup>st</sup> phase: most of the single battery's terminal voltage steps up to 2.4 V;
- 2<sup>nd</sup> phase: the electrode give off a large number of bubbles, the voltage and the specific gravity steadies 4 hours and the charging value gets to 4.5-5 times than rated capacity.

Truck type	Battery type	charging voltage (V)	charging current(A)	
			1st phase	2nd phase
1.0t~1.8t	D-420	72	40	20
2.0t~2.5t	D-630B	72	63	32
3.0t~3.5t	D-500	120	50	25
charging time (h)			35-45	35-45

- Adjusting the specific density and height for the electrolyte

If the specific gravity is smaller, it will be adjusted as follow: then take out some electrode from the battery, pour the compounded sulfuric acid that its specific gravity is 1.400g/cm<sup>3</sup>.

If the specific gravity is larger, it will be adjusted as follow: then take out some electrode from the battery, pour some distilled water, but you must keep the electrode height accord with demand

- After adjusting, you should keep charging on 1 hour; make the density of electrode even upper and under. At this time we have finished the first charging.
- close the pouring plug and clean the battery surface acid, then you can use it.

**CAUTION**

I During the charging, the temperature of electrolyte should not be exceeded  $45^{\circ}\text{C}$  . otherwise you should low the temperature. If the temperature do not lowing, you should stop recharging , till the temperature drop down.

### Daily Charging

- The battery that has been made the first charging and used regular, then charged again, is named daily charging.
- Its way is almost same as the first charging.
- The recharging value is 1.2 times than the last electric discharging. But the electric-charge for new battery's fore five times should be 1.5 times than the last electric discharging.
- During any charge, the temperature of electrode should not be exceeded  $45^{\circ}\text{C}$ , otherwise it should be taken measures such as reducing artificially charging current or lowing the temperature. If the temperature doesn't drop, you should stop charging, till the temperature dropping down.

- compared to most of the batteries , often finds that single battery's proportion of voltage and electrolyte rises slowly during the course of charge and during the

Truck type	Battery type	charging voltage (V)	charging current(A)	
			1st phase	2nd phase
1.0t~1.8t	D-420	72	55	25
2.0t~2.5t	D-630B	72	88	44
3.0t~3.5t	D-500	120	70	35
charging time (h)			4-6	6-10

Adopt intelligent charging for the daily charging. The first five charging should using Equilibrium charge according to the intelligent charger operate manual.

### Equilibrium charge

- During using of the battery, it often occur disequilibrium among the voltage, the density and the capacity.

course of discharge, its battery's proportion of voltage and electrolyte declines faster than most of other batteries.

- Make equilibrium charge in the following case:
  - a. Discharge voltage often drop down ending voltage;
  - b. Discharge current is often larger;
  - c. Not charge in time after discharge
  - d. The electrolyte is mixed with impurity with a little harm.
  - e. It often be charged deficient or has not been used for a long time;
  - f. After taking out the battery group for checking or cleaning settling.

#### **The method of Equilibrium charge:**

- Firstly, charge the battery normally, and then rest for 1 hour after the end of charge.
- charge it again with the current belongs to the second normally charge until the electrolyte gives off a large number of bubbles, then stop charging for 1 hour.
- Repeat it several times as mentioned above until the voltage and the density keep invariable and the battery gives off a large number of bubbles immediately when charge again.

#### **complementarity charge**

- If one day's work cannot be fulfilled with one charge, carry out opportunity charge during breaks.
- when the temperature of circumstance is low, carry out opportunity charge.

#### **charge for long-term storage**

- carry out equilibrium charge before storing.

- carry out equilibrium charge once every 15 to 30 days during the storage period.
- The special orders storage battery carries on the charge according to "Accumulator Instruction for use".

### Battery replacement

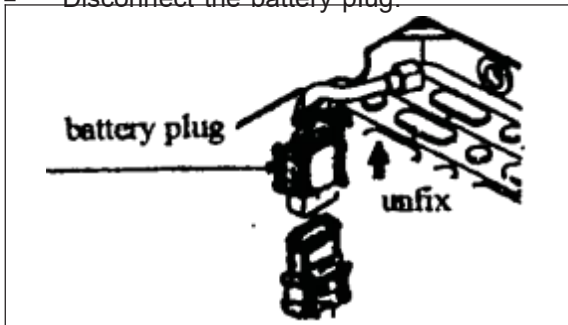


#### CAUTION

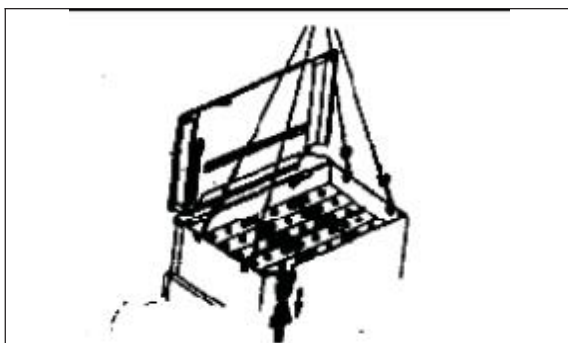
- Be sure that the Voltage, the capability, the size and the weight of the new battery are according with the forklift truck before replacing the battery.
- Forbid to use battery with different Voltage or capacity or weight except being promised by factory.

### Replacement step

- stop the forklift truck on the plain ground, pull up the hand brake lever.
- open the hood cover.
- Disconnect the battery plug.

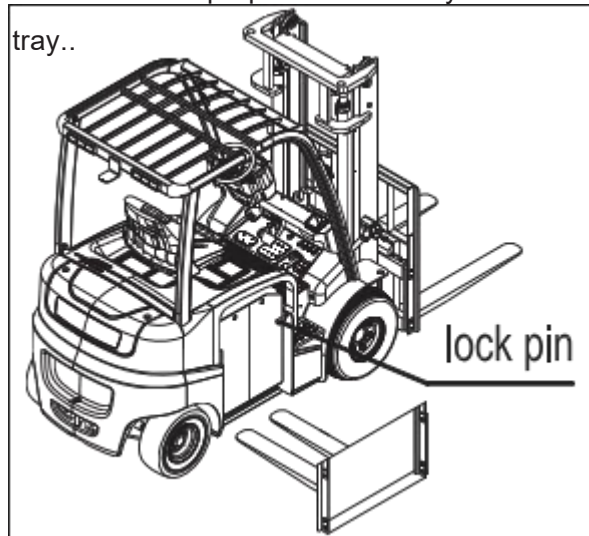


- Remove the lock pin.
- use the proper tools to pull up the battery.



If you choose the forklift whose battery case

can be move out from the side, you can use the fork to prop out the battery case tray..



### Battery idposal

Batteries may only be disposed of in accordance with national environmental protection regulations or disposal laws. The manufacturer's disposal instructions must be followed.

### The weight and dimension of Battery

el weight	Mod	1.0t~1.8t
Min. weight		700 kg
Max. weight		900 kg
Dimension		980 mm×465 mm×780 mm

el weight	Mod	2.0t~2.5t
Min. weight		930 kg
Max. weight		1200 kg
Dimension		1028 mm×570 mm×780 mm

el weight	Mod	3.0t~3.5t 2.5t Long wheelbase
Min. weight		1200 kg

Max. weight	1500 kg
-------------	---------

Dimension	1028 mm×710 mm×780 mm
-----------	-----------------------

**CAUTION**

- | The box must be pulled up with using 4 holes of the pothook at the same time. It is not allowed to pull up with only two holes. otherwise, the asymmetric power will cause the battery damaged.
- | The steering wheel and other equipment should not be bumped, avoid being damaged when pulling up the battery box.
- | when you lift the battery side-on, you need to keep it stable and lift it slowly, to avoid hitting against the forklift which will break the battery.

- After exchange the full electricity of battery, plug into the lock pin, shut to the hood cover, and plug into the pin of the battery hard.

The waste electrolyte of the replaced battery should be dealt according to environment and protection law rather than reject at will.

**The proportion and level of electrolyte**

**CAUTION**

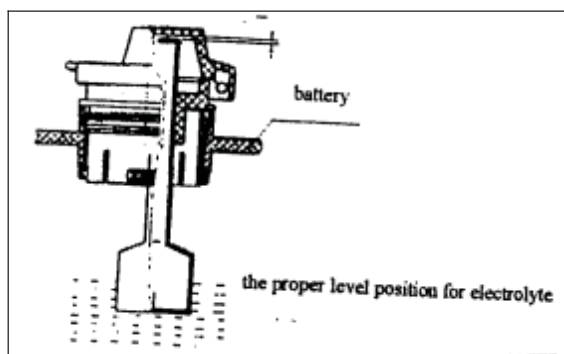
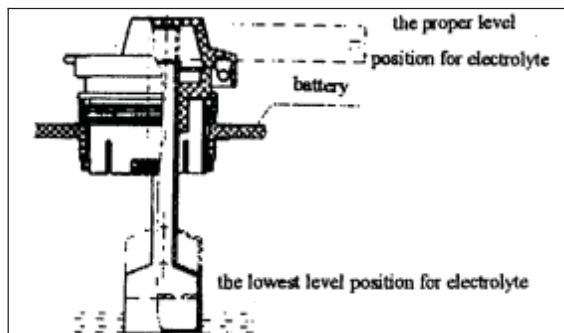
- | If the level of the electrolyte is low, using the battery will cause the battery over-heat and shorten the battery's life.

**1. Inspect electrolyte**

The battery without a dobber

The battery with a dobber

Depending on the dobber of the winded cover, and read the level position of the electrolyte.



**2. Replenish the distilled water**

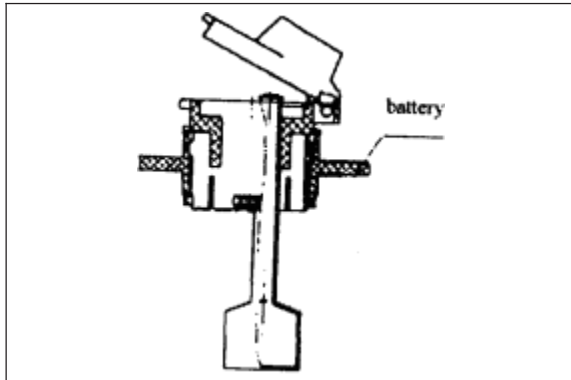
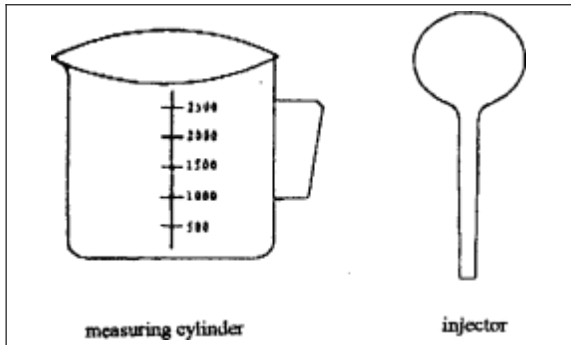
wear the blinkers, rubber overshoes and rubber glove.

- using the measuring cylinder to take out the distilled water with a certain quantity.
- open the battery cover for every battery cell.
- Imbibe distilled water with injector and then supply it into the battery.

The battery with a dobber

when the red dobber rises, the white line is appeared, please stop to replenish the distilled water.

It is proper to pour the electrolyte 15-20mm above the electrode plate.



The battery without a dobber

when the electrolyte is above 15-20mm of the electrode plate, stop replenishing the distilled water.

- After replenishing the distilled water, close the pouring plug and battery cover.
- using the damp cloth to clean the surface of every battery cell.



### CAUTION

It is not permitted to overrun the appointed tiptop level when replenishing the distilled water. Adding it too much will result in leakage of electrolyte, and it will damage the truck when charging and discharging..

Draw it out with injector if adding it too much.

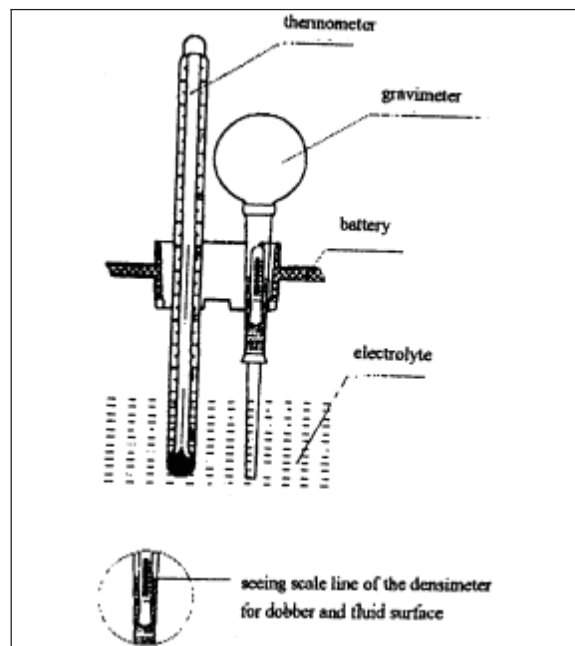
### 3. Read the specific gravity

- The specific gravity of the electrolyte should change follow the temperature.
  - a. use thermometer to measure the temperature of electrolyte.

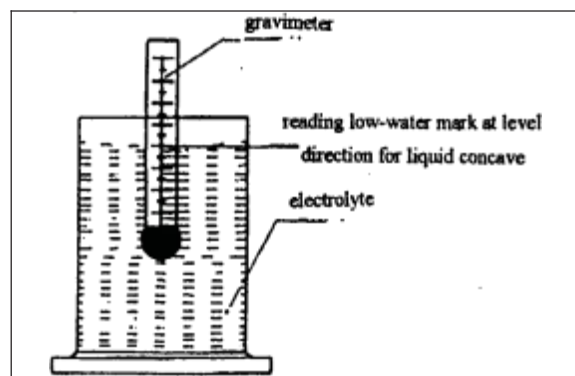
b. put the straw of densimeter into electrolyte uprightly, extrude rubber tube with hand and the electrolyte will be sucked into the glasses tube and then the floater of the densimeter will float.

c. Numerate the reading of the densimeter.

**Notice:** The dobber of densimeter must rise uprightly without depending on the glass pipe.



- specific gravity measure using the densimeter to measure the specific gravity.



- conversion of the specific gravity  
The specific gravity at the standard temperature of 30°C should be converted as follow:

$$D_{30} = D_t + 0.0007(t - 30)$$

where :  $D_{30}$  —the specific gravity at  
the standard temperature of  $30^{\circ}\text{C}$

$D_t$  —the specific gravity at the  
temperature of  $t^{\circ}\text{C}$ .

$t$  — the temperature of the distilled  
water during convert.

The specific gravity that was refered in  
this book is measured all at the  
temperature of  $30^{\circ}\text{C}$ .

### 13. Maintenance summarization

- The fork lift truck needs inspection and maintenance periodically so as to make it in good working condition.
- Inspection and maintenance are usually ignored; you'd better find the problems and solve it in time.
- Use the orthodoxy spare part of HANGCHA GROUP CO., LTD.
- Don't use different oil when changing or adding oil.
- Forbid to repair the fork lift truck if you haven't been trained.
- Don't rave about oil and electrolyte used at will, and carry on handling according to the local environmental protection laws and regulations.
- Maintenance on schedule.
- After you make maintenance, you'd better make a record.



#### **CAUTION**

- | **No smoking.**
- | **You should shut off key switch and pull off the plug before service(except some trouble shooting).**
- | **Clean the electric part with compress air, do not with water.**
- | **Do not place your hands, feet or any part of body into the gap between the mast and instrument.**

#### **The weight of the counterweight:**

Tonnage	1.0 t /1.5 t	1.8 t	2.0 t 2.5t Long wheelbase	2.5 t	3.0 t	3.5 t
weight	570±15 kg	780±20 kg	700 kg	1020 kg	1170 kg	1540 kg

**preventive maintenance schedule**

O— check, revise, adjust    × — Replace  
 D—Daily; w—weeklY; M—MOnthlY; T—TrimOnthlY; s—semiannuallY

**BatterY**

Item	service required	TOOLS	D (8 h)	w (40 h)	M (166 h)	T (500 h)	s (1000 h)
Battery	Electrolyte level	Eyeballin g		O	O	O	O
	Electrolyte proportion	Densimet er		O	O	O	O
	Battery quantity		O	O	O	O	O
	Terminal looseness		O	O	O	O	O
	Looseness of connecting wire		O	O	O	O	O
	cleanness of the battery surface		O	O	O	O	O
	If there are tools on the battery.		O	O	O	O	O
	The tightness and smoothness of air cap			O			
	Far away from firing		O	O	O	O	O

**cOntrOller**

Item	service required	TOOLS	D (8 h)	w (40 h)	M (166 h)	T (500 h)	s (1000 h)
controller	check connector for worn					O	O
	check contactor for running					O	O
	check micromove switch for running					O	O
	check the connection among motor, battery and power unit.					O	O
	check the controller error diagnose system						First time 2 years

### MOTOr

Item	service required	TOOLS	D (8 h)	w (40 h)	M (166 h)	T (500 h)	s (1000 h)
Motor	clean the foreign body on the motor				○	○	○
	clean or replace the bearing						○
	check the carbon brush and commutator for worn, whether spring is normal				○	○	○
	whether the connection is correct and firm.				○	○	○
	Brush carbon powder on shift plate and shift device.					○	○

### Driving system

Item	service required	TOOLS	D (8 h)	w (40 h)	M (166 h)	T (500 h)	s (1000 h)
Heck wheel hub bolts for tighten torque	check for noise		○	○	○	○	○
	check for oil leaks		○	○	○	○	○
	change oil						×
	check wheel hub bearing for looseness,noise			○	○	○	○
	clean and replace grease					×	×
	Leakage check		○	○	○	○	○
	check wheel hub bolts for tighten torque				○	○	○

### wheels (FrOnt, Rear wheels)

Item	service required	TOOLS	D (8 h)	w (40 h)	M (166 h)	T (500 h)	s (1000 h)
Tyre	check for charge pressure	Barometer	○	○	○	○	○
	check for abrasion, cracks or damage		○	○	○	○	○
	check for spikes, stones or foreign				○	○	○

matter						
check the wheel hub for damage		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
check the split body wheel hub-bolts for looseness	Test hammer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**steering system**

Item	service required	TOOLS	D (8 h)	w (40 h)	M (166 h)	T (500 h)	s (1000 h)
steering wheel	check for clearance		○	○	○	○	○
	check for radial looseness		○	○	○	○	○
	check for axial looseness		○	○	○	○	○
	check for operation		○	○	○	○	○
steering Gear box and valve	check mounting bolts for looseness				○	○	○
steering axle	check king pins for looseness or damage				○	○	○
	check for deflection, deformation, cracks or damage				○	○	○
	check for fixing condition	Test hammer			○	○	○
steering cylinder	check for operation		○	○	○	○	○
	check for oil leaks		○	○	○	○	○
	check for looseness when fixing or hinging				○	○	○

## Brake system

Item	service required	TOOLS	D (8 h)	w (40 h)	M (166 h)	T (500 h)	s (1000 h)
Brake pedal	check for free travel	scale	○	○	○	○	○
	check for pedal travel		○	○	○	○	○
	check for operation		○	○	○	○	○
	check for air mixed in brake piping		○	○	○	○	○
parking brake	check for lever is securely locked and has sufficient lever stroke		○	○	○	○	○
	check for operation		○	○	○	○	○
Rod, cable, etc	check for operation				○	○	○
	check connections for looseness				○	○	○
	check decelerator connector lug for abrasion					○	○
Hoses and pipes	check for damage, leakage or collapse				○	○	○
	check connection or clamping parts for looseness				○	○	○
Brake master cylinder and wheel cylinder	check for leakage		○	○	○	○	○
	check for fluid level, change brake fluid		○	○	○		×
	check master cylinder and wheel cylinder for operation					○	○
	check master cylinder and wheel cylinders for fluid leaks or damage					○	○
	check master cylinder piston cup, and check valve for wear or damage change						×

## Hydraulic system

Item	service required	TOOLS	D (8 h)	w (40 h)	M (166 h)	T (500 h)	s (1000 h)
Hydraulic reservoir	check for oil level, change oil		○	○	○	○	×
	clean suction strainer						○
	clean foreign matter						○
control lever	check levers for looseness		○	○	○	○	○
	check for operation		○	○	○	○	○
control valve	check for oil leak		○	○	○	○	○
	check relief valve and tilt lock valve for operation				○	○	○
	Measure relief pressure	oil press gauge					○
Hose, piping Hose Reel & swivel Joint	check for oil leak, looseness, collapse, deformation and damage				○	○	○
	Replace hoses.						× 1-2 years
Hydraulic pump	check hydraulic pump for oil leak or noise		○	○	○	○	○
	check pump drive gear for wear				○	○	○

## Lifting system

Item	service required	TOOLS	D (8 h)	w (40 h)	M (166 h)	T (500 h)	s (1000 h)
chains & sheave	check chain for tension, damage or rust		○	○	○	○	○
	Add lubrication for chains				○	○	○
	check connection of chain anchor pin and chain for looseness				○	○	○
	check sheaves for deformation or damage				○	○	○
	check sheave bearings for looseness				○	○	○
Attachment	perform general inspection				○	○	○
Lifting cylinder and tilting cylinder	check piston rod, rod screw and connection for looseness deformation or damage	Test hammer	○	○	○	○	○
	check cylinders for operation		○	○	○	○	○
	check for oil leak		○	○	○	○	○
	check pins and cylinder bushings for wear or damage				○	○	○
Fork	check forks for damage, deformation or wear				○	○	○
	check for stopper pins for damage or wear					○	○
	check fork base and hook welding for defective cracks or wear				○	○	○
	check weld between cross members with outer and inner masts for defective, cracks or damage				○	○	○
	check tilt cylinder bracket and mast for defective weld ,cracks or damage				○	○	○

check outer and inner masts for defective weld, cracks or damage				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
check for defective weld, cracks or damage of lift bracket				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
check roller bearings for looseness				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
check mast support bushings for wear or damage						<input type="radio"/>
check mast support cap bolts for looseness	Test hammer			<input type="radio"/> (for 1st time )		<input type="radio"/>
check lift cylinder tall bolts, piston rod head bolts, U-bolts, and piston head guide bolts for looseness	Test hammer			<input type="radio"/> (for 1st time )		<input type="radio"/>
check rollers, roller pins and welded parts for cracks or damage				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**others**

<b>Item</b>	<b>service required</b>	<b>TOOLS</b>	<b>D (8 h)</b>	<b>w (40 h)</b>	<b>M (166 h)</b>	<b>T (500 h)</b>	<b>s (1000 h)</b>
overhead	check for tight installation	Test hammer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Guard & Load Backrest	check for deformation, cracks or damage		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Turn signal	check for proper operation and tight installation		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Horn	check for proper operation and tight installation		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Light & Lamps	check for proper operation and tight installation		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buck-up Buzzer	check for proper operation and tight installation		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meters	check meters for proper operation		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
wire	wire damage or looseness			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Looseness of Electric circuit Joint				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Replace the key safe parts termly

- some parts should be checked periodically to detect the damage, for improving the safety, users should replace the parts periodically Which are listed in the table as follows.
- If the parts are abnormal before the replacing time is coming, it should be replaced immediately.

key safe parts description	Term of using (year)
Brake hose or tube	1~2
HYdraulic hose for lifting sYstem	1~2
Lifting chain	2~4
High-pressure hose , hose for hYdraulic sYstem	2
Brake oil cup	2~4
Brake master cYlinder , brake slave cYlinder cover and dust sleeve	1
Inner hermetic , rubber matter	2
Rubber pad of the steering axle	4

**Table for boltS tightening torque**

**unit: N.m**

<b>BoltS diameter</b>	<b>Grade</b>			
	<b>4.6</b>	<b>5.6</b>	<b>6.6</b>	<b>8.8</b>
<b>6</b>	4~5	5~7	6~8	9~12
<b>8</b>	10~12	12~15	14~18	22~29
<b>10</b>	20~25	25~31	29~39	44~58
<b>12</b>	35~44	44~54	49~64	76~107
<b>14</b>	54~69	69~88	83~98	121~162
<b>16</b>	88~108	108~137	127~157	189~252
<b>18</b>	118~147	147~186	176~216	260~347
<b>20</b>	167~206	206~265	245~314	369~492
<b>22</b>	225~284	284~343	343~431	502~669
<b>24</b>	294~370	370~441	441~539	638~850
<b>27</b>	441~519	539~686	637~784	933~1244

**Note:**

I use entirely 8.8 grade bolt in the important joint position.

I Bolt's grade can be found in the head of the bolt, if it can't be found, the grade is 8.8.

**Table for oil Used in the truck**

<b>Name</b>	<b>Trademark, code name</b>	<b>capability</b>	<b>Remark</b>
Hydraulic oil	Normally: L- HM32 Cold environment :L-HV32	35 L	
Gear oil	GL-585W/90	4.5 L	1.0t~1.8t
		6 L	2.0t~3.5t
Brake Fluid	(Choice) HZY3 or DOT3	1.5 L	
Industrial Vaseline	2#		Electrode of storage battery
Lubrication grease	Automobile general lithium base lubricant		

#### **14. The use, Install and safety Rules of attachment**

HANGCHA will choose attachment that according with International standard ISO2328 《Forklift pothook fork and install size of carriage》, such as clamp, rotator, paper roll clamp, carrying ram, side-shifter ect.

##### **Attachment use**

- know well the content of nameplate on attachment, read the instruction manual before
- usage.(Especially the manual from attachment company)Before operate the attachment, the people should be trained and obtain the qualification.
- It should be understand the basic capability and operate methods of attachment. Especially the admit load, lift height, size of cargo and adapt range of attachment.
- operate the multi-functional attachment, such as with side-shifter, clamp or rotator, it is not allowed that two action at one time. operate one functional then do another one.
- prohibit the cargo at a high position when truck move with attachment. If the size of cargo is too big, prohibit the truck move on. Transport the cargo, make sure that the distance of bottom of cargo and ground is less than 300mm and mast incline back.
- The weight of cargo couldn't exceed the limited value of combination carrying capacity of forklift and attachment. It is not allowed that partial load at high position. It is a short time work for attachment with side-shifter. partial load is around 100mm (Above 5 ton (including 5 ton),the side-shifter movable within 300mm.
- In the range of the projection forth 2m of the lower of attachment and cargo, prohibit stand to avoid the suddenness except the driver position under overhead.
- It is not allowed that an emergency brake in moving. Run slowly with load.
- prohibit outside force when attachment working.
- It couldn't be use at malfeasance situation and overstep normal work range.
- when the attachment failure, prohibit use without check.

##### **check and maintenance:**

- check the clearance of carriage beam and below catch of attachment if accord the attachment manual.
- check the rise catch is right on the flute of fork carriage.
- use the auto currency lithic-grease per 500 hours to bearing surface.
- If the tighten firmware become flexible.
- check the tie-in of hydraulic pressure loop, if tube attain. prohibit use after repair.
- check the drive of attachment timing or turn the component if fray or block, change betimes.
- check each element if in normal under load attachment is work in gear. If not, check the hydraulic pressure loop, find out the broken part, change air poof or whole loop part.

## Attachment assy



### **WARNING**

- | **untempered technology licence of our company, any refit at safety and capability to attachment is strict prohibit.**
- | **Fact rating load capacity should be the least of rating load capacity, the load capacity of attachment, colligate load capacity of truck. Generally speaking, the colligate load capacity of truck is the least. Attachment load capacity just a count value of attachment pressure.**
- | **Assy go to in reason, credibility, safety to avoid the attachment glide around carriage in using.**
- | **After hang attachment, embed the rise catch block to the gap of top beam, let the offset of centre line of attachment and carriage is less than 50mm.otherwise,it will be affect the landscape orientation stability of forklift.**
- | **To these attachment with rotating function, such as paper roll clamp, bale clamp, muti-purpose clamp, drum clamp, it needs to weld chock block in the joint of carriage beam and attachment to prevent move from side to side in the operation.**
- | **Assy the attachment of below catch orientation, it need to adjust the clearance between below catch and beam of carriage.**

## 15. Battery automatic filling water system(optional)

### Makeup of the automatic filling watering system:

- Automatic watering Plug
- End Plug
- Floater
- T-piece & L-piece
- Flow Indicator (with filter)
- 6mm, 8mm ,10mm watering pipe
- Male & Female couplings (Kv10 and Kv6, etc.)
- water Tank



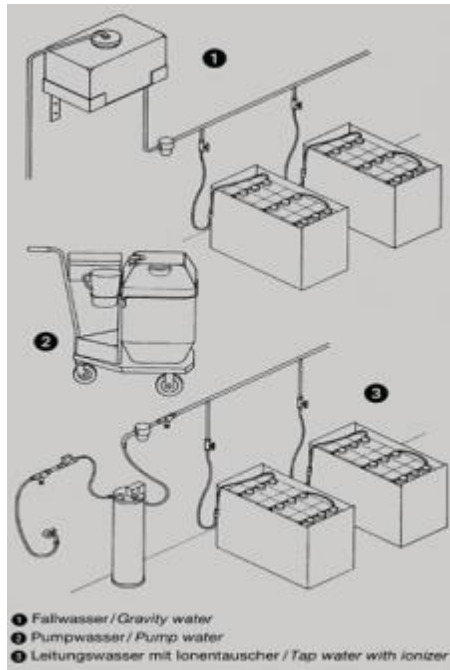
### Application specification and installation

During the period of development and long-term practical usage, the leak tightness of automatic watering system has received complete recognition.

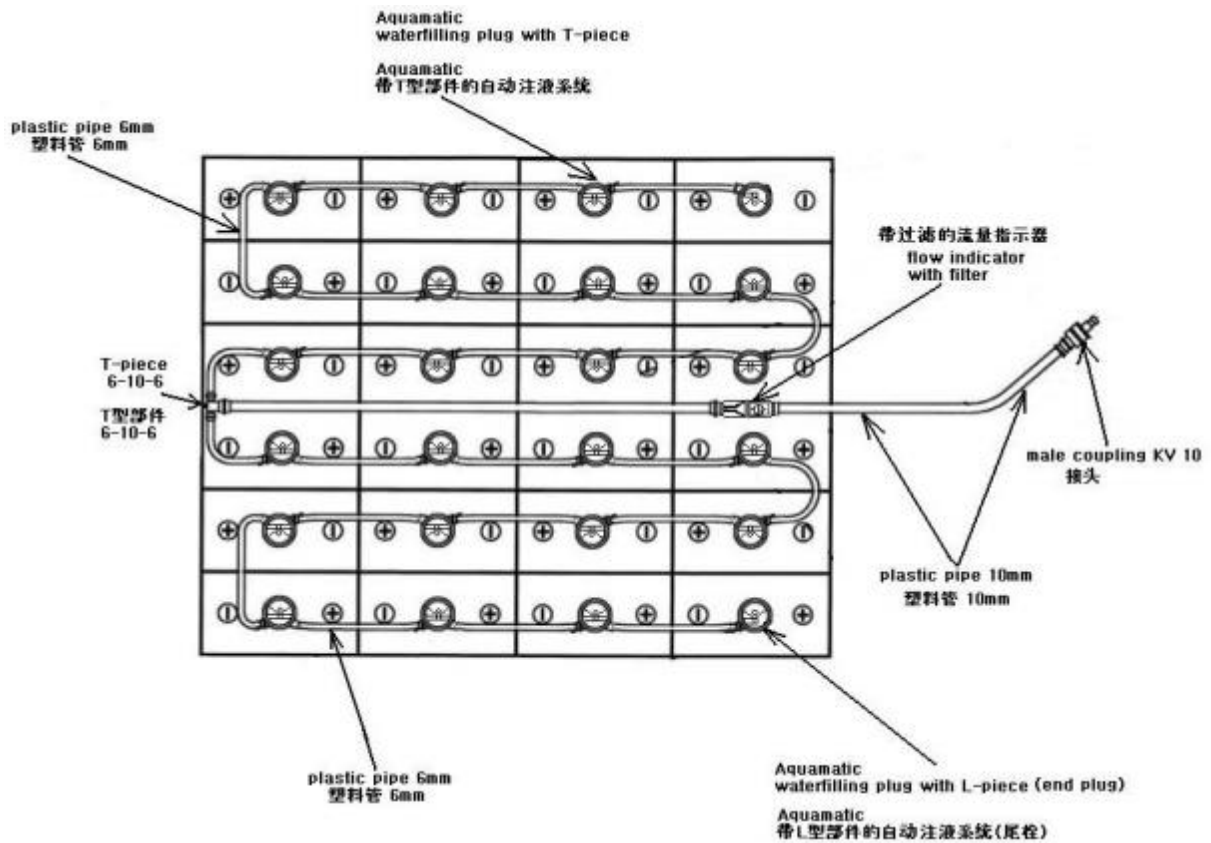
But when you use it, you need to keep the automatic watering system clean and there can't be any filth on the surface.

How to properly install the automatic watering system: our automatic watering system is easy to operate, no need to finish watering the electrolyte in the storage battery by hand, time saving and labor saving, besides, it can extend the service life.

How to correctly install the water tank, choose proper floaters, how to confirm the specification & quantity of the installed accessories according to different types of battery, including correct application rules for automatic watering plug, watering pipe, T/L-pieces and male/female couplings as well as the cleaning of the flow indicator. we will give you a brief introduction for the above items as follows:



Battery spec.	watering head	T-piece (6-10-6)	Flow indicator (filter)	6mm watering pipe	10mm watering pipe	end plug	Male/female K10	water tank specification
	T-piece							
24 V	12 pcs	1 pcs	1 pcs	3m	5m	2pcs	1pcs	30L 1pcs
48 V	24 pcs	1 pcs	1 pcs	5m	5m	2pcs	1pcs	30L 1pcs
80 V	40 pcs	1 pcs	1 pcs	10m	5m	2pcs	1pcs	60L 1pcs



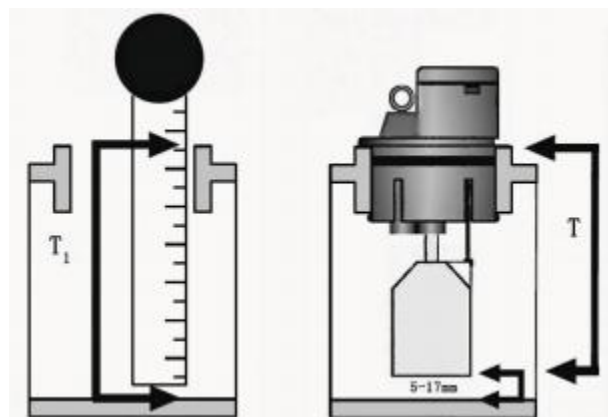
Automatic watering system of Forklift storage Battery-48v battery group

### Floater

#### How to choose proper floaters correctly:

According to different storage battery, we have five kinds of floaters for you to choose. In order to achieve our expected standard and completely reflect the effectiveness of the automatic watering system, the most important thing is to choose proper floaters. At present our company can offer a rule for the client to make judgment and choose the type of floater. (see diagram)

#### The diagram the installation waY of the floaters:



$T = T_1 - (5 \sim 17 \text{ mm})$

T approaching	47	50.5	58	61	72
Float	13	16.5	24	27	38

## watering pipe

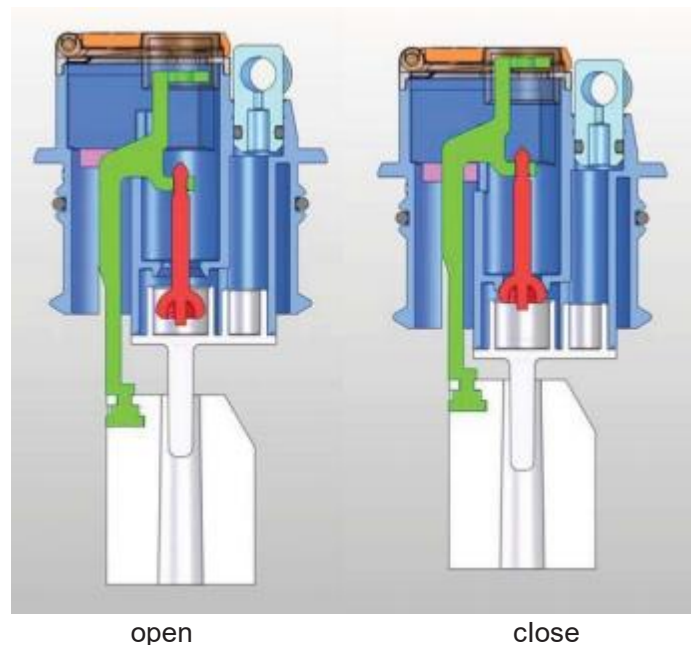
our company offers watering pipes of different types and the clients can choose what they need according to the specification of the battery. The watering pipe must be perfectly sealed with T-piece and L-piece.

### Notes during the filling process:

- In order to ensure a safe watering process, we hereby recommend you to use flow indicator (with filter), the flow indicator with filter can not only timely indicate whether it finishes watering, but also avoid unclean impurities entering the battery to result interruption.
- The watering pressure should be within the range of 0.2-0.6, no less than 200mbar.
- You'd better conduct watering within the specified periods, because frequent filling will lead to overflowing for too much water, which will do great damage to the storage battery.

Note: Filling after finishing charging is the best ideal state, besides, do not filling before charging. **Cleaning**

- During the period of development and long-term practical application, the leak tightness of automatic watering system has been completely approved.
- when you use it, you must pay much attention to keep the automatic watering system clean. No filth remaining on the surface.
- The users should regularly clean the watering plug for the plug is a kind of plastic good. Clean the surface directly with tap water and no need to use other detergent.



structure Diagram of the watering Plug

### **characteristics of the automatic filling watering system**

- No need to water by hand, labor saving.
- No malfunction factor leading to damage the battery.
- Easy & safe operation.
- Ensure a precise electrolyte level in every battery cell.
- prevent leakage when watering.
- Effectively avoid the acid liquid to erode the storage battery and the electrolytic bath.
- Extend the service life of the battery.
- Environment protection.
- save energy.

### **Function Introduction:**

- Function of the automatic watering system: the floater of the automatic watering plug can reach correct water level, when the level rises in the cell, the pressure closes the valves and prevents further water entering the cell. when the system finishes watering, the flow indicator will stop running and you can see the water-level indicator clearly through the top of the watering system.
- Besides, the material of floater can avoid damage and ineffectiveness.
- As for the structure of automatic watering system, there is a terraced step, when the electrolyte gas rises to the watering plug, the terraced part can prevent the leakage of the electrolyte gas as well as quickly cool the electrolyte gas to make them go back to the storage battery in time.

## 16. Related safety Instruction and standard(For CE)

For trucks exporting to Europe or option.

The model by CE certification which according to the following instruction and standard:

- DIRECTIVE 2006/42/EC OF THE EUROPEAN PAMENT AND OF THE COUNCIL, DIRECTIVE 2000/14/EC OF THE EUROPEAN PAMENT AND OF THE COUNCIL, EN1726-1:1998(Engineering Industry truck safety standardize), EN12053:2001, EN1175-1:1998, EN13059:2002 coordinate standard.
- Main safety factor will be according with DIRECTIVE 2006/42/EC OF THE EUROPEAN PAMENTAND OF THE COUNCIL and EN1726-1:1998 、 EN1175-1:1998 standard.
- The design and manufacture of electrical element comply with the low voltage standard 2006/95/EC.
- Noise will be according with EN12053:2001 and 2000/14/EC.  
Sound pressure level on the operator's position is lower than 75dB(A), measurement uncertainty is 1.5dB(A).  
Vibration parameters are measured according to standards of ISO5349-2:2001, EN13059:2002, ISO2631-1:1997, and the result meets the requirement of 2002/44/EC.  
whole body vibration is lower than  $1.1\text{m/s}^2$ .
- Electromagnetism compatibility is measured according to standard of EN12895:2000 , and meets the requirement of 2004/108/EC.