Aerial Work Platform Vehicle Driving Skill Training Auxiliary Textbook

This supplementary text, “Aerial Work Platform Vehicle Driving Skill Training Auxiliary Text Newly Revised”, is with the cooperation of the Japan Association of Registered Training Institutions (issued by the Japan Association of Registered Training Institutions on 1 November 2016, first revised edition). This is an excerpt from bilingual translation created in the Ministry of Health, Labor, and Welfare project commissioned in 2021. It was created to enhance educational effect or foreign workers.

Please note that when conducting skill training, it is necessary to use this supplementary material combined with the training text provided by the registered training institution, not by using it alone.

March 2022

Contents

Preface

The aerial work platform is developed and widely used with the purpose to perform work safely and can efficiently perform high-altitude work such as construction, inspection, repair, etc., at the various industrial sites starting with the electrical and communication industry, construction, shipbuilding, railway, the landscaping industry and more.

Furthermore, in recent years the aerial work platform vehicles have adopted electronic control devices, and the technological innovations in working devices and safety devices have been remarkably progressing.

However, it is regrettable that many occupational hazards occurred while working with the aerial work platform vehicle. To countermeasure this, further efforts related to proper use of aerial work platform vehicles, not only in inspection and maintenance but also in safe driving and operation, are required. (From Textbook preface)

Chapter 1　Basic knowledge about Aerial work platform vehicle

1.1　Definition of Aerial Work Platform Vehicle (Textbook page 1)

The term “Aerial Work Platform Vehicle” refers to a machine that is used for construction, inspection, repair, etc., at high altitude places, which consists of a work platform and a lifting device or other devices. The machine also has a facility for the work platform to be raised or lowered by the lifting device or other devices, which is powered and can be self-propelled to an unspecified location.

Furthermore, fire services such as ladder trucks and articulated ladder trucks used by fire-fighting organizations for fire-fighting activities are not included in aerial work platform vehicles.

※ Ministry of Health, Labor and Welfare, Labor Standards Bureau Director’s Notice (September 26, 2002, Notice No. 583))

1.2　Qualification and types of work required to drive aerial work platform vehicle

(1)　Eligibility to drive aerial work platform vehicles (Textbook page 3)

Table 1-1 Qualifications required to operate an aerial work platform vehicle

Classification \ Qualification	Persons who have completed technical training (Article 20, Paragraph 15 of the Safety and Health Ordinance)	Special education for those who have completed (Article 36, No.5 of No. 10 of the Code of Safety and Health)
Aerial work platform vehicles with a work platform height of 10m. Or more	○	×
Aerial work platform vehicles with a work platform height of less than 10m	○	○

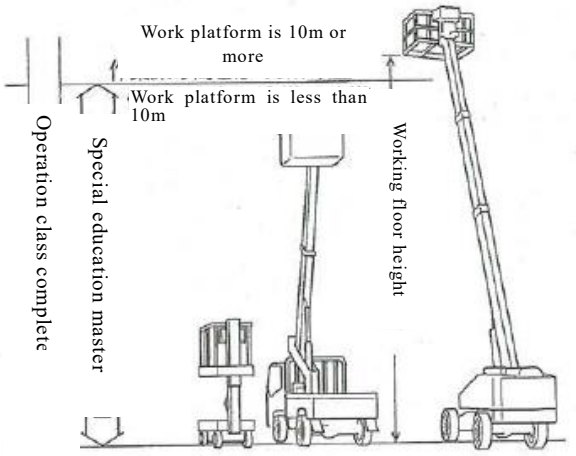


Figure 1-4 Driving Operation Qualifications

※What is the work platform height

The vertical height from the ground to the floor when the work platform (a device for loading people and loads) is raised to its highest point.

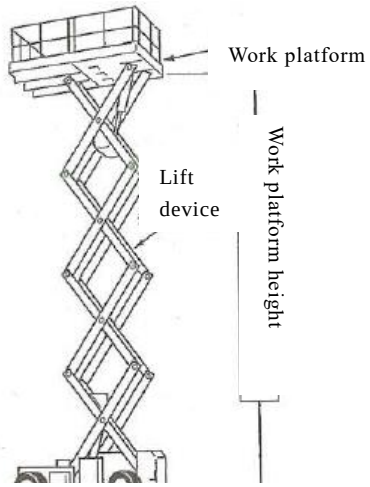


Figure1-5 Work platform height

(2) Qualification for driving aerial work platform vehicle on public roads (Textbook page 4)

A driving license is required to drive a truck-type aerial work platform vehicle if you are driving on a public road.

(3) Types of aerial work platform vehicles (Textbook page 5)

An aerial work platform vehicle consists of a working device to bring the work platform closer to the work area and a traveling device to move it to the place where the work is to be done, and various types of work trucks have been developed to suit different applications and work locations.

1) Working device (Textbook page 5)

This refers to devices in which the work platform is raised or lowered by a lifting device or other devices, and there are 4 types as follows

① Telescopic boom-type (Textbook page 5)

The boom, on which the working floor is mounted, extends, and retracts to approach the working position in a straight line.

【 Main Features 】

A. Positioning of the work platform is easy.

B. Good operability can take place if there are no obstacles in the workplace

C. Widely used in electrical and communication works, construction works, shipyards etc.

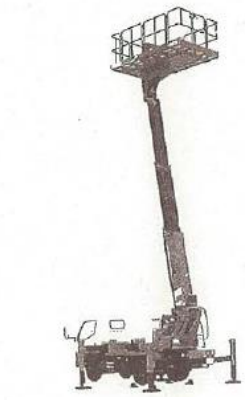


Figure 1-6 Telescopic boom type example

② Articulating boom type (Textbook page 5)

The middle of the boom can be articulated.

【 Main Features 】

A. By deflecting the boom, it is possible to enter the work platform deeply.

B. It is used for work that involves dodging obstacles along the way.

Figure 1-7 Articulating boom type example

③ Mixed boom-type (Textbook page 6)

The work platform height of less than 10m. The boom has both expansion and contraction and articulating functions.

【 Main Features 】

A. The reachable area of the work platform can be higher and wider.

B. It is often used for construction work and maintenance work that requires work in high places and in a wide range.

Figure 1-8 Mixed boom type example

④ Vertical lifting type (Textbook page 6)

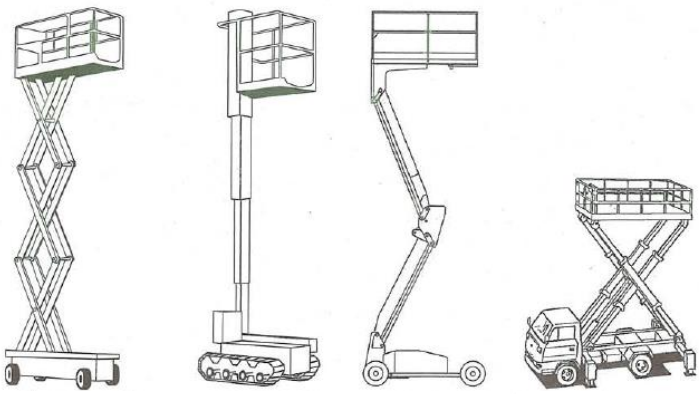
There are scissors-type, mast type, sigma type, and X type, in which the working floor can be raised and lowered vertically.

【 Main Features 】

A. The work area is limited to the upper part of the traveling device.

B. It is often used for interior and facility work in construction.

C. Many of them are relatively small.



Scissors type Mast type Sigma type X type

Figure 1-9 Vertical lifting type examples

2) Traveling Device (Textbook page 7)

A powered device that can self-propel to an unspecified location is called a traveling device, and there are 2 types: truck-type and self-propelled type.

① Truck type (Textbook page 7)

It is a type attached to a truck and can travel on ordinary roads, making it highly mobile and easy to move to the worksite. There are two types of trucks, one is an ordinary truck equipped with a working device, and the other is a large crane trolley.

【 Major features 】

A. It is possible to drive on public roads.

B. It can be moved quickly to the worksite and has good mobility.

C. It is often used for work on public roads, work of relatively short duration, maintenance, and inspection work, etc.

Applications: Short construction period sites, electrical and communication work, signboard installation, maintenance of streetlights and traffic signals, pruning, etc.

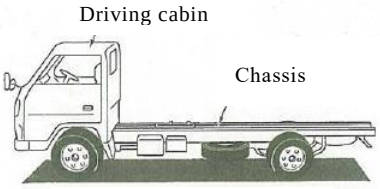


Figure 1-10 Truck type

② Self-propelled type (Textbook page 8)

Those not attached to a truck are called self-propelled type and cannot be driven on public roads. Among the self-propelled types, there are wheeled and crawler types.

a) Wheel type

The wheel type generally has four tires, of which the front or rear two are the drive wheels.

The tires used are non-punk tires. Many of them use white rubber tires that do not leave running marks on the road surface.

A hydraulic motor drives the tires through a reduction gear.

【 Main Features 】

A. It is easy to work while moving around.

B. Traveling speed is slower than the truck type.

C. Compared to the crawler type (made of iron), there is less damage to the road surface during driving.

D. Often used for maintenance and inspection in factory facilities, finishing work in construction works, shipyards, etc.

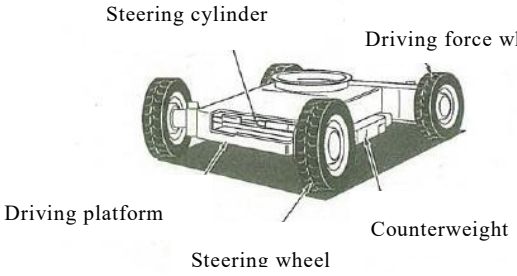


Figure 1-12 Wheel type

b) Crawler type

The crawler type also uses a hydraulic motor with a reduction gear to drive the crawler.

Some of the smaller ones use rubber crawlers and are used for indoor construction. Many of them use white rubber crawlers that do not leave running marks on the road surface easily.

【 Major features 】

A. It is easy to work while moving around.

B. As with the wheeled type, the traveling speed is slow.

C. It is possible to run on relatively uneven ground.

D. It is possible to run on relatively soft ground.

E. Often used in construction and facility work.

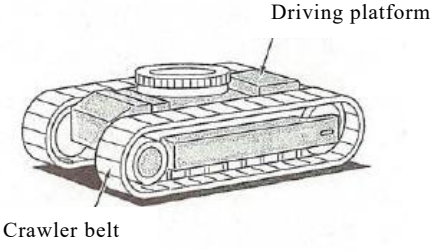


Figure 1-13 Crawler

1.3 Terms related to aerial work platform vehicles (Textbook page 14)

It is important to understand the correct terminology and meaning of aerial work platform vehicles and operate them correctly and safely.

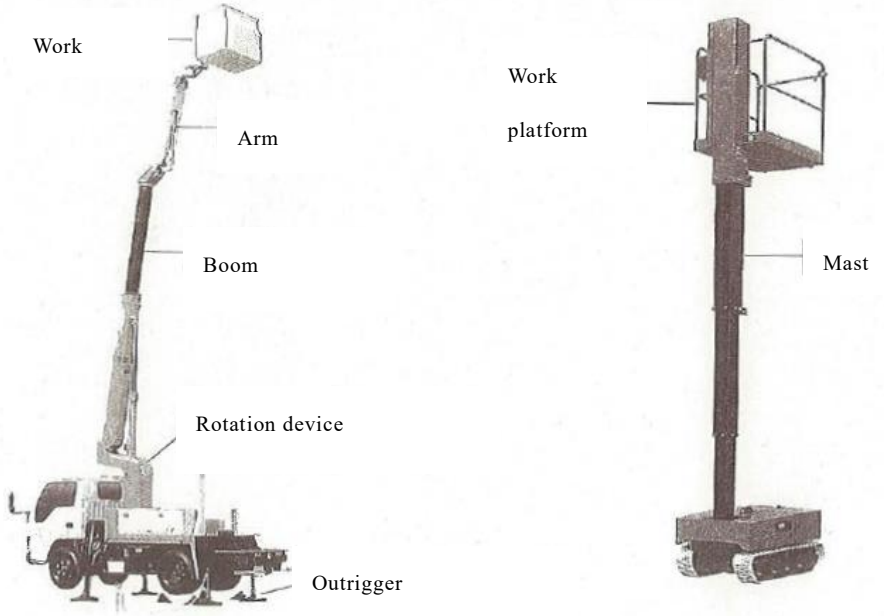


Figure 1-24 Names of each part of aerial work platform vehicles

(1) Work platform (Textbook page 15)

The device on which people and loads are placed is called the work platform.

① Platform

A handrail attached to the floor.

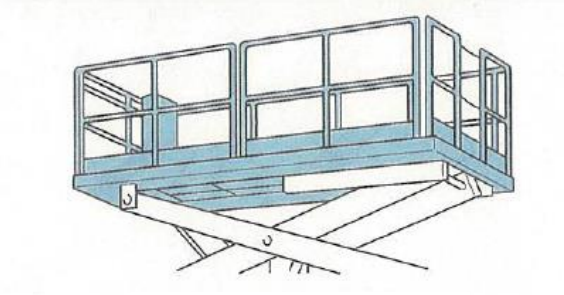


Figure 1-25 Platform

② Basket

A platform that is basket-shaped or enclosures.

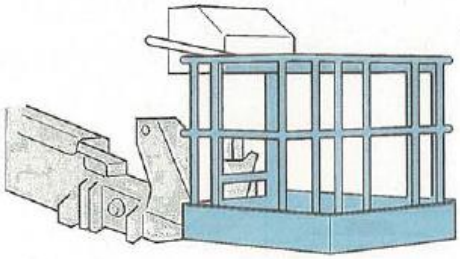


Figure 1-26 Basket

③ Bucket

Floors and enclosures are integrated.

（Note） Material：Iron or FRP※Made

※FRP：Fiber Reinforced Plastics

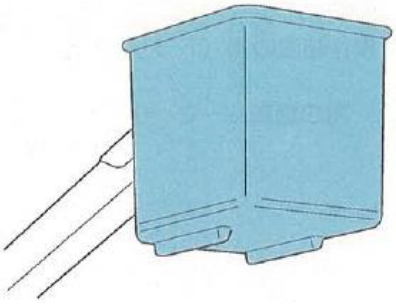


Figure 1-27 Bucket

(2) Leveling device (Textbook page 16)

A device that maintains the working floor leveled at all times.

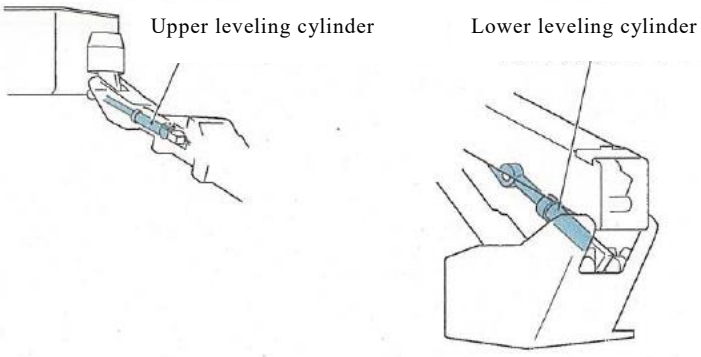
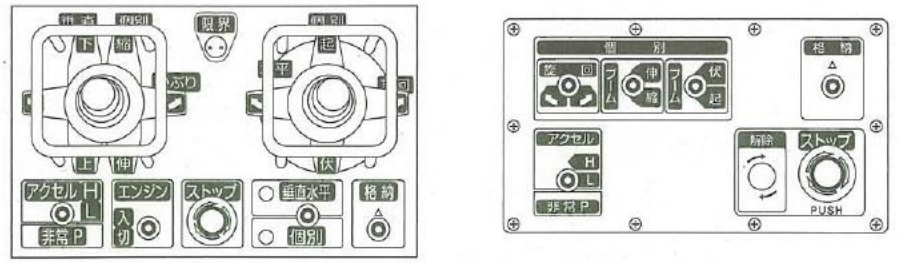


Figure 1-28 Leveling device example

(3) Operating device (Textbook page 16)

A device that operates working devices, traveling devices, etc.

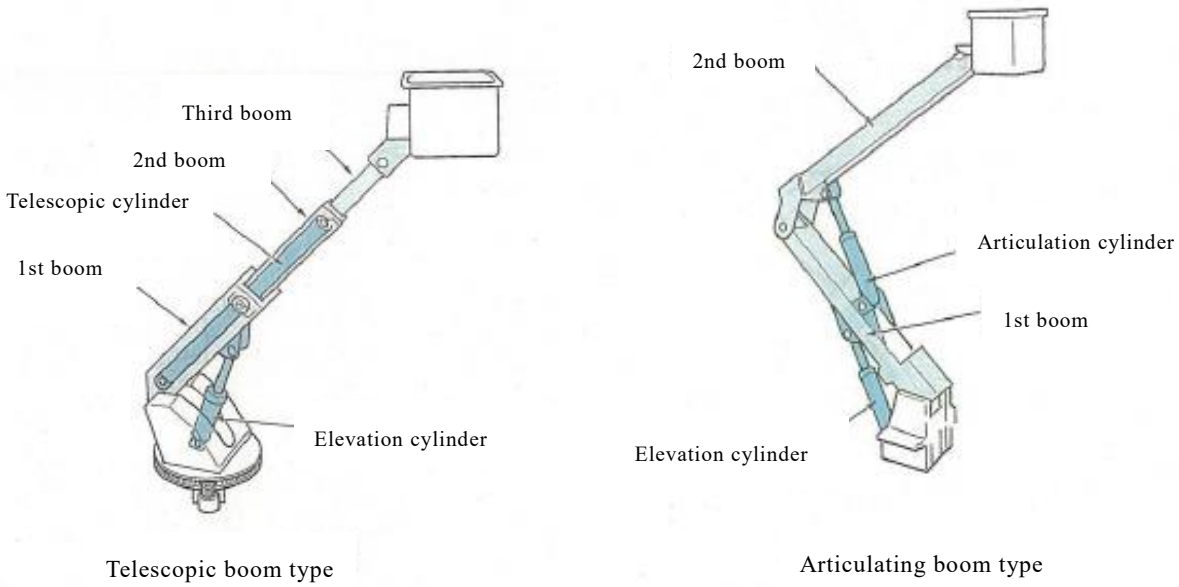


Upper control device　　Lower operation device panel

Figure 1-29 Operating device example (truck type telescopic boom type)

(4) Boom device (Textbook page 17)

A device that supports the work platform and can raise and lower, elevate, etc.



Telescopic boom type　　Articulating boom type

Figure 1-30 Boom device example

(5) Swivel device (Textbook page 18)

A device that swivels the working device.

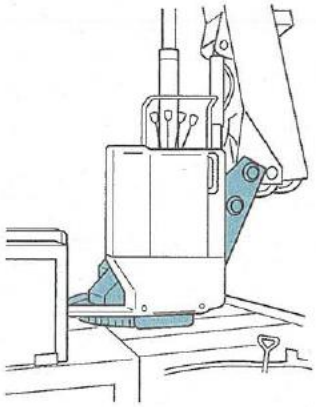


Figure 1-31 Swivel device example

(6) Outrigger (Textbook page18)

A device that secures the stability of the machine with a jack.

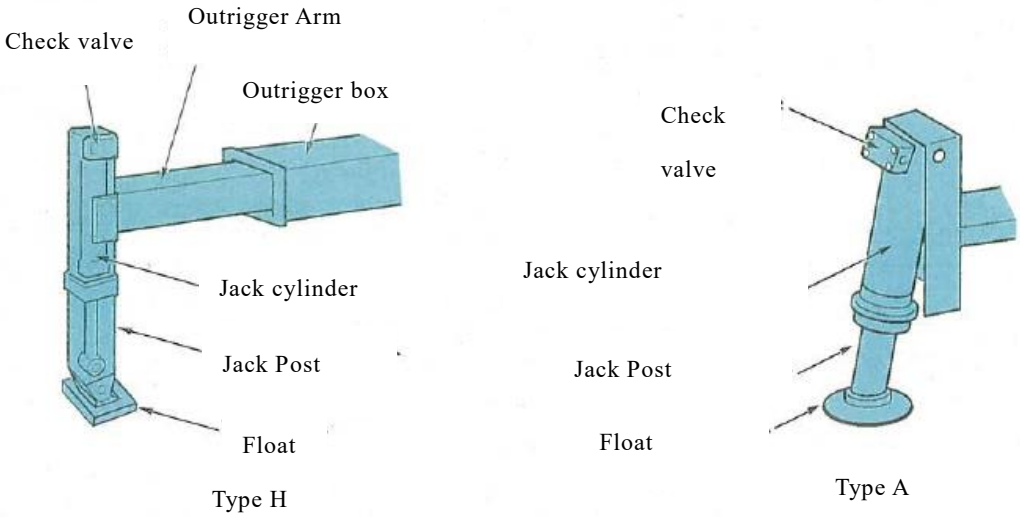


Figure 1-32 Example Outrigger

(7) Vertical Lifting Device (Textbook page19 ）

A device that raises and lowers the work platform vertically.

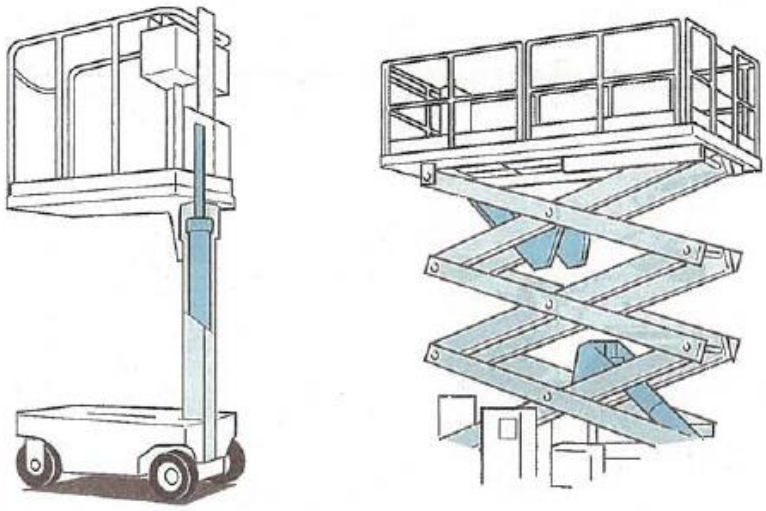
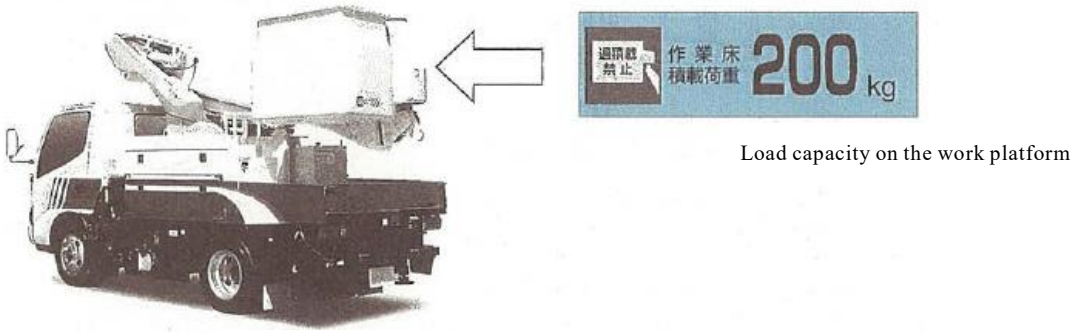


Figure 1-33 Vertical lifting device examples

(8) Load capacity (Textbook page 20 ）

This is the maximum load that can be carried with a person or load on the work platform. If a load exceeding the load capacity is applied to the work platform, it may lead to a serious accident.



Load capacity on the work platform

Figure 1-35 Plate display on the work platform

(9) Work platform height (Textbook page 20)

The vertical height from the ground to the floor surface when the work platform is raised to its highest point.

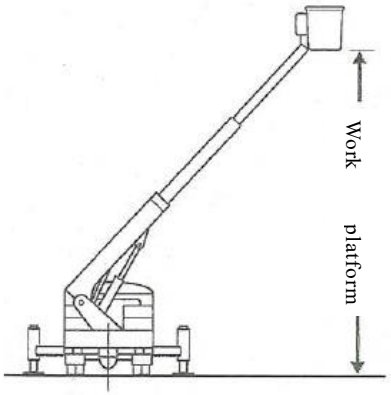


Figure 1-36Work platform height

(10) Height above ground (Textbook page 20)

The vertical height from the ground to the floor surface when the work platform is raised to an arbitrary height.

(11) Working radius (Textbook page 21)

The horizontal distance from the swing center to the leading edge of the inner surface of the work platform.

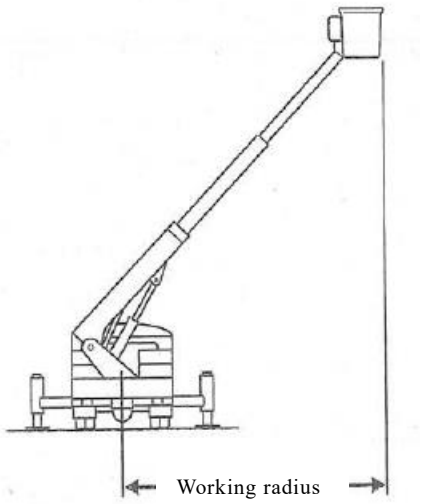


Figure 1-37 Working radius

(12) Working radius chart (Textbook page 21)

The working range varies depending on the capacity (load capacity, lifting capacity, boom length, working radius, outrigger overhang, etc.). That displays the range in which the aerial work platform vehicle can work safely.

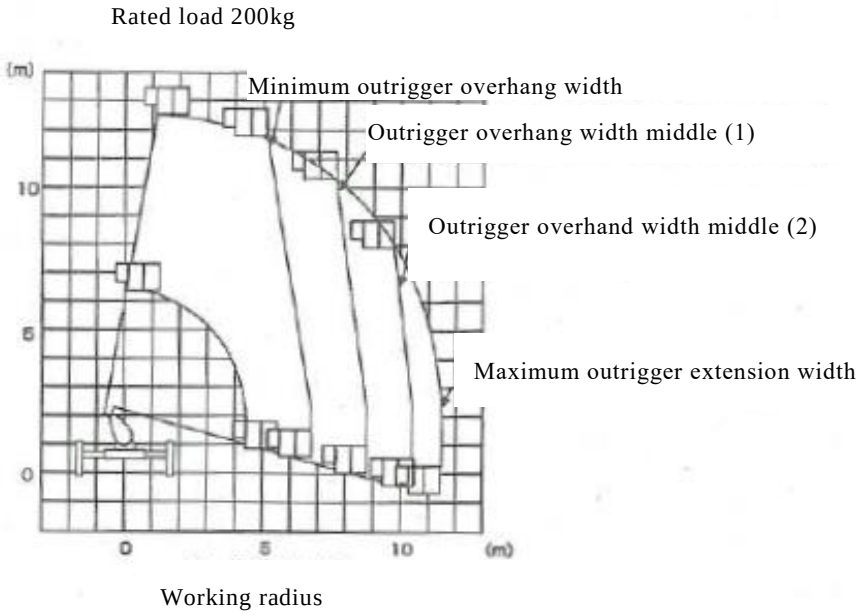


Figure 1-38 Example of working radius chart of aerial work platform vehicles

Chapter 2 Structure and handling of working devices, etc. for aerial work platform vehicles

2.1 Working device structure (Textbook page 25)

The work device of the aerial work platform vehicle is operated by hydraulic devices such as hydraulic motors and cylinders. In order to work safely, it is important to understand the structure of these working devices and safety devices, and to operate them correctly.

2.1.1 Working devices for boom-type aerial work platform vehicles

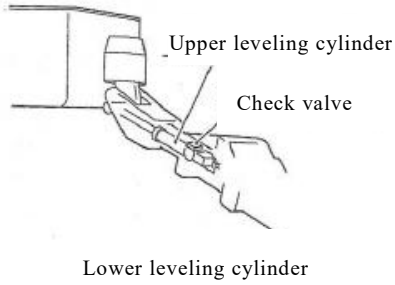
(1) Working devices (Textbook page 25)

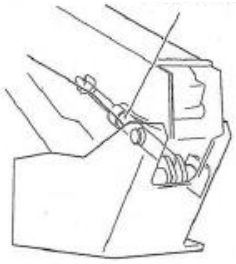
Depending on the structure of the boom, there are three types of boom-type aerial work platform vehicles: telescopic boom type, articulating boom type, and mixed boom type.

The working devices consist of boom devices, boom swinging devices, boom raising and lowering devices, work floor, work floor swinging devices, work floor leveling devices, etc.

1) Work platform Leveling System (Textbook page 28)

If the work platform tilts when the boom is raised or lowered, or articulated, there is a risk that the operator may fall from the work platform. In order to prevent this, this device always keeps the work platform leveled regardless of the boom's up-down or articulating operation. (This device is provided on all elevating work vehicles except the vertical elevating type).





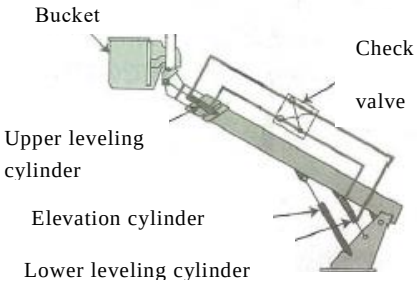


Figure 2-8 Cylinder type leveling system

① Cylinder type leveling system (telescopic boom type, mixed boom type) (Textbook page 28)

The system consists of a lower leveling cylinder connected to the first boom and the swivel base and an upper leveling cylinder connected to the tip boom and the work platform.

Hoses or pipes connect both cylinders, and the oil pushed out of the lower leveling cylinder expands and contracts the upper leveling cylinder when it is raised and lowered, always maintaining the level of the work platform.

② Wire rope (chain) type leveling system (articulating boom type, mixed boom type) (Textbook page 29)

The system consists of a wire rope and guide sheaves. The guide sheaves are attached to both ends of the first and second booms, and the wire rope is fixed to the swing platform at one end and to the work platform at the other end through these guide sheaves.

A level is maintained as the wire rope moves around the guide sheaves during raising, lowering, and articulating operations.

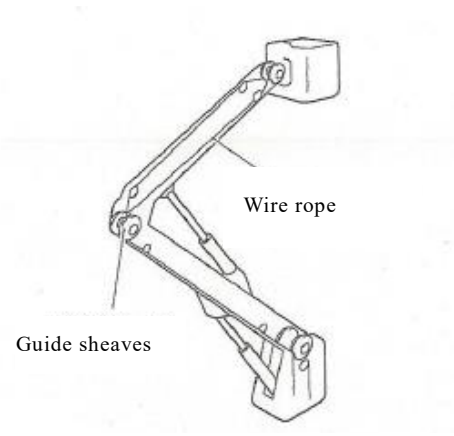


Figure 2-9Wire rope type leveling system

※ Some models use a chain instead of a wire rope.

In such cases, a sprocket is used instead of a guide sheave.

(2) Outrigger structure and characteristics (Textbook page29)

There are two types of outriggers: the H-type, which sticks out horizontally and contacts the ground, and the A-type, which makes direct contact with the ground at an angle, both of which are devices that stabilize the work vehicle at height. H-type outriggers are often used for relatively large elevating vehicles with a working floor height of 12 m or more, and A-type outriggers are often used for relatively small elevating vehicles with a working floor height of 12 m or less.

Further, the hydraulic cylinder for the jack is equipped with a check valve to prevent the cylinder from contracting when the hydraulic hose is damaged.

Many wheel-type aerial platforms and crawler-type aerial work platforms are not equipped with outriggers.

a) H-type outrigger (Textbook page 29)

The H-type outrigger consists of four outrigger arms. Mounted on the front, rear, left, and right sides of the vehicle body, respectively, and cylinders for extending the arms, jack posts, and jack cylinders.

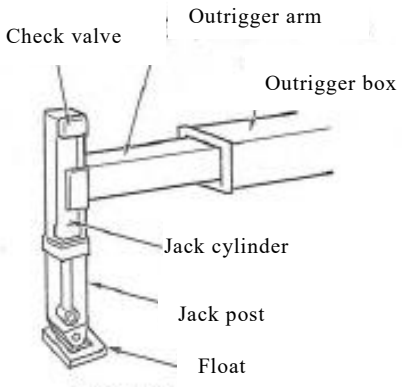


Figure 2-10 H-type outrigger

b) A-type Outrigger (Textbook page 30)

The A-type outrigger has no outrigger arm and has a structure in which the jack is projected diagonally, so it has the advantage of not requiring a large installation space.

Therefore, it is often used for relatively small telescopic boom type or articulating boom-type elevating vehicles.

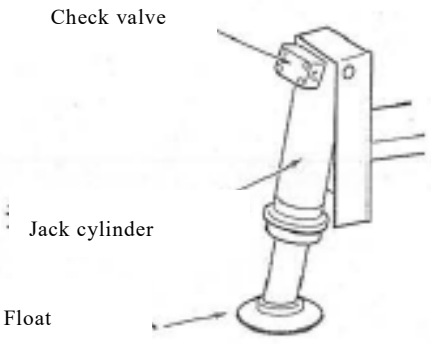


Figure 2-11 A type of Outrigger

(3) Structure and characteristics of the operating device (Textbook page 30)

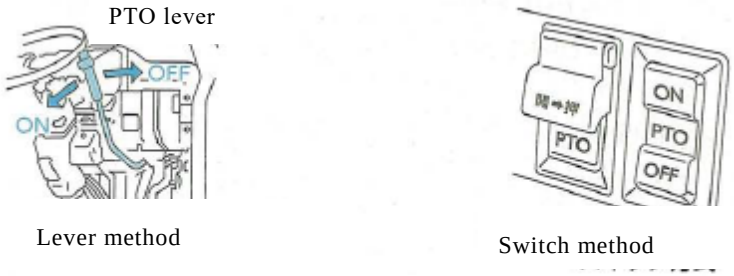
The operating devices include the PTO (Power Take-Off) changeover control (equipped only on track type) to operate the hydraulic pump, the outrigger operating device to operate the outrigger, and the lower and upper operating devices to operate the working devices.

In addition, there are electric control (switch control), lever control, and electromagnetic proportional control systems in the operating system.

1) PTO changeover control (Textbook page 30)

The clutch is installed in the cab of the truck and is used to transmit the prime mover's power to the working devices.

A lever or switch system is available, and in either case, the clutch pedal is depressed to engage or disengage the clutch.



PTO changeover control

※ At the end of the work, be sure to set the PTO to "OFF".

Running the machine while the PTO is "ON" may cause damage to the pump.

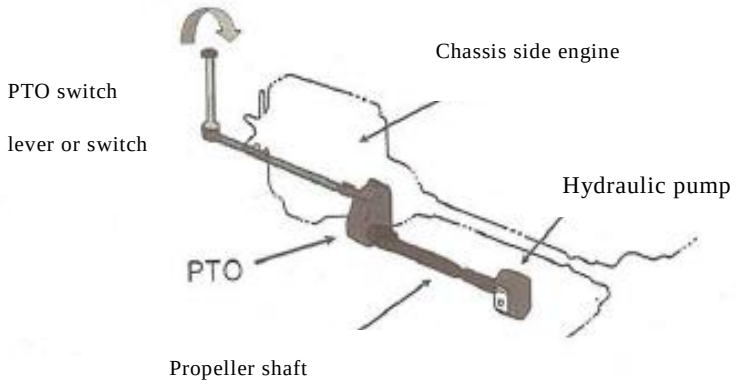


Figure 2-13 PTO changeover control

2) Outrigger Operation Device (Textbook page 31)

The outrigger operating device is equipped on the rear or left and right sides of the vehicle body and is used to operate the outrigger arm and jack cylinder.

The operating device is electrically controlled or lever-controlled, and in some cases, the engine gas pedal is linked to the operating lever.

In addition, some operating devices are equipped with a lamp to indicate the amount of slide of the outrigger arm and a level to level the elevated work vehicle.

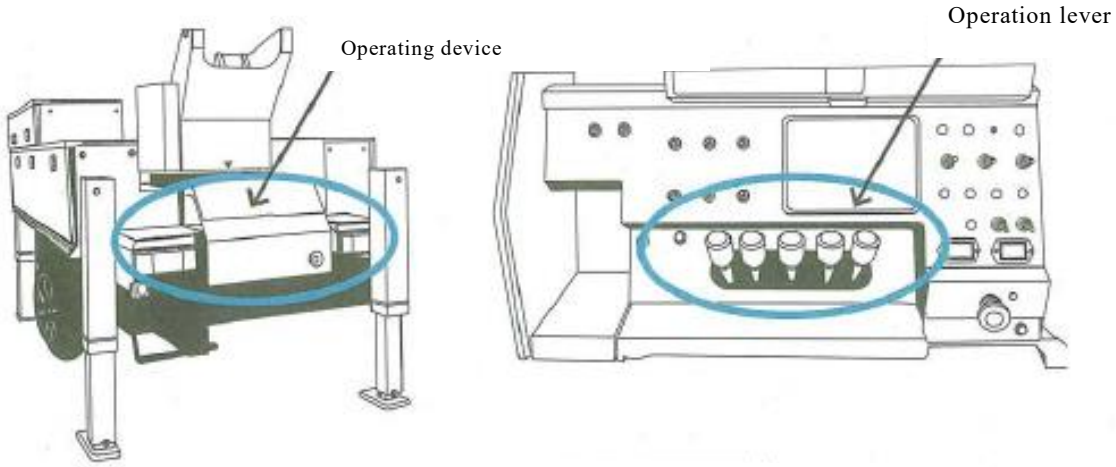


Figure 2-14 Outrigger operating device

3) Lower Control Unit (Textbook page31)

The lower control unit is installed near the swing table or lower traveling body, mainly for the purpose of pre-work inspection or in case of emergency

There are two types of operation methods: lever and switch.

Since the switch system is inferior to the fine control system, it is advisable to avoid working with the lower control unit as much as possible.

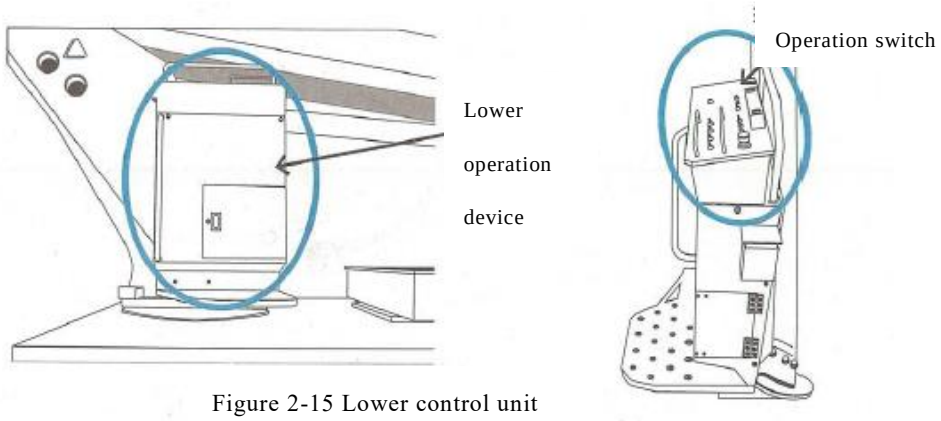


Figure 2-15 Lower control unit

4) Upper Control Unit(Textbook page32)

The upper control device is installed on the work platform and is used to bring the work platform closer to the position where it is easier to work. This device basically has the same function as the lower control device, and in addition to the lever and switch systems, the electromagnetic proportional control system has been increasing in recent years.

In addition, some upper operation devices are equipped with switches, levers, pedals, gauges, lamps, etc., for traveling operation and steering devices (self-propelled), lifting devices, work platform pivoting devices, emergency pumps, engine starters, gas pedals, etc.

In recent years, computer-controlled systems have been developed that automatically retract the boom, control the vertical and horizontal working floor, and prevent interference between the main body and the boom.

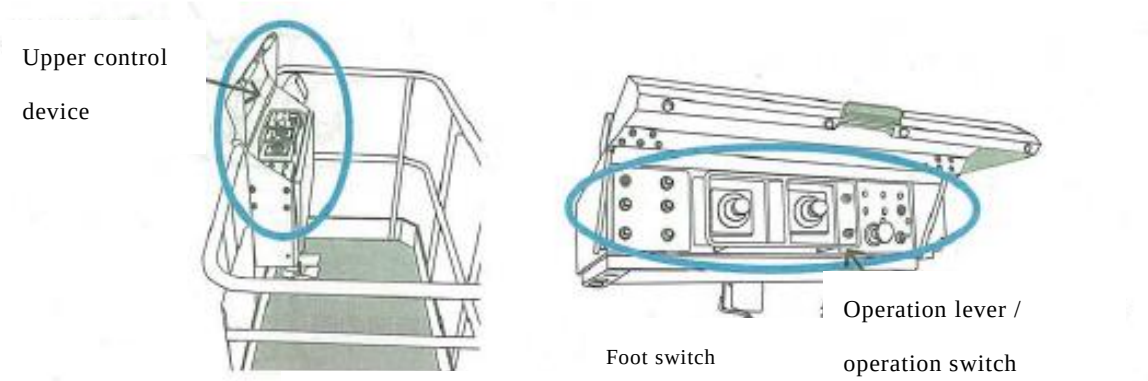


Figure 2-16 Upper control unit

2.1.2 Working Decices of Vertical Elevating Type Work Platforms (Textbook page 34)

(1) Arm

Vertical elevating type work trucks can be classified into the following 4 types according to the structure of the lift arm.

① Scissors type

② Mast type

③ Sigma type

④ X type

The scissors-type, sigma type, and X (X) type are either engine type or battery type and are used both indoors and outdoors. Most mast types are battery-powered and are often used indoors.

2.1.3 Safety device for aerial work platform vehicles (Textbook page 36)

Aerial work platform vehicles are equipped with a variety of safety devices to ensure safe and reliable work at high elevations. Some of these safety devices are specified in the Work Platforms Structure Standard, while others have been developed by the users and manufacturers of work platforms to make work safer.

As safety devices are changed or added over time, it is important to read the instruction manual carefully before use.

The following is a list of safety devices that are legally required by the structural standards for aerial work platform vehicles.

(1) Boom operation control device (Article 9 of the aerial work platform structure standard) (Textbook page 36)

The boom operation regulator is a device that automatically regulates (stops or alerts) the operation of the boom when the working floor is about to exceed the set working range, preventing the aerial work platform vehicle from tipping over.

① Telescopic boom-type (Textbook page 36)

This system electrically detects the boom angle of elevation and extension, as well as the rotation angle and outrigger extension width, and stops the up/down, boom extension, and rotating from the center of the vehicle when the working range is about to be exceeded.

This is displayed in an easy-to-understand manner in the work area diagram.

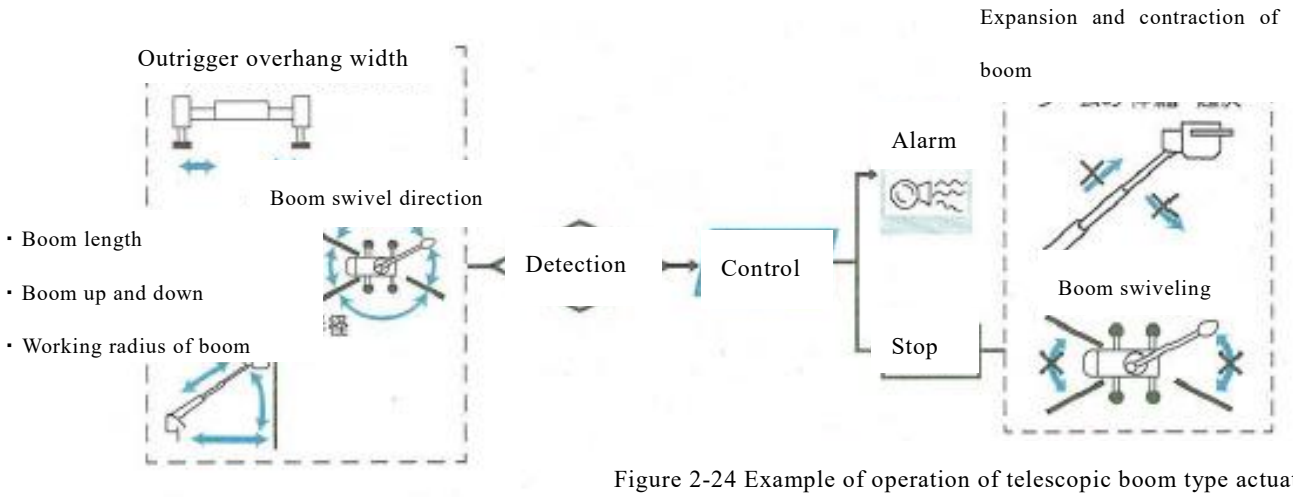


Figure 2-24 Example of operation of telescopic boom type actuation regulator

Rated load 200kg

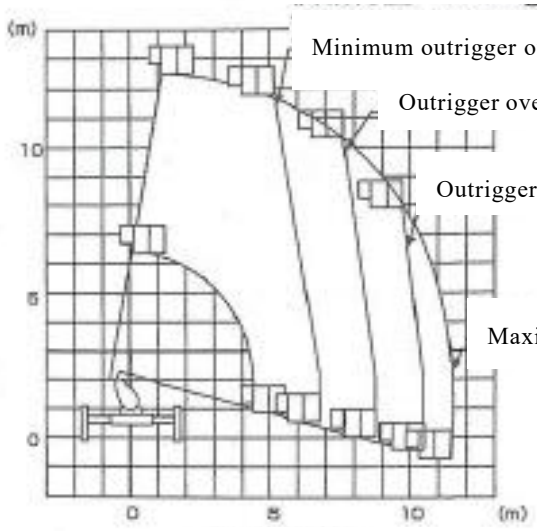


Figure 2-25 Example of telescopic boom type working radius chart

※For telescopic boom types, there are 2 types of boom operation control devices.

(a) Detected increase or decrease of the load in the work platform.

Depending on the load on the working floor, the working range also changes.

Outrigger maximum overhang width Rated load 1000kg

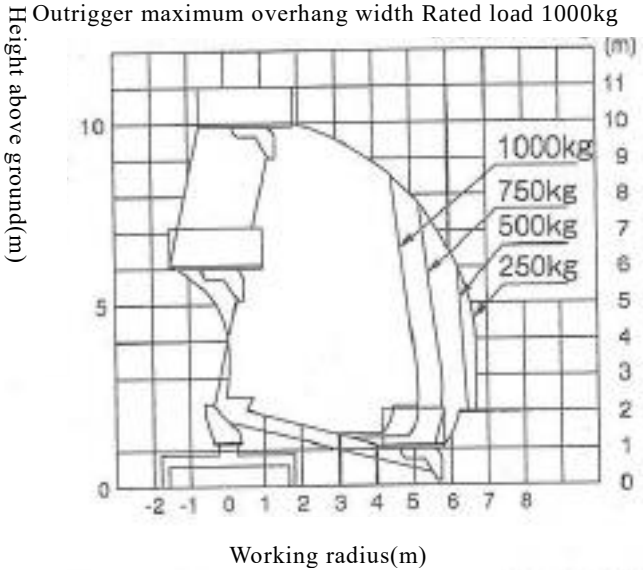


Figure 2-26 Example of telescopic boom type working radius chart

(b) Those that do not detect an increase or decrease in the load on the work platform.

The working range does not change even if the load on the working floor increases or decreases.

※(b) If the load on the working floor exceeds the load, there is a risk of not only damage to the machine but also of it tipping over.

In addition, most of the platform type detects the increase or decrease of load, while most of the basket type does not detect the increase or decrease of load.

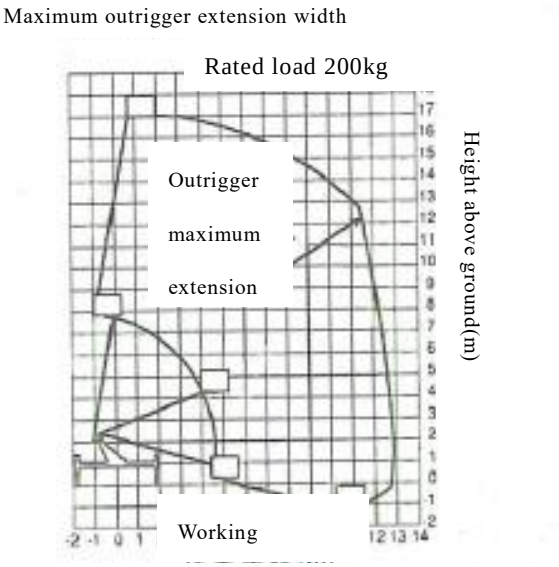


Figure 2-27 Example of a telescopic boom type working radius chart

② Articulating boom type (Textbook page 37 ）

The angle of the second boom to the horizontal of the vehicle is detected mechanically or electrically. When the working range is shown in Figure 2-29 is about to be exceeded, the elevation, and articulations are stopped.

Note that this is not related to the angle of the first boom.

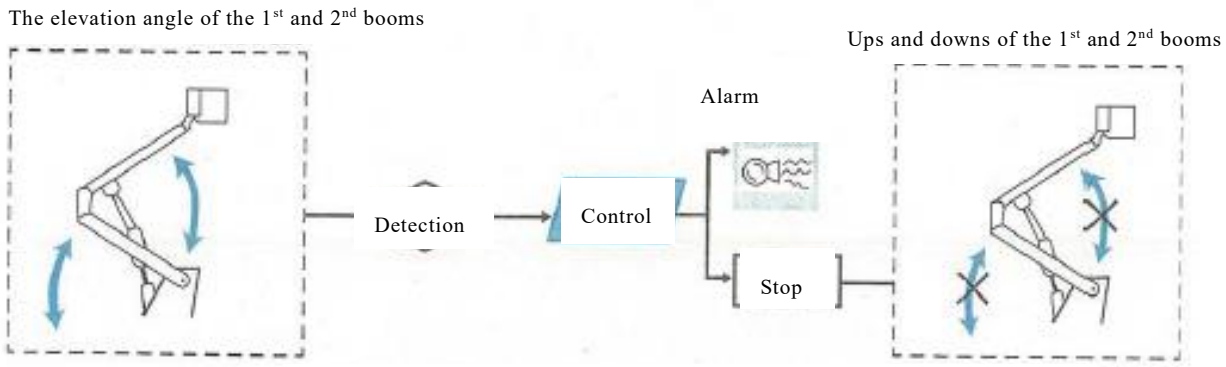


Figure 2-28 Operation example of articulating boom type work regulation device

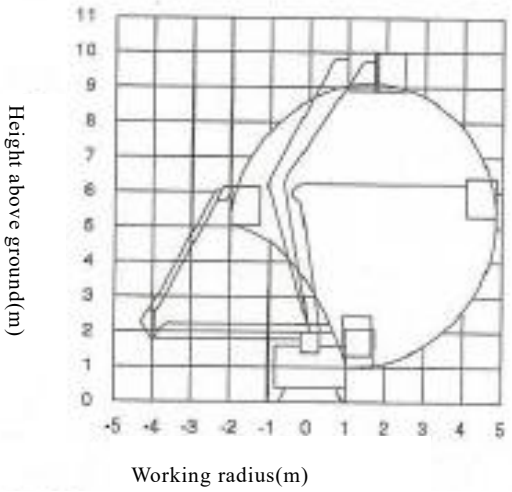


Figure 2-29 Example of articulating boom type working radius chart

(2) Emergency stop device (Aerial work platform structure standard Article 13 No. 1) (Textbook page 38 ）

The emergency stop device immediately stops operation when the operator senses danger while the boom is operating or is running in the case of self-propelled aerial work platform vehicles. It is generally a red button switch, and there are two types: one that stops the engine when pressed and one that does not stop the engine but releases the hydraulic pressure.

※ Another use of an emergency stop device is to prevent a machine from operating suddenly against the operator's will during operation.

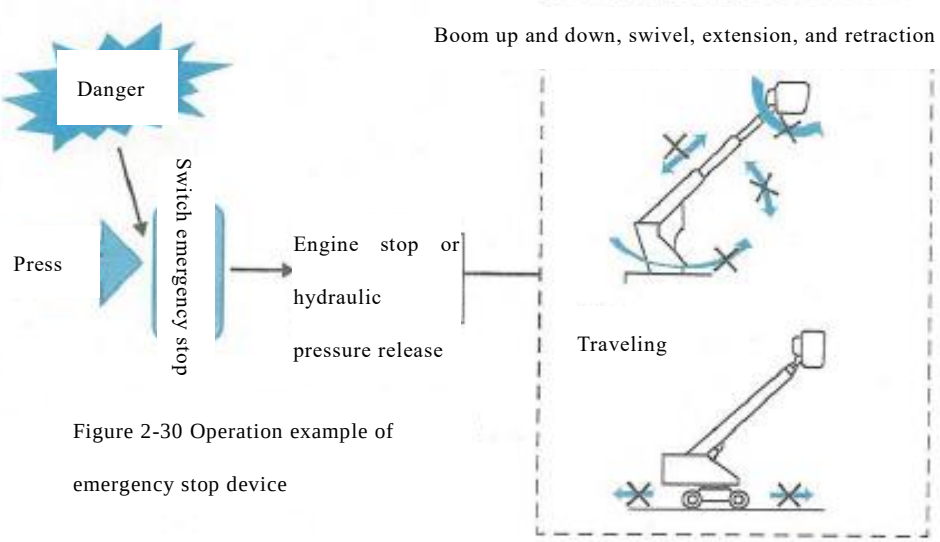


Figure 2-30 Operation example of emergency stop device

(3) Emergency disembarking device (Aerial work platform vehicles structure standard Article 13 No. 2) (Textbook page 39)

An emergency disembarking device is a device or apparatus that allows a worker on the work platform to descend to the ground in the event of an unforeseen event such as a machine stoppage.

※ As devices, engine-powered aerial work vehicles are generally equipped with an emergency pump powered by a battery. Some vehicles equipped with a separate low-noise prime mover are not equipped with an emergency pump.

※ Vertical lift aerial work platforms are generally equipped with a descent control valve.

※ Devices such as a rope ladder or descent rope may be used.

(4) Approach warning device （ Article 20 of the aerial work platform structure standard ）(Textbook page 39)

An approach warning device is a device that automatically emits an alarm (buzzer) when traveling and is switched on in conjunction with the travel control lever.

※ It is attached to a self-propelled aerial work platform.

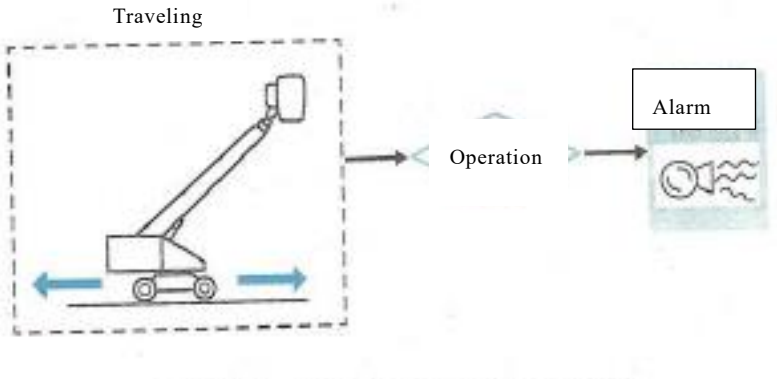


Figure 2-31 The travel warning device

(5) Vehicle body inclination angle control device (Structural Standard for Work Platforms, Article 10) (Textbook page 39)

There are two types of body inclination angle regulators: those that emit an alarm when an attempt is made to raise the work platform while the vehicle body is inclined, or when the allowable body inclination angle is exceeded while traveling, and those that automatically stop the work platform from being raised.

※ Mounted on a self-propelled high-altitude work vehicle.

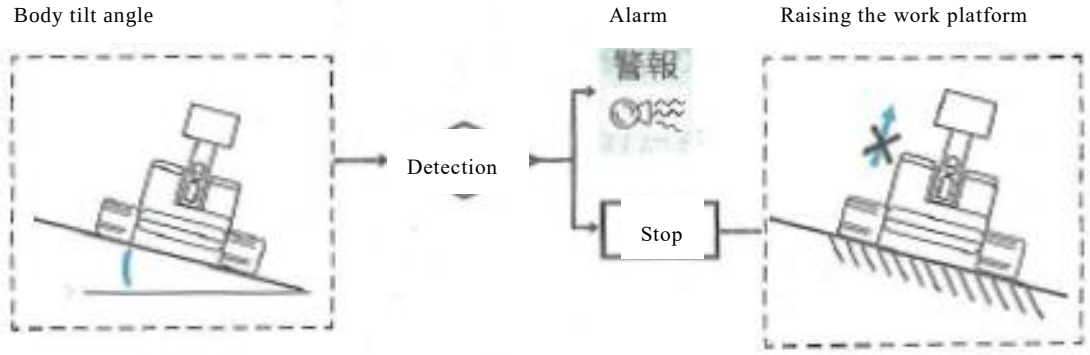


Figure 2-32 Example of operation of the tilt limiter

(6) Safety valve, check valve (Article 22 of the aerial work platform structure standard) (Textbook page 40)

When an overload or shock load is applied during operation, abnormally high pressure is generated in the hydraulic circuit, which may cause damage to the machine. In order to prevent this, the hydraulic system of an aerial work platform is equipped with a safety valve, and the pressure to be used is determined for each work truck so that the pressure in the circuit does not rise above the set pressure at any time.

In addition, If the pipes and hoses are damaged or their connections are disconnected, the pressure in the cylinder drops abnormally, causing the work platform, etc., to drop rapidly. To prevent this, check valves are installed in each of the cylinders for jacking, raising, lowering, extending, and retracting, leveling, articulating, and vertical lifting. In particular, double check valves are used for jacking, telescoping, and elevation of the articulating boom type, since external force is applied in the direction of cylinder extension.

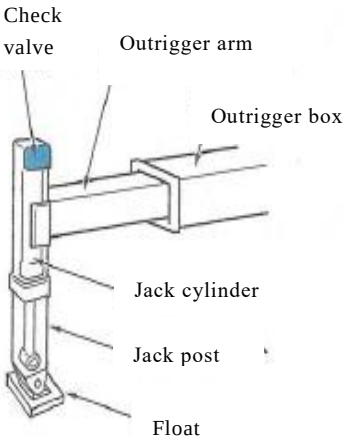


Figure 2-33Check valve

(7) Outrigger interlocking system (Article 12 of the aerial work platform structure standard) (Textbook page 40)

The outrigger interlocking system is an electrically controlled device that stops all boom operations when the jack is not under the specified load to prevent the operator from forgetting to set the jack and operate the boom.

※ It is attached to aerial work platforms equipped with outriggers.

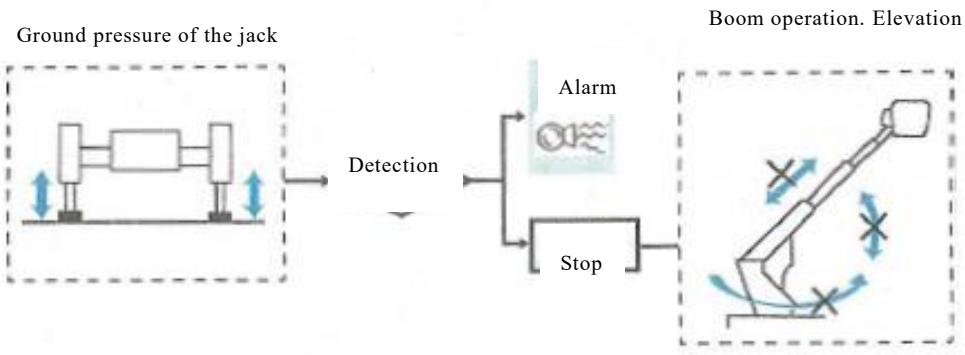


Figure 2-34 Operation example of outrigger interlocking system

(8) Indication of the front/rear direction of the vehicle body (Article 21 of the aerial work platform structure standard) (Textbook page 41)

The aerial work platform, which can be operated on the work platform and the work platform, turns together with the swivel table so that the vehicle's front-rear direction (traveling direction) to be checked from the work platform.

※ It is mounted on a self-propelled, swiveling, aerial work platform.

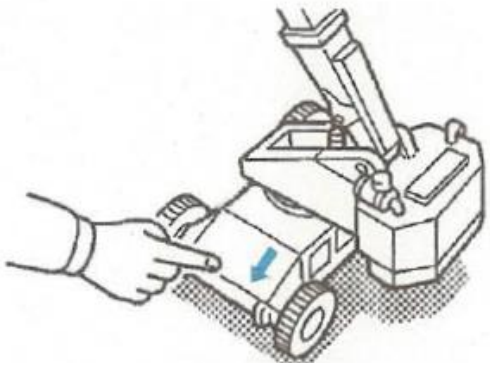


Figure 2-35 Indication of the front/rear direction of the vehicle body

(9) Overload l miter (Article 11 of the aerial work platform structure standard) (Textbo ɔk page 41)

The overload limiter is a device that detects the pressure in the hydraulic cylinder for the lift and stops the lift operation or issues an alarm when a load is placed on the work platform in excess of the allowable load (Accumulated load).

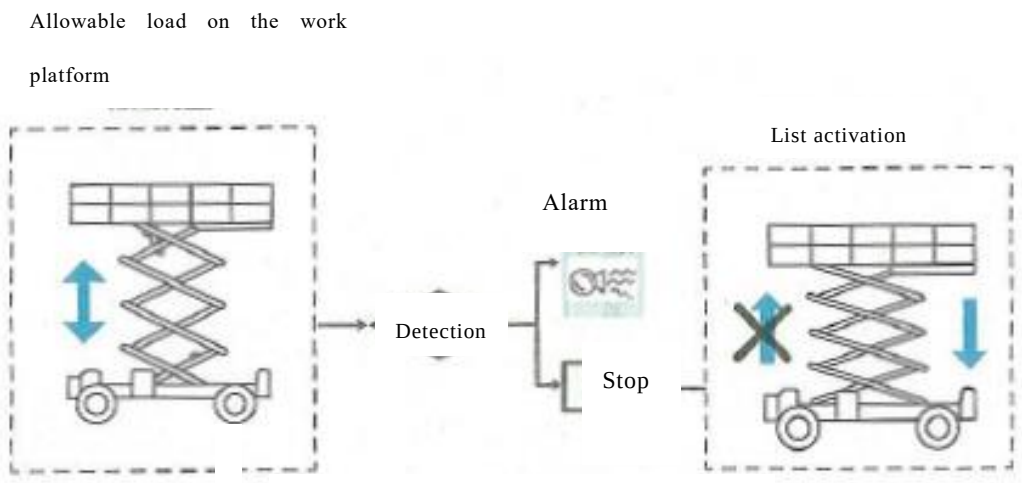


Figure 2-36 Operation example of Overload limiter

※ It is attached to the vertical elevation.

There are many other safety devices in addition to those specified in the structural standards for elevating work vehicles.

2.2 Handling of working devices and traveling device and precautions（Textbook page 42 ）

According to the application, aerial work platform vehicles have been improved or have various functions.

In order to prevent accidents caused by aerial work platform vehicles, it is important to understand their characteristics and operate the working devices and traveling device appropriately.

Since the operation method of the working devices differs depending on the manufacturer and model of the aerial work platform vehicle, it is important to carefully check the instruction manual and operate it.

2.2.1 Outrigger installation procedures and precautions （Textbook page 49 ）

1) Basic procedure for installing outriggers （Textbook page 49 ）

① Apply the parking brake.
② On flat ground, put a wheel chock on the front and back of the rear wheel.
③ Maximize the outriggers. (For H-type outriggers)
④ In places with poor ground, cure with a floor plate.
⑤ Make sure to set the jack. Float the tires and level the aircraft.

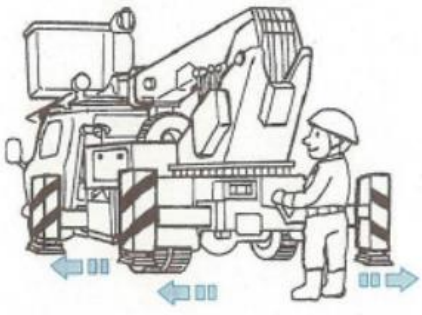


Fig 2-41 Outrigger to maximum

2) Installation of outriggers on slopes （ Textbook page 49 ）

① Be sure to position the aerial work platform vehicle downward.
② Apply the parking brake.
③ Put a wheel chock on the lower slope of all wheels to ensure that they are in contact with the tires.
④ Overhang outriggers. (For H-type outriggers)

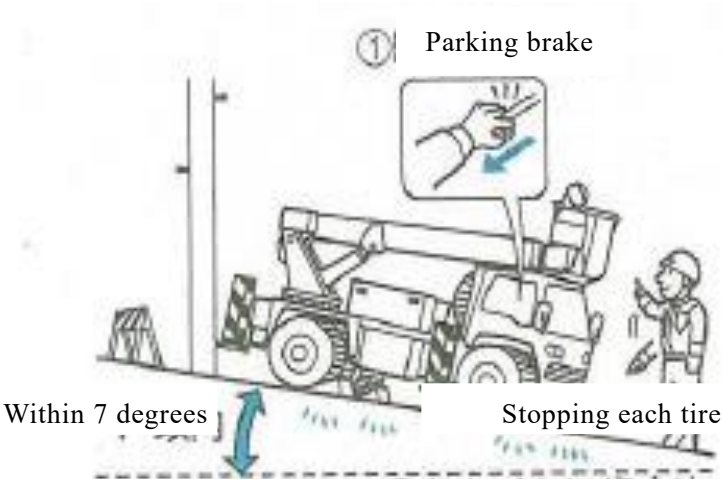


Fig 2-42 Installation of aerial work platform vehicle on slopes

⑤ Cure with a floor plate.

(a) Use a large floor plate.

(b) The maximum number of floor plates on the front jack should be two.

(c) The floor plate should be within 20 cm in height and should be high enough to fit between the outrigger float and the ground in front of the jack set.

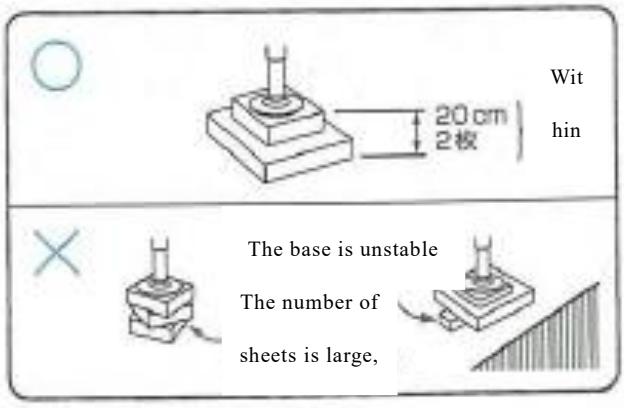


Fig 2-43 How to use the floor plate

⑥ Overhang the outriggers in the following procedure.

(a) Be sure to do it in the order of the front jack and the back jack.

(b) The jack should be extended on the left and right simultaneously.

(c) Make fine adjustments by operating each jack.

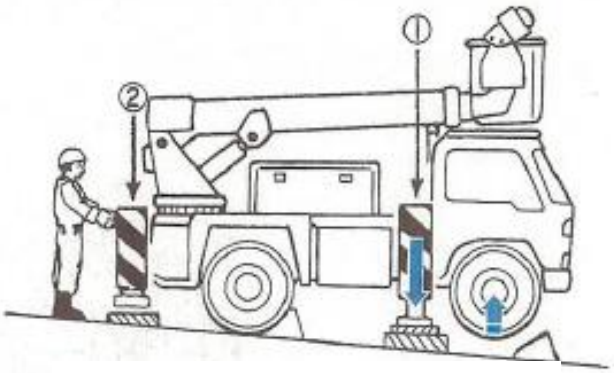


Fig 2-44 Jack up from the front side

⑦ Float all the tires and level the airframe.

Float all tires and level the airframe. Since the angle of inclination that can be cut differs depending on the model, check the instruction manual, nameplate, etc.

Although it depends on the model, it can be adjusted and leveled if the inclination is 5 to 7 °.

⑧ If the airframe cannot be leveled, strictly observe the following items.

(a) Be sure to work with the boom facing uphill.

(b) Make sure that the left and right directions of the aircraft are horizontal.

(c) If the rotation work is going downhill, move the vehicle.

(d) In the case of the telescopic boom type, use it facing uphill and within 45 ° to the left and right.

(e) Even in the case of the articulating boom type, use it when the working position is on the slope above the rotation center, and the rotation range should be within 45 ° to the left and right.

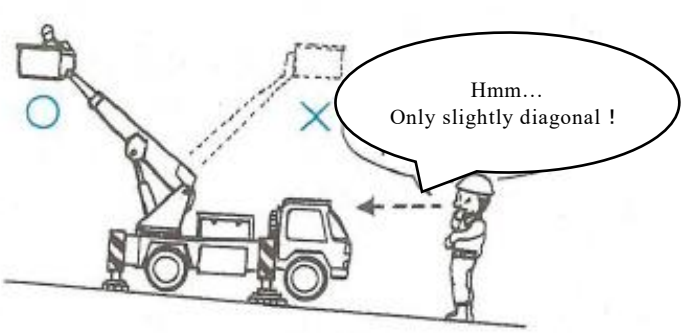


Fig 2-45 The boom is always on the slope

⑨ After the work is completed, store the outriggers according to the following procedure.

(a) Return the boom to the driving posture.

(b) Check the position of the wheel chock.

(c) Be sure to put it back from the jack on the back side.

(d) Operate the jack simultaneously on the left and right.

(e) Remove the wheel chock.

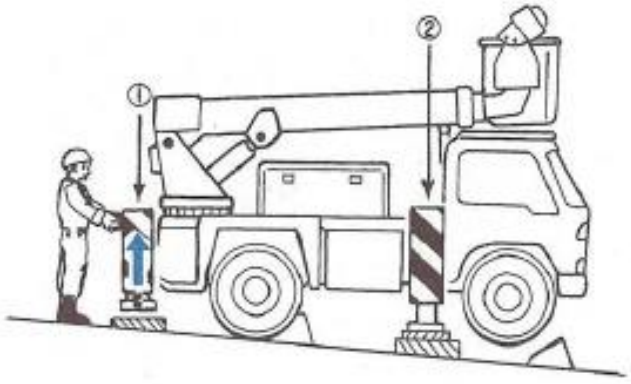


Fig 2-46 Jack can be stored from the rear side

2.2.2 Telescopic boom-type basic operation procedure and precautions (Textbook page 53)

【Basic operating procedure】

① Using the elevation device to separate the boom from the pedestal with the boom retracted.
② Set the target position to some extent by rotation.
③ Bring it closer to the target position to some extent by elevating.
④ Get closer to about 1m before the work position by expanding and contracting (extending).
⑤ Make fine adjustments to the left, right, up, and down by elevating and rotating.
⑥ Approach the work target position by stretching operation.
⑦ Adjust by swinging according to the situation of the workplace.
⑧ When moving away from the work position, first move away by the contraction operation.

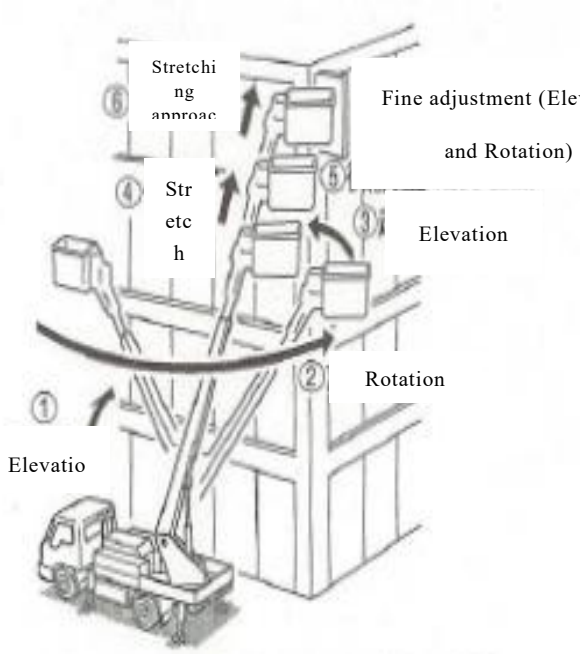


Fig 2-48 Telescopic boom type operation procedure

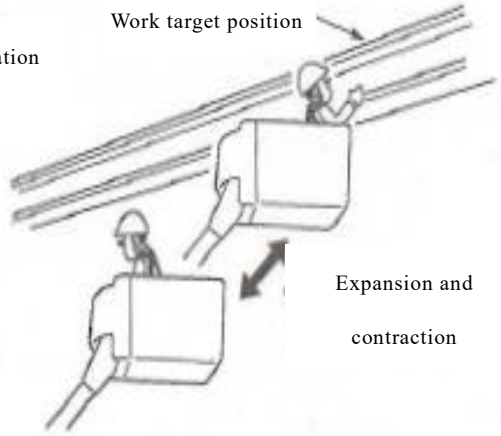


Fig 2-49 Operation near the work position

【Points to note】

When rotating or elevating, be careful because the moving speed of the work platform differs depending on the length of the boom

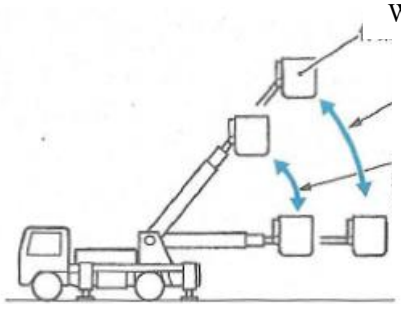


Fig 2-50 Difference in moving speed due to difference in boom length

2.3 Transfer of aerial work platform vehicle (Textbook page 59)

The transfer of aerial work platforms is carried out by self-propelled or by using trucks or vehicles dedicated to transfer.

Normally, truck-type aerial work platform vehicles are transferred to the work site by self-propelling, and self-propelled aerial work platform vehicles such as wheel-type and crawler-type are used.

Since it is not possible to drive on public roads, it is often loaded on a transfer-only vehicle and transferred.

2.3.1 Precautions for self-propelled movement (Textbook page 62).

When moving aerial work platform vehicles on their own, comply with relevant laws and regulations such as the Road Traffic Act, Road Transport Vehicle Act, and Vehicle Restriction Ordinance, and pay attention to the following matters.

(1) For truck-type aerial work platform vehicle (Textbook page 62)

When moving aerial work platforms, it is important to pay attention to （2.5.1 (1) Points to note when driving）.

※As a characteristic of the truck type, it is important to pay attention to the following points.

① Since the work platform is on the upper part and the position of the center of gravity (jyuushin) tends to be high, there is a risk of falling if the steering wheel is operated suddenly while driving.

② Since the lower vehicle is equipped with many weights and the vehicle weight is heavy in order to widen the working range, and as a stability measure, it is desirable to start from the 1st speed when starting.

③ Since the vehicle's weight is heavier than an ordinary cargo truck with no luggage loaded, the braking distance is longer. Therefore, it is important to keep a sufficient distance between vehicles.

④ Because the working devices is higher than the driving cabin,
if you do not know the vehicle height and drive, there is a risk of collision under the guard.

(2) For self-propelled aerial work platform vehicle (Textbook page 63)

Self-propelled aerial work platform vehicles, such as wheel type and crawler type, cannot run on public roads.

If it is unavoidable to travel on public roads, it is necessary to obtain the permission of the police chief in charge.

Note the following points.

① Crawler-type aerial work platform vehicles may damage the paved surface, so perform necessary curing.

② Keep the boom to the shortest and keep the work platform below horizontal when driving.

2.4 Inspection and maintenance of aerial work platform vehicle (Textbook page 64)

It is very important not only to improve workability but also to prevent occupational accidents by properly carrying out daily inspections and maintenance and always maintaining the aerial work platform vehicle in the optimum condition.

In addition, the Occupational Safety and Health Regulations also require that aerial work platform vehicles be inspected and maintained, as shown in Table 2-1.

It is important to carry out daily inspections and maintenance reliably so that the aerial work platform vehicle can always be used in the best condition.

Table 2-1 Regulation regarding inspections and self-inspections

Item	The person who implements ・ Qualification	Remarks
① Pre-work inspection (Article 194-27 of the Safety Regulations)	・What the business operator designated (operator)	・Checklist storage: It is desirable to store it while the machine is running.
② Regular self-inspection (Article 194-24 of the Safety Regulations)	・What the business operator designated	・ Time: Once every month or less ・ Retention period of inspection table: 3 years
③Specific self-inspection (Article 194-23 of the Safety Regulations) (Article 194-26 of the Safety Regulations)	・ Persons with qualifications specified by the Ministry of Health, Labor and Welfare ・ Inspection company	・ Time: Once every year or less ・ Retention period of inspection table: 3 years ・ Attaching the “sticker” that has been inspected

If any abnormality is found in the self-inspection and inspection shown in Table 2-1, it is necessary to make repairs and other necessary measures immediately. (Article 194-28 of the Safety Regulations)

2.4.1 Measures to be taken when an abnormality is found during work (Textbook page 69)

If the aerial work platform vehicle seems to be out of order during work, immediately stop the aerial work platform vehicle on a flat surface, contact the person in charge of the defective part, and it is necessary to perform pre-work inspection and repair.

2.4.2 Inspection of safety device (Textbook page 69)

In particular, aerial work platform vehicles are equipped with many safety devices, so inspection before work is very important.

2.5 Safe work with aerial work platform vehicle (Textbook page 76)

In order to prevent disasters caused by aerial work platform vehicles, it is natural to drive and handle the aerial work platform vehicle properly. Create an appropriate work plan, and it is also important to proceed with the work based on that plan.

2.5.1 Precautions when working with aerial work platform vehicle

(1) Precautions when driving

1) Truck type general precautions (Textbook page 80)

① Before driving, make sure that the outriggers are completely retracted.

② Make sure that the work platform is retracted, and then lower the worker from the work platform before running.

2) Precautions for self-propelled climbing / descending, slopes, and bumps (Textbook page 82)

① Lock the swivel when climbing or descending a steep slope.

② It is dangerous to change direction or cross the slope in the middle of the slope because there is a risk of falling. Once get down to the flat ground.

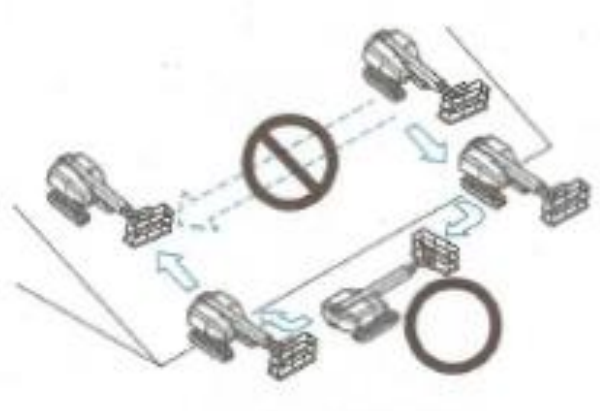


Fig 2-68 Turn around on a slope

③ Turn the counterweight toward the slope and climb up and down at a right angle to the slope.

④ Never perform the boom rotation operation in the middle of the slope because there is a risk of tipping over.

⑤ When climbing a bump (slope), the angle of the aerial work platform vehicle may change suddenly at the top of the bump (slope). Pay attention to the buildings on the upper and lower sides of the work platform.

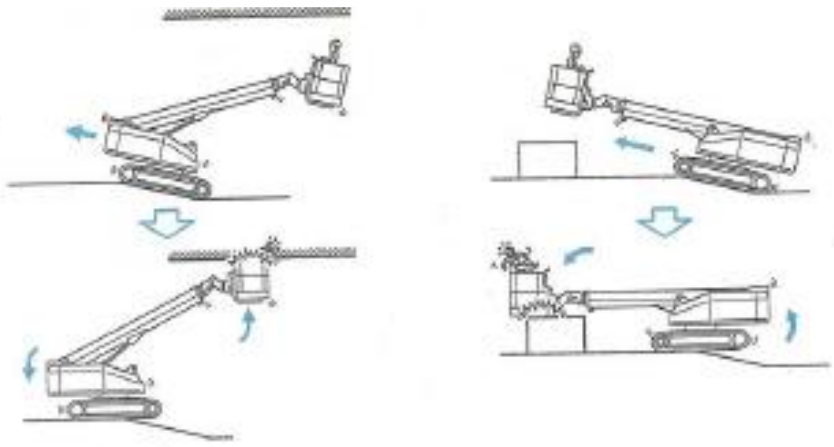


Fig 2-69 When climbing a step

⑥ When going down a bump (slope), the angle of the aerial work platform vehicle may change suddenly at the top of the bump (slope). Pay attention to the buildings on the upper and lower sides of the work platform.

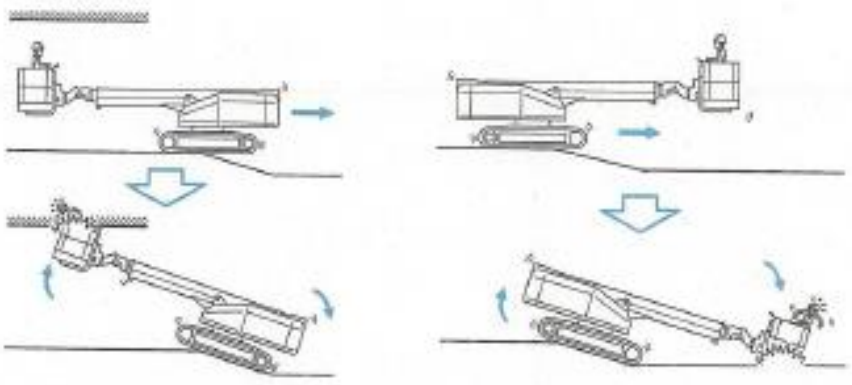


Fig 2-70 When going down a step

⑦ Do not drive with the work platform raised (such as with the boom elevation angle raised), as there is a risk of tipping over if you enter a slight unevenness, bump, or steep slope.

From the tilt movement value of the lower traveling body,

The tilt movement of the work platform is very large.

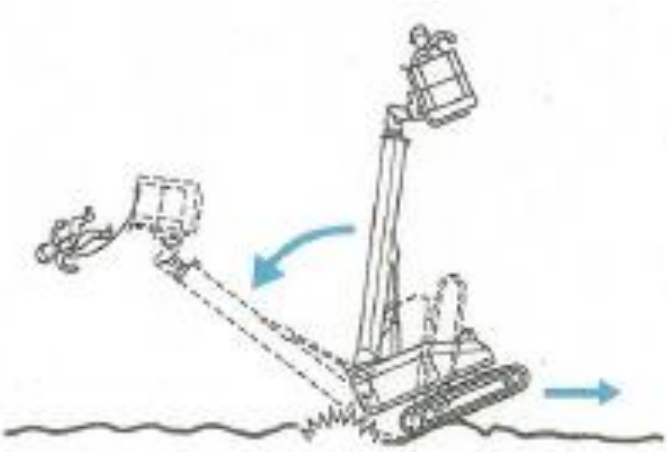


Fig 2-71 Moving with the work platform raised

(2) Precautions for work (Textbook page 86)

1) Obey the rules of safety (Textbook page 86 ）

① Workers should wear the necessary protective caps and fall prevention equipment.

② Immediately after boarding the work platform, hook the fall prevention equipment.

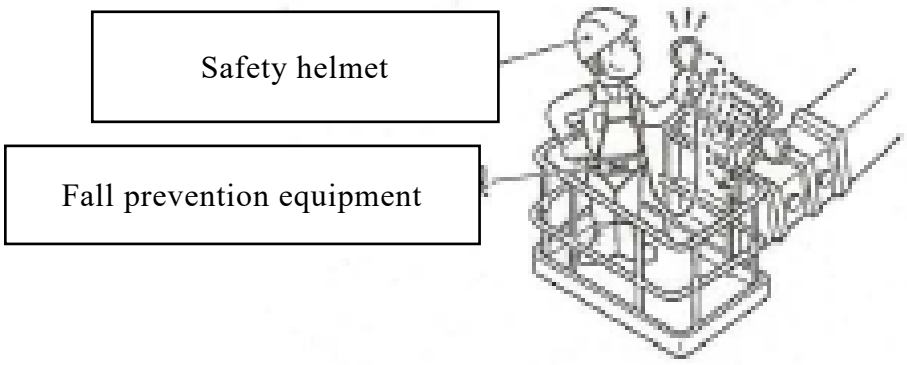


Fig 2-74 Wear protective equipment

③ Never use it for other purposes, such as lifting a load with a boom.

④ Strictly observe the load capacity of the work platform.

Fig 2-75 Strict adherence to load capacity

⑤ Do not transfer from the work platform to other structures.

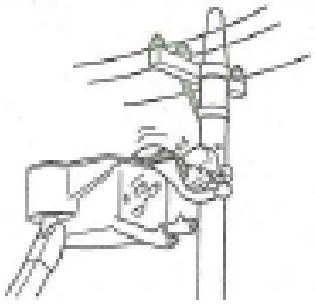


Fig 2-76 Do not transfer

⑥ FRP buckets are flammable, so do not use fire.

⑦ Do not get on (noruna) any place other than the work platform.

⑧ Do not climb the railing on the work platform to work.

⑨ Do not use ladders, stepladders, etc., on the work platform.

⑩ Be careful not to drop (otosuna) anything from the work platform.

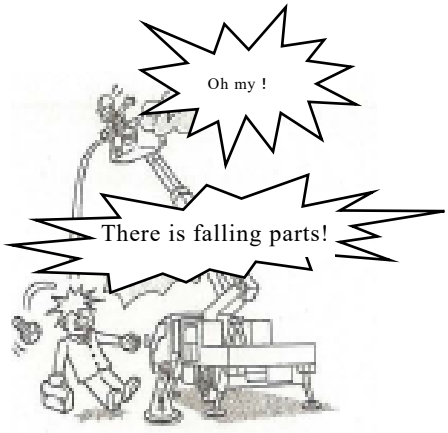


Fig 2-77 Do not drop things

⑪ The work platform should be lowered to 50 cm or less from the ground before getting on and off. (In the case of self-propelled type)

⑫ Use the required route or step when getting on and off the aerial work platform vehicle.

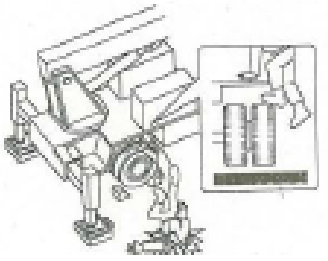


Fig 2-78 No stepping

⑬ The parking brake of a truck-type aerial work platform vehicle has a structure that locks the propeller shaft and does not have a structure that stops the rotation of the wheels. Therefore, if you put your foot on the rear wheel with the outrigger stretched and the tire is floating, the wheel may rotate and fall, so never put your foot on the wheel and get on and off.

⑭ When using two or more aerial work platform vehicles in close proximity, work under the direction of the work commander, paying attention to the danger of accidents, disasters, etc., due to contact.

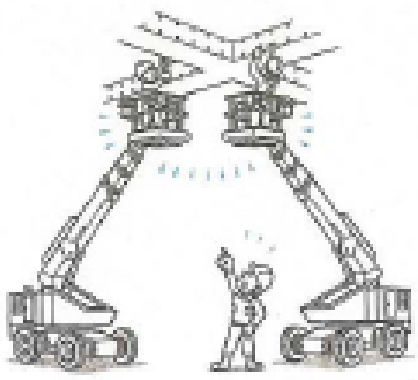


Fig 2-79 Work of 2 or more

2) Thorough safety confirmation (Textbook page 88)

① When working near an overhead power line, check the following items and take necessary measures before starting the work. (Reference: 4.9.2 (4))

(a) How much is the voltage?

(b) Is the separation distance sufficient?

(c) Is power transmission stopped?

(d) Are measures to prevent electric shock sufficient?

(e) Do you have a watchman?

② Stop work in bad weather.

[Criteria for bad weather] Basic No. 309 (April 15, 1971)

・Strong wind: Average wind speed of 10 m / s or more for 10 minutes

・Heavy rain: 50 mm or more for one rainfall

・Heavy snow： 25 cm or more of snowfall per time

Fig 2-80 Cancellation of work in strong

※Do not perform any act that is greatly affected by the wind, such as covering the work platform with a sheet.

③ Always pay attention to the surrounding structures when working.

④ When working in a place that is difficult for the operator to see, drive carefully according to the signal of the signaler.

⑤ Make sure that there are no obstacles in the direction of movement before moving.

⑥ When rotating, check for obstacles within the rotation range before rotating carefully.

3) Dedicated to safe operation (Textbook page 88)

① When driving or operating in the following situations, be sure to fully retract the boom and lower the work platform to below the horizontal level.

(a) When operating the steering

(b) When the road surface is sloping

(c) When there is a lot of unevenness on the road surface

(d) When the wind is strong

※ （Never raise the work platform when the tilt limiter is activated, and a warning sound is heard. ）

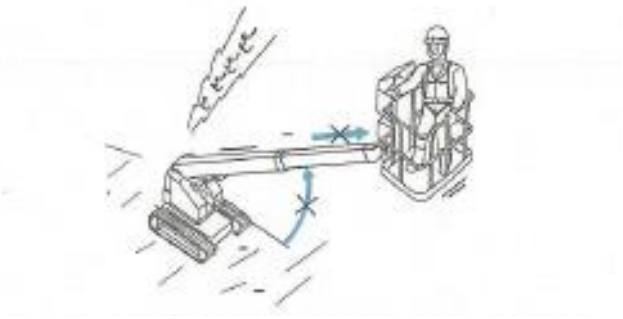


Fig 2-81 Prohibition of raising the work platform when the tilt limiter is notified

② Take measures such as placing and fixing the materials so that the materials loaded on the work platform do not come into contact with the operation levers (sousa reba).

③ Do not operate the lever suddenly.

④ Never approach the work position with a self-propelled aerial work platform vehicle during driving operation.

Be sure to perform the boom ups and downs, expansion, and contraction, rotation or elevation control.

Fig. 2-82 Attention to approach

⑤ When the operator is on board, operate the lower operation device in close contact with the passenger.

⑥ Bring the work platform close to a position where the worker does not need to work in an unreasonable posture.

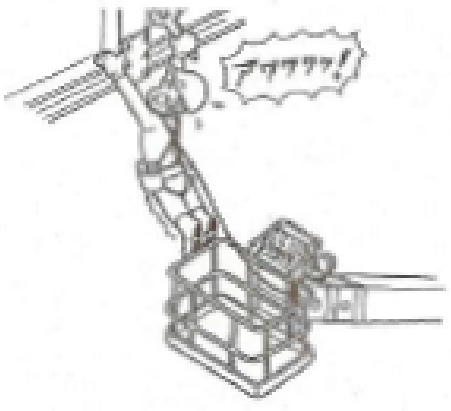


Fig 2-83 Work after approaching

(3) Precautions at the end of work (Textbook page 90)

① Return the work platform, etc., to the storage position.

② Take measures to prevent escape, such as applying the parking brake.

③ Do not jump off（tobioriruna） the work platform.

④ Clean it and store it if it gets dirty due to painting work.

⑤ Report necessary items such as defects during work to the vehicle manager.

⑥ Keep the key in the designated place.

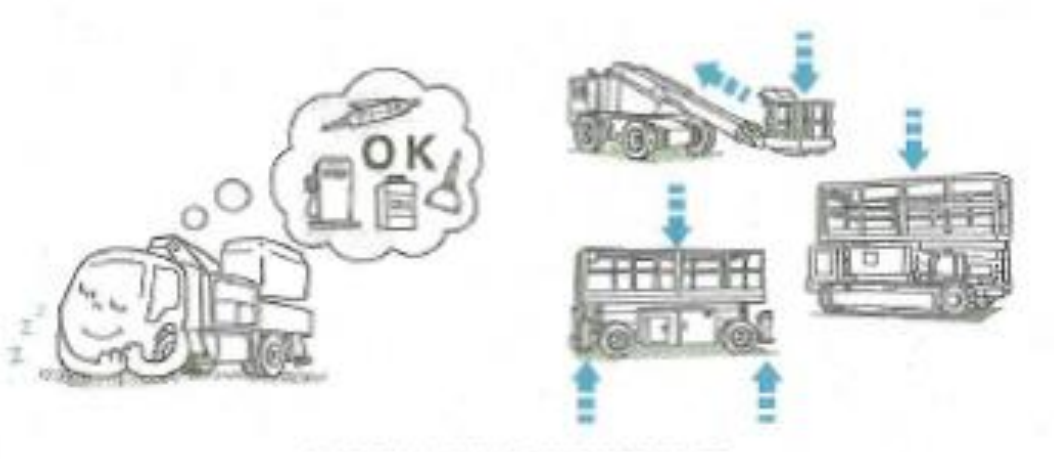


Fig 2-84 Inspection and confirmation at the end of work

Chapter 3　Knowledge of Motors

3.1　Motor（Textbook page 92 ）

A prime mover is a device that has the function of converting various energies into force, and typical ones are an internal combustion engine and an electric motor (the following referred to as “motor”).

3.1.1　Types of motors

(1)　Internal combustion engine (Textbook page 92)

According to their ignition system, internal combustion engines are divided into “diesel engines” and “gasoline engines”.

(2)　Motor (Electric motor) (Textbook page 93 ）

For aerial work platform vehicles that are often used indoors where it is necessary to consider engine noise and exhaust gas, a motor powered by a storage battery (referred to as “battery”) is often used.

3.1.2　Internal Combustion Engine Structure (Diesel Engine) (Textbook page 93)

We will explain the structure of diesel engines among internal combustion engines, which are often used for aerial work platform vehicles.

Diesel engines can be divided into “4-cycle engines” and “2-cycle engines” depending on their operating method.

Most of them are “4-cycle engines” except for large vessels that use “2-cycle engines” that rotate at extremely low speeds.

(1)　Operating principle of 4-cycle diesel engine (Textbook page 94)

The four steps of a diesel engine are as follows: (See Figure 3-1）

I　Intake stroke: The stroke in which the piston is lowered, and only air is sucked into the cylinder.

II　Compression stroke: The stroke in which the piston rises to the top dead center and compresses only air.

III　Combustion stroke: The stroke in which fuel is injected and burned into a high-pressure cylinder, and the combustion gas pushes the piston down to the bottom dead center (explosion stroke).

IV Exhaust stroke: The stroke in which the piston rises due to inertia and pushes the combustion gas out of the cylinder.

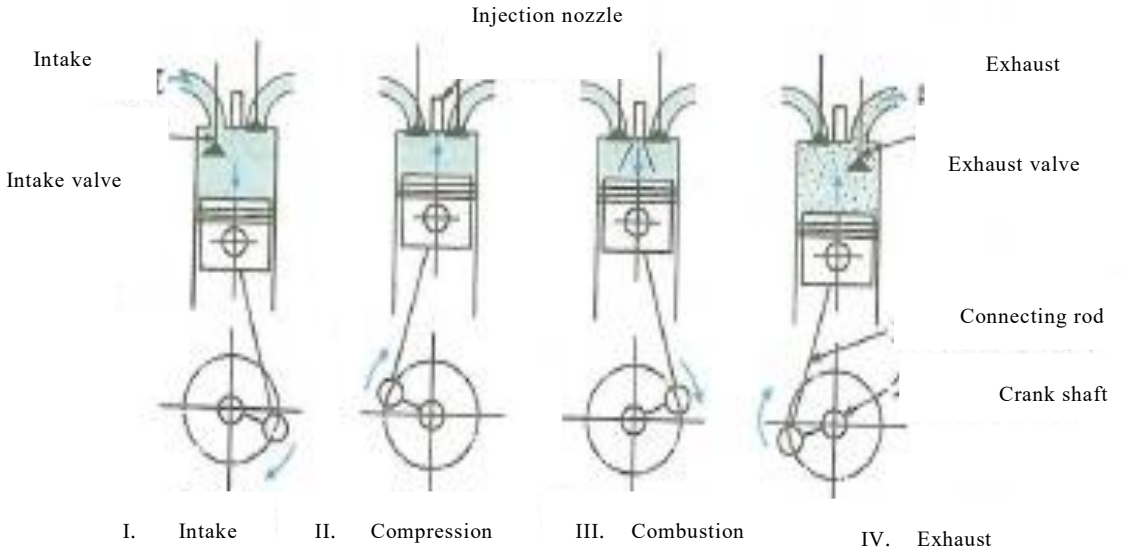


Fig 3-1 4-cycle of diesel engine (Directional injection type)

(2) 4-cycle diesel engine structure

1) Lubrication device (Textbook page 99)

A lubrication device has a piston that moves up and down thousands of times per minute.

It is a device that supplies lubricant (engine oil) to reduce friction and wear of rotating parts due to the same metal soil in each part of the engine, such as cylinders and crankshafts.

Engine oil has various functions as follows, and its quality is important for maintaining the function of diesel engines.

① Lubrication of axle bearings, piston rings, cylinders, etc.

② Engine cooling action

③ Sealing action between the piston and cylinder

④ Cleaning action of impurities in the engine etc.

⑤ Anti-rust effect inside the engine, etc.

It is necessary to use the engine oil of the standard specified in the machine's instruction manual, constantly check the condition of the oil, and change it if necessary.

2) Fuel system (Textbook page 100)

The fuel system includes a fuel tank, an injection pump, an injection nozzle, a fuel filter, a governor, and the like.

(a) Fuel filter (Textbook page 100)

The fuel filter filters the fuel, removes foreign substances such as dust contained in the fuel, and decomposes water.

3.1.3 Characteristics of an electric motor (Textbook page 105)

Electric motors are used as a power source for aerial work platform vehicles, often used in places where measures such as gas emitted from the engine and noise are required.

Batteries for industrial vehicles are used in self-propelled aerial work platform vehicles, and not only DC motors but also AC motors are often used as electric motors.

The power transmission device for a battery-powered aerial work platform vehicle is a replacement of the engine of the power transmission device for wheel-type and crawler-type aerial work platform vehicles with an electric motor powered by a battery.

The power transmission device is almost the same as the wheel type and crawler type.

3.2 Knowledge of hydraulic systems (Textbook page 106)

Most of the working devices of aerial work platform vehicles are operated by a hydraulic system that utilize hydraulic power. The hydraulic system has the following features.

【Strengths】

① Small and lightweight
② Easy to prevent overload
③ Easy stepless shifting
④ Less vibration
⑤ Smooth operation is possible
⑥ Easy remote control

【Weaknesses】

① Plumbing becomes complicated
② Hydraulic fluid leaks
③ Depending on the temperature of the hydraulic fluid, the efficiency of the machine changes a little.

3.2.1 Principle of hydraulic system (Textbook page 106)

The principle of the hydraulic system is an application of Pascal's principle that "the pressure applied to a part of a stationary liquid in a sealed container is transmitted to all parts of the liquid with the same pressure."

For example, in the case of container A and container B connected by a pipe as shown in FIG. 3-12, a pressure of 10N/cm^2 is generated by a force of 10 N applied to the surface of container A of 1 cm^2. Since the pressure is transmitted to all the pipes, the force (F) transmitted to the entire surface of container B having a surface area of 10 cm^2 is as follows.

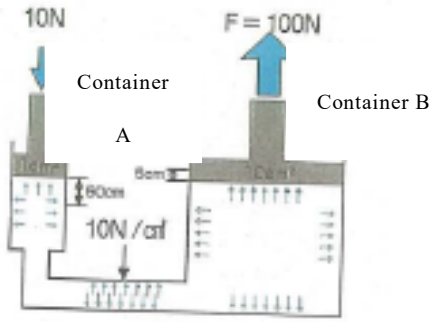


Fig. 3-12 Hydraulic system principle

Force = Pressure × Surface area

F = 10N/cm^2 x 10 cm^2 = 100N

This is the principle of a hydraulic system that moves heavy objects with a small force.

When the container A is pushed down by 50 cm, the liquid pushed down is 50cm^3, so that the container B is pushed up by 5 cm.

3.2.2 Hydraulic system (Textbook page 107)

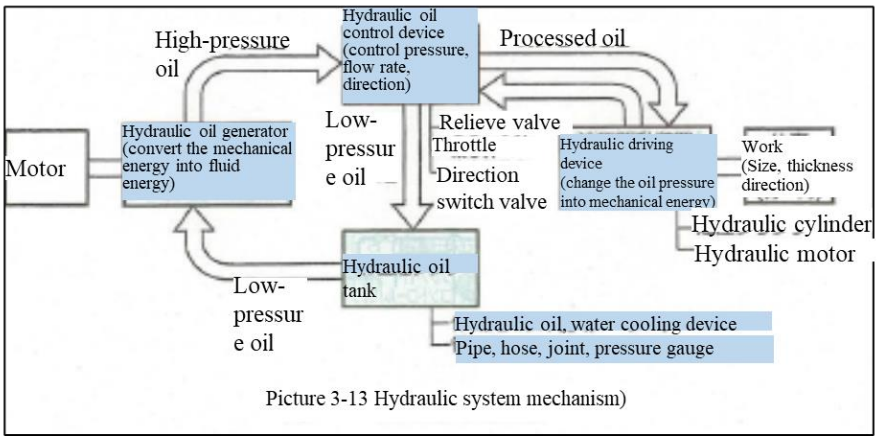
The hydraulic system is a device that operates the working device of the aerial work platform vehicle and is a device that converts the mechanical energy of the engine into fluid energy and further converts it into mechanical energy to perform work operation (work).

(1) Mechanism of hydraulic system (Textbook page 107)

The hydraulic fluid is pressurized by driving a hydraulic pump with the power of an engine or an electric motor, and various hydraulic drive system (actuator) such as a hydraulic motor and a hydraulic cylinder are operated by the pressurized hydraulic fluid.

The hydraulic fluid whose pressure has dropped after being used in the hydraulic drive system returns to the hydraulic fluid reservoir via the low-pressure circuit, is pressurized again by the hydraulic pump, and is supplied to the hydraulic drive system.

It is a mechanism that is used in a circulating manner. (See Figure 3-13)



Picture 3-13 Hydraulic system mechanism)

(2) Hydraulic system configuration (Textbook page 107)

Hydraulic systems can be divided into devices with the following three functions and accessory devices.

① Hydraulic pressure generator (Pump)

A device that sucks hydraulic fluid from the hydraulic fluid reservoir, applies pressure, and sends it into the circuit.

② Hydraulic control unit (Valve)

A device that controls the pressure, flow rate, and direction of hydraulic fluid discharged from a hydraulic pump.

③ Hydraulic drive system (Actuator)

A device that converts the energy of high-pressure hydraulic fluid into the force of rotary motion or linear motion.

Table 3-5 shows the devices included in each device and their relationships.

Table 3-5 Main components of hydraulic systems

Name	Configuration devices		
Hydraulic pressure generator	· Hydraulic pump		
Hydraulic control valve	· Directional control valve	· Flow control valve	· Pressure control valve
Hydraulic drive system	· Hydraulic motor	· Hydraulic cylinder	
Accessory device	· Hydraulic fluid reservoir	· Filter	· Air Breather
	· Hose	· Coupling joint	· Revolving joint
	· Accumulator	· Oil cooler	· Pressure gauge, etc.

(3) Hydraulic circuit of aerial work platform vehicle (Textbook page 108)

As an example of the hydraulic circuit of the aerial work platform vehicle, the hydraulic circuit of the wheel-type aerial platform vehicle is shown in Fig. 3-14.

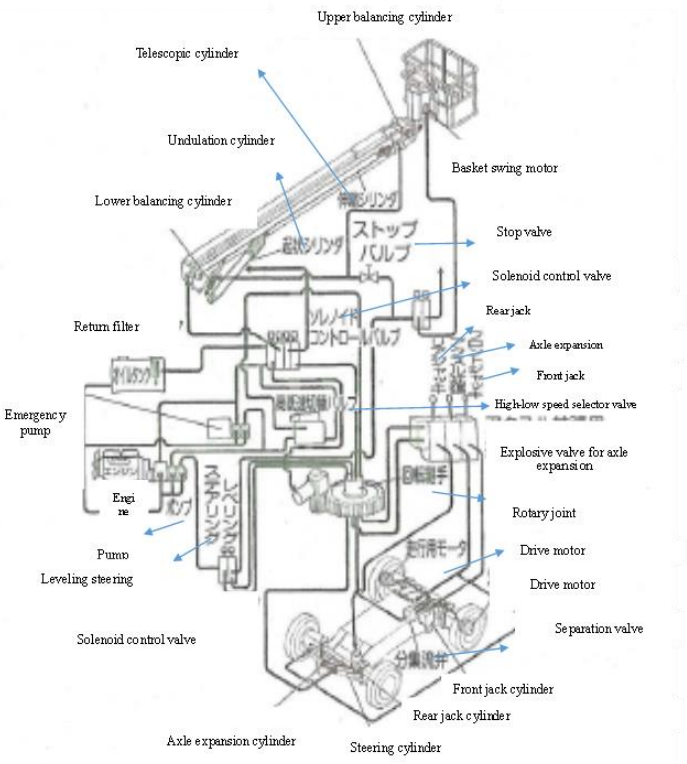


Figure 3-14 Example of hydraulic circuit for wheel type aerial work platform vehicle

(4) Hydraulic pressure generator (Textbook page 109)

1) Hydraulic pump (Textbook page109)

The hydraulic pump is driven by an engine or an electric motor, sucks hydraulic fluid from the hydraulic fluid reservoir, and supplies it to the hydraulic drive system (actuator) as high-pressure pressure oil.

Hydraulic pumps can be classified as follows from the structural point of view.

① Gear pump
② Piston pump (plunger pump)
③ Vane pump
④ Screw pump
⑤ Others

Among the above pumps, the characteristics of the gear pump, which is often used as a hydraulic pump for working devices such as expansion/contraction, elevation, and rotation of the boom of aerial work platforms, will be described.

2) Gear pump (cogwheel pump) (Textbook page 109)

A gear pump is a pump that rotates two gears of the same type in a casing and pushes out hydraulic fluid by engaging them.

Since the gear pump has a simple structure, it is small, lightweight, and has excellent durability. On the other hand, internal leaks are likely to occur, and there was a time when gear pumps were thought to be for low pressure, but recently, due to technological advances, pumps that can be used at high pressure (about 25 MPa) have also been developed.

【Features of gear pump】

① Compact and lightweight
② The structure is simple and durable
③ There are few breakdowns
④ Easy to maintain

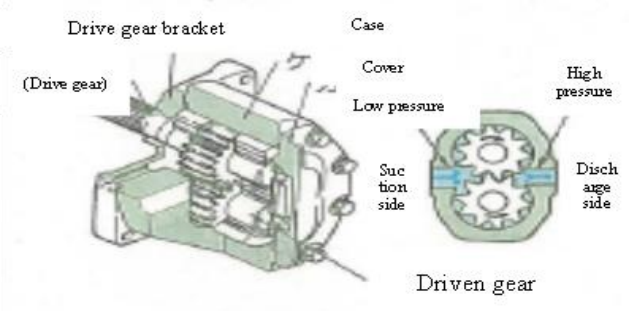


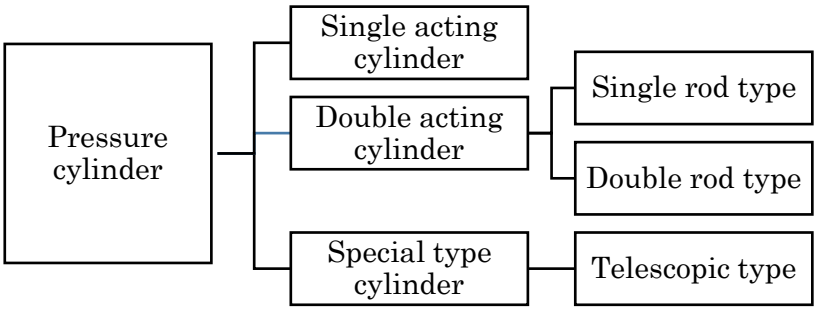
Fig 3-15 Gear pump

(5) Hydraulic drive system (actuator) (Textbook page 111)

An actuator is a device that converts hydraulic fluid sent from a hydraulic pump into mechanical motion (energy). Depending on the movement method, it can be divided into a hydraulic cylinder that moves linearly and a hydraulic motor that moves rotary.

1) Hydraulic cylinder (Textbook page 111)

Hydraulic cylinders can be classified as follows from the structural point of view.



【Single acting cylinder】

The single-acting cylinder has an inlet/outlet for hydraulic fluid mainly on the head side and operates by sending pressure oil in only one direction. The operation in the opposite direction is performed by its own weight or load, spring, other cylinders, etc.

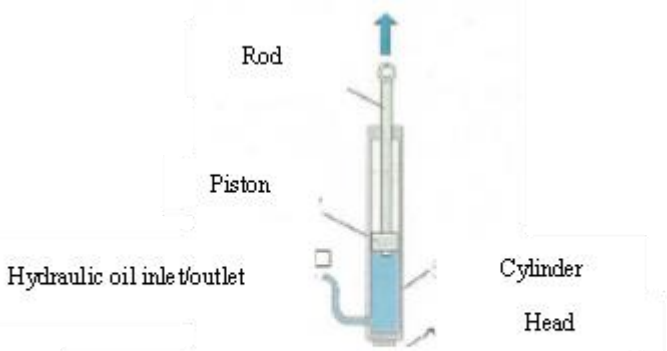


Fig 3-17 Single acting cylinder

Single-acting cylinders are used in vertical lift-type aerial work platform vehicles.

【Double acting cylinder】

The double-acting cylinder has a hydraulic fluid inlet/outlet on both the rod side and the head side, and the direction switching valve switches the inflow and discharges directions of the hydraulic fluid to reciprocate the piston.

Double-acting cylinders are used for booms, outriggers, and the like.

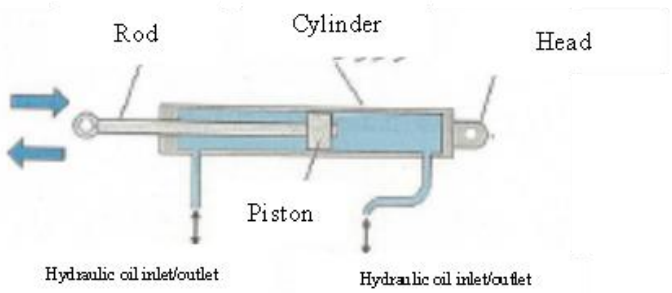


Fig 3-18 Double-acting cylinder

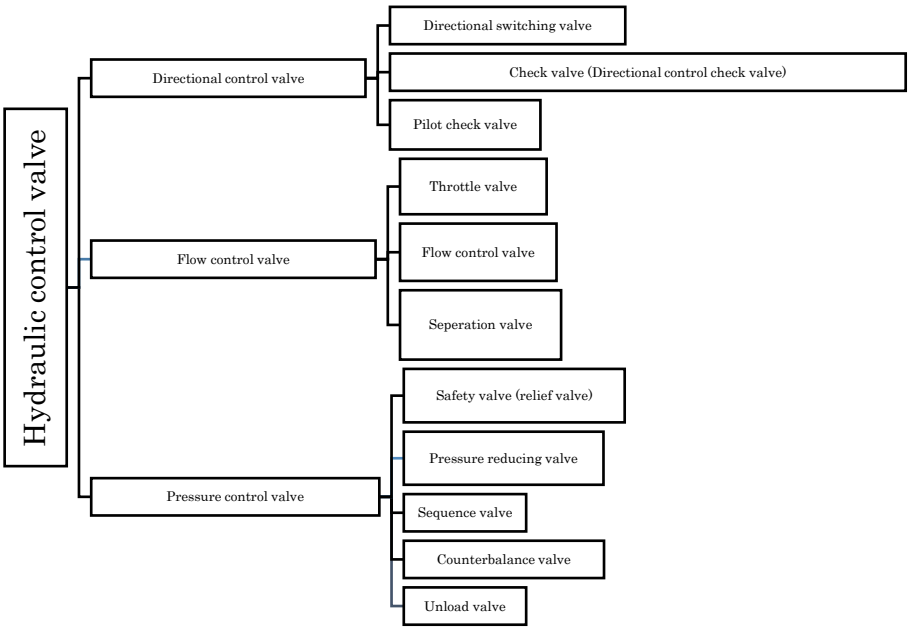
【Special type cylinder (telescopic type)】

Another cylinder is built inside the hydraulic cylinder, and when hydraulic fluid is injected, the cylinder expands and contracts sequentially from the built-in cylinder and is used when a large stroke is required.

(6) Hydraulic control valve (Textbook page 113)

The hydraulic control device is a device that controls the flow direction, pressure, and flow rate of hydraulic fluid to a hydraulic drive system (actuator) such as a hydraulic motor or a hydraulic cylinder.

The hydraulic control valve can be classified as follows from the functional point of view.



1) Directional control valve (Textbook page 114)

The directional control valve is an important valve that switches the flow direction of the hydraulic fluid to control the operation direction, start, stop, etc., of the hydraulic drive system (actuator).

2) Flow control valve (Textbook page 115)

The flow rate control valve is a valve that controls the amount of hydraulic fluid flowing and controls the speed of the actuator.

3) Pressure control valve (Textbook page 116)

The pressure control valve is a valve to adjust the pressure of the hydraulic fluid discharged from the pump and release the secondary generated pressure to prevent mechanical damage. It also has an important function in determining the torque and thrust of the actuator.

3.2.3 Hydraulic fluid (Textbook page 121)

The hydraulic fluid is pressurized to a high pressure by a hydraulic pump, moves the hydraulic drive device through the pipeline, and repeatedly performs the work of moving the working device. For this reason, the hydraulic fluid becomes hot and is in contact with metal or air, and is vigorously agitated, so that deterioration (oxidation) of the hydraulic fluid and contamination of foreign substances cannot be avoided.

Since the use of this deteriorated or contaminated hydraulic fluid causes a failure of the hydraulic system, it is important to constantly inspect the hydraulic fluid and manage it appropriately.

(1) Changes in properties and causes due to deterioration of hydraulic fluid (Textbook page 121)

Deterioration (oxidation) is the deterioration of the components of hydraulic fluid by causing a chemical reaction. Table 3-6 shows the changes in properties and causes due to deterioration.

Table 3-6 Changes in hydraulic fluid properties and causes

Properties	Changes due to deterioration and pollution	Cause
specific gravity	Increase	Deterioration of hydraulic fluid, foreign matter contamination, dissimilar oil contamination
Moisture content	Increase	Intrusion of moisture from the outside
Precipitate content	Increase	Deterioration of hydraulic fluid and contamination with foreign matter
Flash point	Deterioration	Deterioration of hydraulic fluid and contamination with foreign matter
Hue	Transparency decreases	Deterioration of hydraulic fluid, contamination with foreign substances, emulsification
Viscosity	Increase	Deterioration of hydraulic fluid
Oxidation	Increase	Increased oil temperature and contamination with metal powder

(2) Inspection and management of hydraulic fluid (Textbook page 121)

1) Judgment and replacement of hydraulic fluid (Textbook page 121)

The air that goes in and out of the hydraulic fluid reservoir brings in dust and moisture. In addition, the hydraulically operated device itself also generates metal powder little by little due to wear.

Since these impurities are mixed in the hydraulic fluid, it is necessary to replace the hydraulic fluid regularly.

There are two methods for determining whether the usage limit has been reached due to deterioration of the hydraulic fluid or contamination of foreign matter, such as a visual inspection for visually determining the hydraulic fluid and a property test by scientific analysis. Both are judged by comparing with unused hydraulic fluid of the same type.

If the collected hydraulic fluid becomes cloudy or foamy, it is deterioration due to a malfunction or lack of management of the hydraulic fluid reservoir. Normal hydraulic fluid usually contains about 0.05% of water, but when more water enters the tank, the hydraulic fluid turns milky white.

In addition, when grease is mixed in, it becomes foamy. If the deteriorated hydraulic fluid is used as it is, the circulation of hydraulic pumps and hydraulic systems will be lost, and the seal will corrode. When foreign matter is mixed in the hydraulic fluid, the foreign matter enters the sliding part (rubbing part) or gap between the piston and cylinder, causing abnormal friction and generating new foreign matter such as metal powder.

As a result, abnormal noise, abnormal heat generation, speed decrease, pressure increase failure, oil leakage, etc., occur. If this is left as it is, extensive disassembly and repair will be required, so if it is extremely dirty, it will be necessary to replace or clean the hydraulic fluid or clean or replace the element.

Table 3-7 shows the method and countermeasures for visually discriminating hydraulic fluid.

Table 3-7 How to identify hydraulic fluid and how to take measures

Appearance	Smell	Condition	Measure
Transparent and no color change	Good	Good	Continue to use as it is
Transparent but pale in color	Good	Dissimilar oil mixed	Change hydraulic fluid
It has changed to milky white	Good	Air bubbles and moisture are mixed	Change hydraulic fluid
It has changed to bdlackish brown	Stink	Deterioration	Change hydraulic fluid
Transparent but with small sunspots	Good	Foreign matter mixed	Change hydraulic fluid
Bubbling can be seen	—	Grease mixed	Change hydraulic fluid

3.3 Knowledge of lower part traveling body and power transmission system (Textbook page 124)

The lower traveling body of the aerial work platform vehicle is equipped with the upper working device and travels.

It is classified into the truck type and self-propelled type (wheel type, crawler type) according to the traveling method.

The structure of power transmission differs depending on each traveling method.

3.3.1 Truck type vehicle (Textbook page 124)

Since the truck-type aerial work platform vehicle has a working device mounted on the upper part of the chassis of the truck, the traveling device, and the operating device are the same as those of a general truck.

Therefore, when driving on a public road with a truck-type aerial work platform vehicle, it is necessary to have an operator's license corresponding to the vehicle and to comply with the Road Traffic Act.

(1) Power transmission system (Textbook page 124)

The power transmission system for truck-type aerial work platform vehicles is generally a front-engine/rear drive type, and the engine drives the rear wheels at the front. The engine's power is transmitted to the rear wheels, which are the driving wheels in the order shown in Fig. 3-35.

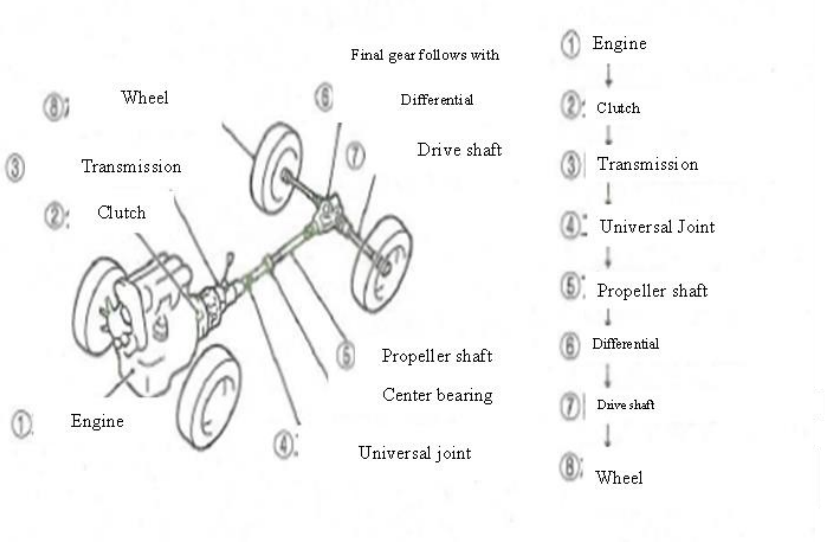


Fig 3-35 Power transmission device (Front engine and Rear drive type)

(2) Braking device (brake) (Textbook page 129)

The brakes include a foot brake for decelerating or stopping a moving vehicle, and a parking brake used when parking, and a friction type brake is generally used as the mechanism.

1) Parking brake (Textbook page 130)

Structure and handling precautions for truck-type parking brakes (hand brakes)

① Parking brake structure

The hand brake of a passenger car has a structure that directly stops the rear wheels. However, in the case of trucks, it goes further through the differential (differential) instead of the tires.

The structure is such that the hand brake stops the propeller shaft. (Fig. 3-43)

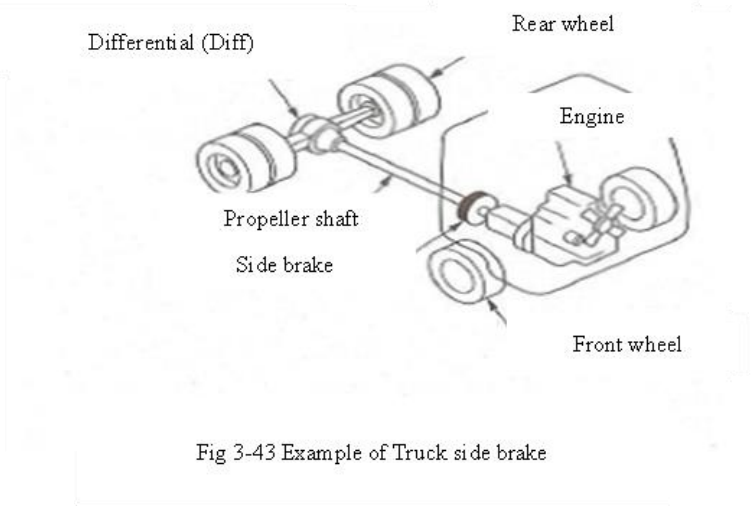


Fig 3-43 Example of Truck side brake

② Handling precautions

Due to the structure, even if the hand brake is applied, if either of the rear wheels floats from the ground, the rear wheels will easily rotate, and the parking brake will not work.

3.3.2 Wheel-type traveling unit (Textbook page 131)

There are two types of wheel-type aerial platform vehicles, one in which the working device turns and the other in which the working device does not turn, but both have a structure that allows both running and working with one engine.

In addition, since the operation unit often operates the wheel-type aerial platform vehicle on the upper work platform, the direction switching valve, pressure control valve, etc., provided at the lower part are provided.

In many cases, the flow control valve and the like are controlled by electric signals.

(1) Power transmission system (Textbook page 131)

The lower traveling body of the wheel-type aerial platform vehicle converts the mechanical energy generated by the engine into fluid energy (hydraulic pressure) with a hydraulic pump and transmits it.

It is a structure that travels by rotating a traveling hydraulic motor with that hydraulic pressure. The configuration of the power transmission system of the wheel-type traveling body is as shown in FIG. 3-44.

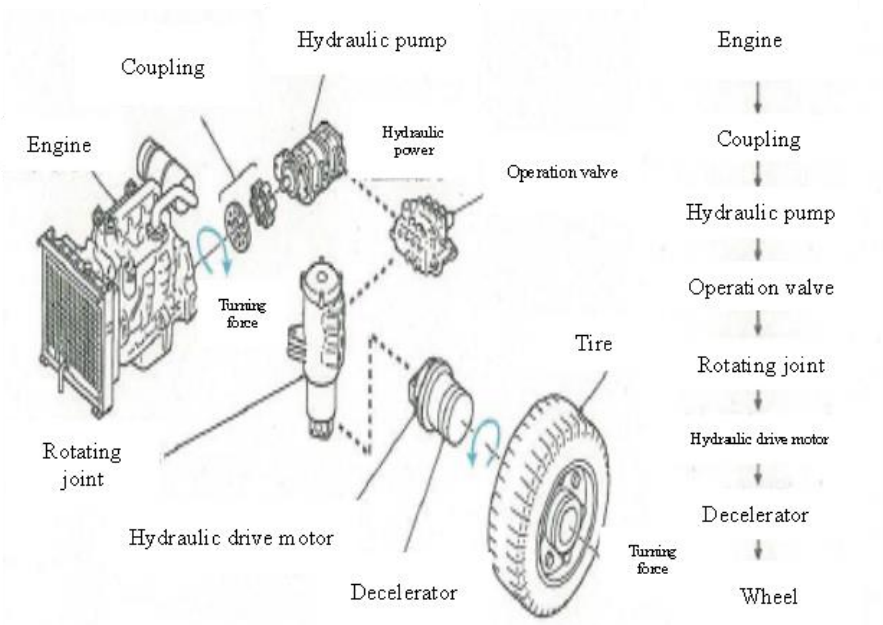


Fig 3-44 Wheel-type vehicle mechanism and power transmission

3.3.3 Crawler type vehicle (Textbook page 135)

(1) Crawler type vehicle (Textbook page 135)

The power transmission system of the crawler type aerial work platform vehicle is basically the same as that of the wheel-type aerial platform vehicle,

The difference from the wheel type is that the left and right traveling devices can be driven independently.

Chapter 4　Knowledge of mechanics, electric shock, etc. required for driving（Textbook page 138）

「to move」,「being moved」,「to put」,「to raise」,「to bring down」,「to shift」,「to roll」etc. an object is performed under certain law (law of force) in the natural world.

When working with machines, tools, devices, etc., which are limited to High altitude work platforms, understanding these rules is very important for efficient work and safe work.

4.1　About Mechanics（Textbook page 142）

4.1.1　Force (Textbook page 142）

(1)　3 components of forces (Textbook page 142）

Figure 4-4 shows the state of force when a human is pushing an object.

In this way, “the place where the force acts” (point of action) and “the direction in which the force acts” (direction), “Magnitude of force” (magnitude) can be represented by a straight line. Force always has these three elements, which are called “three elements of force”.

Figure 4-4
3 components of force

The force can be drawn as follows.

If a straight line is drawn from the point of action A of the force to the direction B of the force and the length of AB is proportional to the magnitude of the force (for example, if 1N (Newton) is determined to be 1 cm, 5N is 5 cm. It is the length.) This straight line (AB) is called the force action line.

The direction of the arrow indicates the direction of the force.

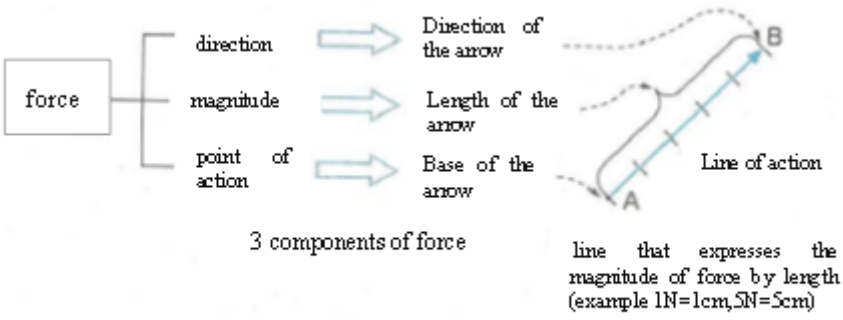


Figure 4-5 image of force

4.1.2 Force composition and decomposition (Textbook page 143)

When two or more forces are acting on an object, replacing these two or more forces with force having the same effect as these is called synthesis, and this replaced force is applied to the object. It is called the “combined force” of two or more forces.

(1) Composition of two forces（Textbook page 143）

(a) Composition of forces on a straight line（Textbook page 143）

As shown in Figure 4-7, the resultant force (R) when two forces (F1 and F2) are acting on a straight line is the sum of the forces when they are in the same direction and the opposite. When it is a direction, it can be calculated by the difference.

Figure 4-7 Composition of forces on a straight line

(b) If the direction and size are different（Textbook page 144）

Figure 4-8 shows that the “resultant force (R)” is obtained when two forces, F1 and F2, with varying directions of force act on the O point.

Draw a parallelogram (OBDA) with F1 and F2 as two sides, and the diagonal line is the “resultant force (R)”.

This is called the “parallelogram of force”.

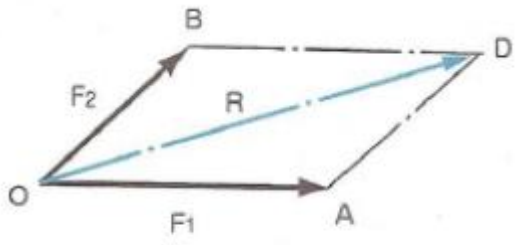


Figure 4-8 Law of parallelogram of forces

(2) Decomposition of force（Textbook page 145）

As shown in Fig. 4-10, the ship floating in the flowing river is tied to the stakes (A, B) on both banks with a rope so that it does not depend on the shore, and the force F at which the ship is swept, at that time Let the forces applied to the rope be Fa and Fb, respectively.

The force applied to this rope can be obtained by using the “parallelogram of force” in reverse, as shown in Fig. 4-10.

A parallelogram is drawn with the reaction force R of the force F flowing by the ship as a diagonal line, and each rope has two sides, and the lengths Fa and Fb of the sides at that time are the forces applied to the rope.

Dividing one force into two or more forces in this way is called “force decomposition”, and the divided forces such as Fa and Fb are called “components”.

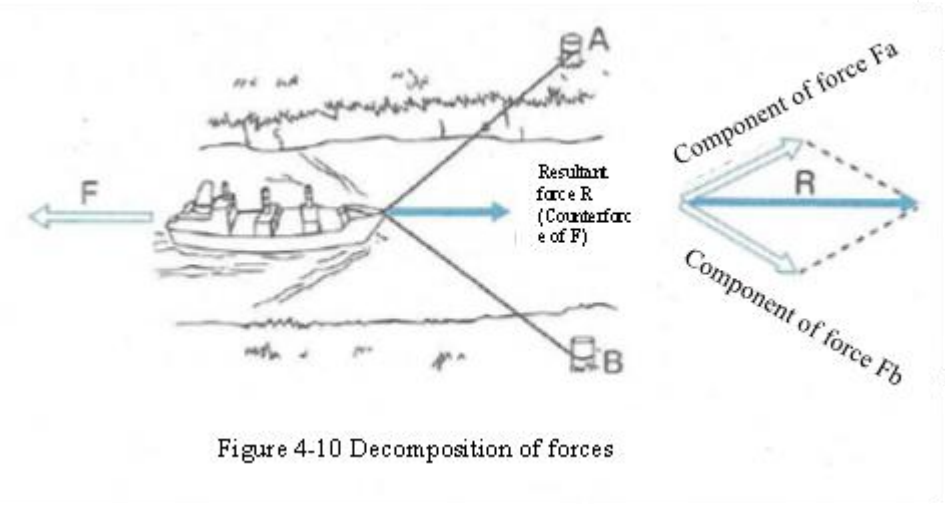


Figure 4-10 Decomposition of forces

4.1.3 Moment of Force （Textbook page 146）

The force that tries to rotate an object is called the “force moment”, and the magnitude of this moment (M) is not only the magnitude of the force (F) but also the center of the rotating axis and the force point of the force. The distance (arm's length: L) is related and can be expressed as follows.

Moment (M) = Force (F) × Distance (L)

(1) Tightening force and moment（Textbook page 146）

In figure 4-12, the forces acting on the force point A 2 L away from the rotation axis O and the force point B separated from L are referred to as Fa and Fb, respectively.

Each moment (Ma, Mb) can be obtained as,

Ma = Fa x 2L
Mb = Fb x L

If the force (moment) for tightening this nut is the same,

Ma = Mb will be,

Fa x 2L = Fb x L
2Fa = Fb
Fa = Fb/2

When the force (moment) for tightening the nut is the same, the force Fa for tightening at point A, where the arm's length is doubled, is half the force Fb for tightening at the near point B.

However, in this case, the distance for moving the arm becomes long, and the amount of work is the same regardless of whether the arm is tightened with A or B.

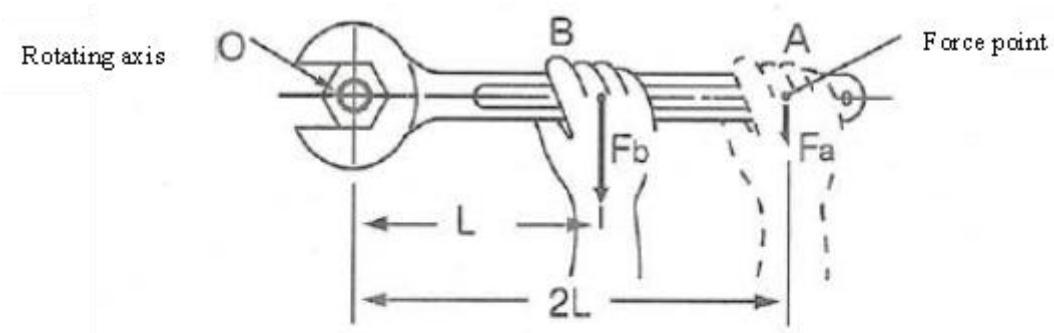


Figure 4-12 tightening force and moment

(2) toppling and moment（Textbook page 148）

The relationship between stability and moment against a toppling during aerial work platform work will be explained as an example.

【Terms】

O: Toppling fulcrum (outrigger overhang position)

W_G : Weight of aerial work platform (Mass of vehicle x g)

W : Total weight of load on the work platform (Loaded mass x g)

L: From the fulcrum O to the position of the center of gravity of the aerial work platform distance

ℓ : From the fulcrum O to the center of gravity of the load Horizontal distance

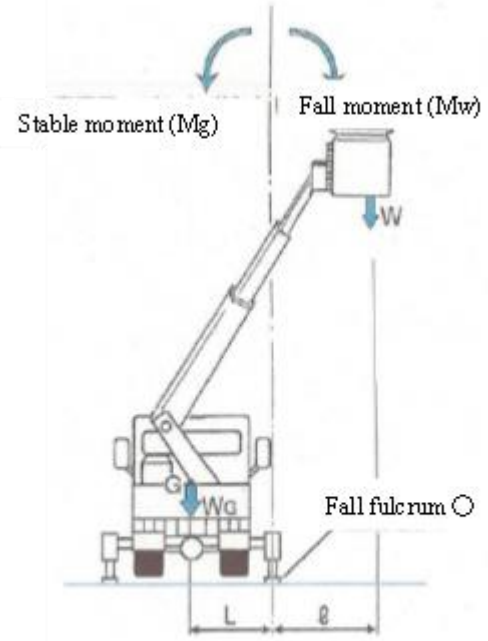


Figure 4-14 fall moment of aerial work platform

With the fulcrum O as the axis, the moment of the force that tries to overturn the aerial work platform is the overturning moment (MW), and the moment that acts in opposition to the moment that tries to overturn and tries to stabilize it (MG) is next. It can be calculated by an expression。

Toppling moment M_w＝ W×ℓ

Stable moment M_G＝ W_G×L

If $M_G > M_w$, the aerial work platform is stable against a toppling, and if $M_G < M_w$, the aerial work platform toppling.

Even if the load is the same, by lowering or lengthening the boom, the distance (Q) to the load's center of gravity becomes longer, the toppling moment (M_w) increases, and the risk of toppling increases.

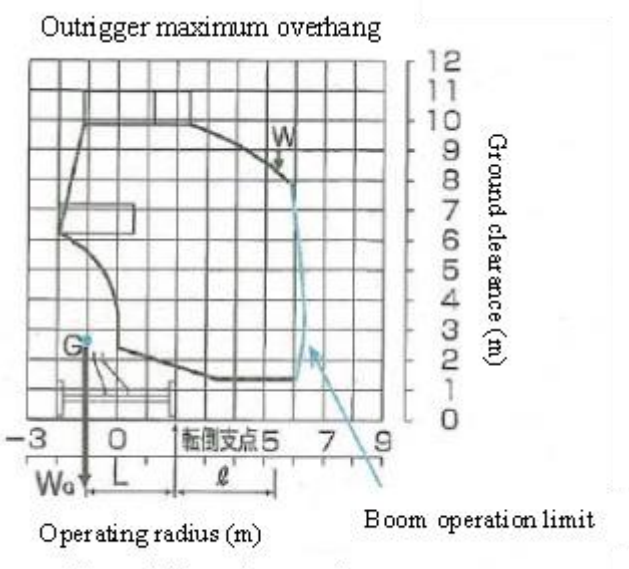


Figure 4-15 work range diagram

Furthermore, the “boom operation regulation device” (see 2.1.3 (1) Boom operation regulation device), which is a safety device for aerial work platforms, automatically detects this toppling moment and stability moment and issues an alarm or stops the operation.

The working range diagram in Fig. 4-15 shows the limit of operation of the boom.

4.1.4 Balance of force（Textbook page 149）

When several forces are acting on one object, and the object does not move, their forces are said “balanced”.

For example, when a load is hung with a rope, the fact that the load is stationary means that an upward force (F) having the same magnitude as the gravity (W = mg) generated by the mass of the load acts on the rope, and the force is applied. It means that they are in a balanced state.

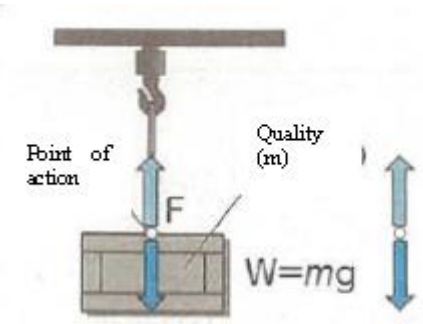


Figure 4-16 Balance of parallel forces

(1) Balance of parallel forces（Textbook page 149）

The force acting on the balance in Figure 4-18 is standstill, it means the counterclockwise moment (Ma) of the fulcrum, and the clockwise moment (Mb) is equal. It can be expressed by the following equation.

Ma = Mb

Ma = Wa x a

Mb = Wb x b

In addition, on the shoulder of the person who supports this, Wa + Wb = The force of P is acting.

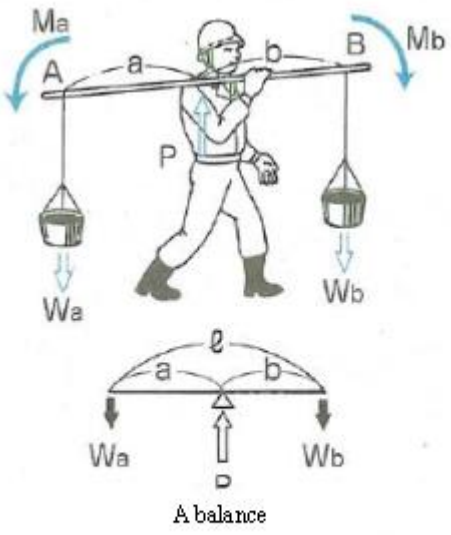


Figure 4-18 Balance of parallel forces

4.2 Mass and center of gravity (*shitsuryou & jyuushin*) （Textbook page 150）

(1) Mass (*Shitsuryo*)（Textbook page 150）

The mass of an object differs depending on the material even if the volume is the same. For example, lead is heavier than iron and wood is lighter than aluminum.

This is due to the difference in “mass per unit volume” (d).

(2) Center of gravity (*jyuushin*)（Textbook page 151）

The "center of gravity"(*jyuushin*) is "the point where the force acts when the gravity acting on each part of the object is put together", but simply put, it is the "center" (*chuushin*) of the weight of the object.

A specific object has a center of gravity (*jyuushin*) peculiar to the object, and if the object is not deformed, the position of the center of gravity does not change even if the position or placement of the object changes. Also, it is not always inside the object.

The position of this center of gravity is an important factor when considering the position where an object is lifted and the overturning of a machine such as an aerial work platform.

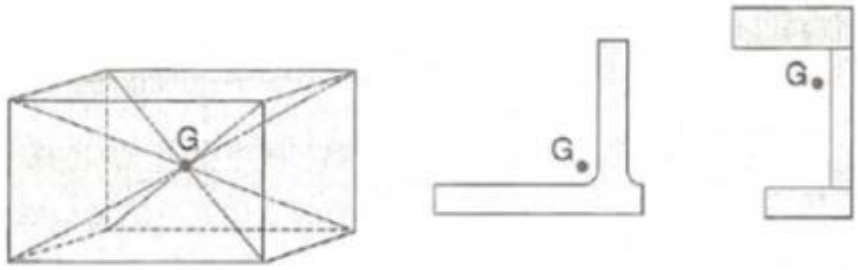


Figure 4-19 Position of center of gravity

1) Center of Gravity and Stability (*Jyuushin & Antei*)（Textbook page 153）

① Object stability（Textbook page 153）

The fact that the placed object is "stable" (*suwari ga ii*) means that it is stable without the risk of toppling.

As shown in Figure. 4-21, when the perpendicular line passing through the center of gravity (*Jyuushin*) of the object passes through the bottom face supporting the object, the object sits well and is stable, but conversely, when the perpendicular line deviates from the bottom face, it is unstable and topples.

This is the reason objects tend to toppling over when placed on a slope or at an incline angle.

Also, even if this vertical line passes through the bottom face, an elongated object with a high center of gravity (*Jyuushin*) may topple off the vertical line even if it is tilted a little.

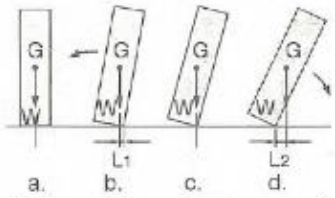


Figure 4-21 position of center gravity and stability.

On the contrary, the flatter ones have less risk of toppling.

Even if it is the same object as shown in (a) and (b) of Figure. 4-22 (b) has a larger base area than (a) just by changing the placement. It is highly stable because the position of the center of gravity is low.

Furthermore, to keep the object stable is important to place it in a low position and a large base area

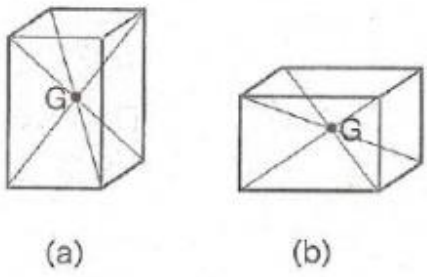


Figure 4-22 bottom area and stability

② Center of gravity and stability of two objects（Textbook page 154）

In figure. 4-24, workers and materials (mass M_2, weight $W_2 = m_2 g$, center of gravity position G2) were placed on the work platform of an aerial work platform (mass m_1, weight $W_1 = m_1 g$, the center of gravity position G1). In that case, the position of the center of gravity (*jyuushin*) (G) becomes higher ($h_b \rightarrow h_a$) as the work platform becomes higher.

In addition, as the boom is extended and the work platform moves away from the center of the aerial work platform, the vertical line passing through G approaches the overturning fulcrum (wheels, crawlers, outriggers, etc.) that supports the aerial work platform ($\ell 1 \rightarrow \ell 2$). It becomes an unstable state where it is easy to topple.

Therefore, it is dangerous to load more than the specified mass of material on the work platform and work without fully overhanging the outriggers.

For the same reason, it is important to install the aerial work platform as horizontally as possible because there is a risk of tipping over when using the aerial work platform on a slope or in an inclined state.

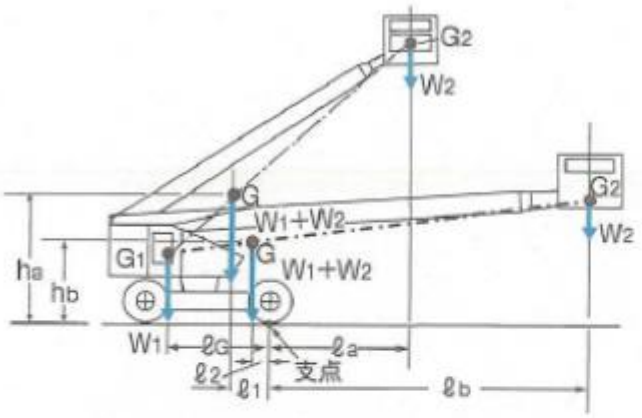
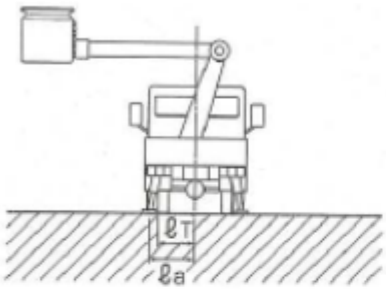
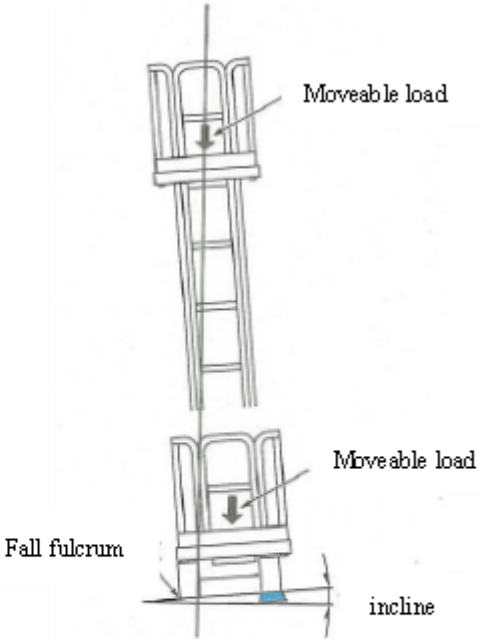


Figure 4-24 change of the center gravity position in the aerial work platform

m1: mass of aerial platform
m2: mass of movable load
W1: weight of aerial work platform (W1=m1g)
W2: mass of movable load (W2 = m2g)
G: Entire center of gravity position
G1: Aerial work platform center gravity position
G2: movable load center of gravity position
ℓa: distance to the weight position of the movable load (close to the work floor)
ℓb: distance to the weight position of the movable load (far to the work floor)
ℓG: distance to the aerial work platform center gravity position
ℓ1: distance to the position entire center of gravity position
ℓ2: distance to the position entire center of gravity position
ha: height to the position entire center of gravity position (close to the work floor)
hb : height to the position entire center of gravity position (far to the work floor)



ℓT: distance to the tire
ℓa: distance to the outrigger
※By overhanging the outriggers, the bottom surface expands, and stability increases.
Figure 4-25 stability of aerial work platform



※Driving with the work floor raised high leads to a fall where the center of gravity position exceeds the fall fulcrum on a slight inclination.
Figure 4-26 height of work floor and stability

4.3 Motion of objects (Textbook page 156)

(1) Inertia (Textbook page 156)

An object has the property of remaining at rest when it is at rest and continuing its motion when it is in motion unless an external force acts on it. Such a property is called “inertia”, and the apparent force acting on an object due to inertia is called “inertia force”. The inertial force increases as the acceleration increases and the mass increases.

When a person rides on the work platform of the aerial work platform vehicle, and the vehicle is rotating, if it stops suddenly, the person will try to jump out in the direction of rotation due to the “inertia”.

Therefore, immediate operation is dangerous.

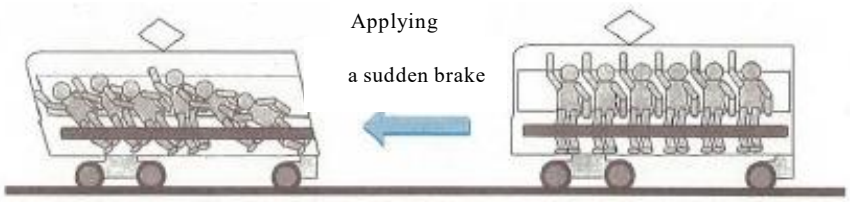


Figure 4-27 Inertial force

(2) Friction

1) Friction and stability of the aerial work platform vehicle (Textbook page 160)

When trying to park an aerial work platform vehicle on a slope, it is necessary to stop with a foot brake, apply a parking brake, further put the wheel chock, and install an outrigger.

Considering the friction, the foot brake can decelerate and stop because the frictional force of the brake works. The parking brake is effective because of the frictional force. Furthermore, because the frictional force acts between the road surface and the tires, the aerial work platform can be kept stopped if the brakes are applied.

However, even if the vehicle is stopped on a steep slope, as shown in Fig. 4-33 and remains stable for a while, it will start to escape in the same way if some external force exceeding the static friction force is applied.

Figure 4-32

Stopped on a gentle slope

Figure 4-33

Stopped on a steep slope

With the outrigger in place, frictional forces between the jack, jack base, and road surface act to keep the vehicle stable. However, if the angle of the slope becomes large and the direction of the force changes as well as the frictional force acting between the tire and the road surface, the aerial work platform vehicle will start to run away.

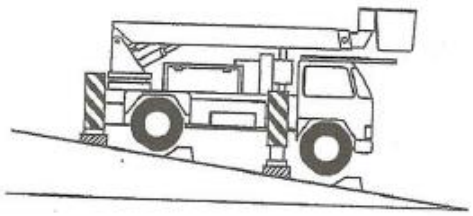


Figure 4-34

Outrigger installation

This friction and the stability of the vehicle is one of the reasons why the aerial work platform vehicle must be installed and used within the specified tilt angle when attempting to work.

4.4 Load and stress (Textbook page 163)

4.4.1 Load (Textbook page 163)

“Load” is the force received from the outside on all or part of an object, such as a machine or structure.

1) Classification of loads (forces) according to action state (Textbook page 163)

(a) Static load (Textbook page 163)

The static load is a constant load in which the magnitude and direction of the force acting on the object are stationary regardless of the change in time.

(b) Dynamic load (Textbook page 163)

① Repeated load (Textbook page 163)

The repeating load is a load in which the direction of the load is the same, the magnitude of the load changes with time, and the load acts repeatedly.

② Impact load (Textbook page 163)

The impact load is a large load that acts instantaneously.

For example, when the rotation of the boom is suddenly stopped, the lateral load applied to the boom is the impact load. The large load acts on the boom, causing the machine to be destroyed momentarily.

3) Classification according to load distribution(Textbook page 165)

It can be classified into the following two types according to the distribution state of the external force acting on the object.

(a) Concentrated load (Textbook page 165)

A concentrated load is a force acting on a point on the surface of an object. For example, it is the load exerted on the ground contact surface by the tires and outriggers of the aerial work platform vehicle.

(b) Distributed load (Textbook page 165)

A distributed load is a force that acts with a distribution on the surface of an object.

For example, the load applied to the ground by the crawler surface of the aerial work platform.

In particular, if the external force is the same on all surfaces, it is called as “uniformly distributed load”.

4.5 Knowledge of ground strength (Textbook page 168)

When working by installing an aerial work platform vehicle on unpaved ground, there is a risk of tipping over due to the subsidence of the supporting ground, so it is important to check the bearing capacity of the ground in advance and use an iron plate to prevent the wheels and outriggers from sinking.

The aerial work platform vehicle is often used for a relatively short time in various places depending on the work content and situation. Therefore, it is difficult to confirm the strength of the ground on which the aerial work platform vehicle is installed each time, but it is possible to estimate the strength of the ground from the ground condition at the place where it is installed and the results of the geological survey at the nearby place.

4.6 Knowledge of ground pressure for the aerial work platforms vehicle (Textbook page 169)

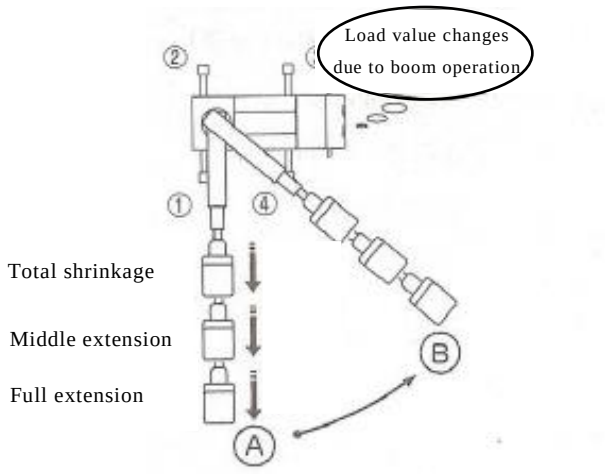
The strength of the ground and the magnitude of the load acting on the ground (ground pressure) is important factor in the overturning of the aerial work platforms vehicle.

4.6.1 Ground pressure when using outriggers (Textbook page 171)

Aerial work platform vehicle that has outriggers such as trucks, the ground pressure applied to the outrigger float changes greatly depending on the direction of the boom and the condition of elevation and expansion/contraction.

This sinking of the outrigger float during work, even if only slightly, is amplified and transmitted to the working floor at the top of the boom, where it can cause the work vehicle to tip over.

Therefore, when installing on unpaved ground, it is important to check the ground pressure applied to the outriggers and to cure them with an iron plate to disperse the ground pressure to prevent uneven subsidence.



4.7 Knowledge for preventing accidents caused by electricity (Textbook page 172)

Aerial work platform vehicles used for outdoor electrical/communication work, construction work, and work alongside electric wires should always be operated with the prevention of accidents due to electric shock.

4.7.1 Electric shock (Textbook page 173)

(1) What is electric shock (Textbook page 173)

"Electric shock" refers to a disturbance caused by an electrification through the human body, also known as an electric shock or electroshock.

The main causes of electric shock when using an aerial work platform vehicle are contact with power lines or distribution lines and electricity leakage due to improper use or poor maintenance of the aerial work platform vehicle.

The human body has low electrical resistance, and especially when it is wet with water, it is highly dangerous because the current easily flows. Mild cases may cause only temporary pain and numbness, but severe cases often lead to electrocution.

Particularly when an electric current passes through the heart, it causes serious symptoms such as cardiac arrest, respiratory arrest, and shock, resulting in death by electric shock, and may cause burns and tissue necrosis in the place where the electric current is excessive.

(2) Factors that determine the risk of electric shock (Textbook page 174)

The severity of the damage to the human body caused by electric shock depends on the situation at the time of electric shock, but the following are the main factors.

① Magnitude and frequency of electrification

② Duration of electrification

③ Route of electrification (path of current through the human body)

④ Type of power source (AC or DC), etc.

In general, it can be said that the greater the energizing current, the higher the risk, the more the electric current flows into an important part such as the heart of the human body, and the longer the electric current flows, the higher the risk.

(3) Effect of electric current on the human body (Textbook page 174)

Table 4-7 shows the effects of electrification through the human body due to electric shock.

Table 4-7 AC current and human body reaction

The magnitude of the electric current	Human body reaction
About1mA	It feels tingling
About5mA	It hurts considerably
About10mA	It feels unbearably chattering.
About20mA	The muscles are very stiff, breathing is difficult, and if it continues to flow, it will lead to death.
About50mA	It is life-threatening, even for a short time.
About100mA	It can be fatal.

(4) Precautions when working near overhead power lines (Textbook page 174)

Many electric shock accidents have occurred in work using an aerial work platform vehicle due to contact with overhead power lines such as transmission and distribution lines.

Especially in the high-voltage power transmission lines, even if workers or the boom of aerial work platforms do not touch directly, there is a risk of electric shock just by approaching the power transmission line, so it is necessary not to approach within the specified distance (minimum separation distance). It is necessary to take protective measures and assign observers to carry out the work.

In addition, accidents due to electric shock are more common in summer, when the body is more exposed and wet with sweat.

When work such as construction, dismantling, inspection, repair, painting, etc., is performed using an aerial work platform vehicle in a place close to the charging electric wire of an overhead electric wire or an electric machine, it comes into contact with the charging electric circuit. Or, if there is a risk of electric shock due to approaching, it is necessary to take the following measures. (Article 349 of the Act on Safety and Health)

① Relocate the charging circuit.
② Enclose to prevent electric shock.
③ Attach insulating protective equipment to the charging circuit.
④ If the measures ① to ③ above are difficult, assign an operation leader to monitor the work.

The basic measures for electric shock prevention when working near transmission/distribution lines where there is a risk of electric shock are as follows.

【Basics of electric shock prevention measures】

① Consult with the electric power company in advance.

② Keep a safe distance (safe separation distance: see Table 4-8) with respect to power transmission lines.

③ Reassign the person in charge of monitoring.

④ Have a preliminary meeting with the work plan.

⑤ Ensure that all relevant workers are familiar with the work procedures.

⑥ Protect the charging circuit as needed.

When performing work such as inspection and repair of a low-voltage charging circuit, it is necessary to have the worker wear an insulating protective device or use a live-line working device. (Article 346 of the Safety Regulations)

In addition, when performing electrical work such as inspection, repair, painting, etc., of the electric circuit or the part supporting in a place close to the low voltage charging electric circuit, it is necessary to take measures such as attaching insulating protective equipment to the electric circuit. Is. (Article 347 of the Safety Regulations)

※１ Protective equipment for insulation: It is worn by workers to prevent electric shock hazards, such as electric safety caps, electric rubber gloves, insulating rubber boots, electric rubber sleeves, etc.

※２ Insulating device: It is used to protect the charging part from electric shock when handling the charging circuit or carrying out electrical work. This includes the insulation sheet, insulation cover, rubber insulation tube, etc.

※３ When working close to a high voltage charging part such as construction work, in order to prevent the worker from getting an electric shock due to contact with the metal body for construction. The construction protective pipes and the construction protective sheets must be attached to the high voltage charging section.

Table 4-8 Safe separation distance from transmission/distribution lines

Electric circuit	Transmission pressure (V)	Minimum separation distance (m)	
		Ministry of Labor Notification※	Power company target value
Distribution line	100・200 or less	1.0 or more	1.0 or more
	6,600	1.2 or more	2.0 or more
Power line	22,000	2.0 or more	3.0 or more
	66,000	2.2 or more	4.0 or more
	154,000	4.0 or more	5.0 or more
	275,000	6.4 or more	7.0 or more
	500,000	10.8 or more	11.0 or more

※Notification from the Director of Labor Standards Bureau, Ministry of Labor: December 17, 1975 No. 759

Chapter 5　Related Laws and Regulations

In order to contribute to the safe driving of aerial work platforms, businesses and workers must comply with occupational health and safety regulations.

The followings are the main items related to the Occupational Safety and Health Regulation that contribute to the safe driving of aerial work platforms.

Matters to be observed by workers (related to Article 29 of the Safety and Health Regulations) (Textbook page 189)

Workers must observe the following items regarding safety devices, etc.

① Do not remove the safety device nor lose its function.

② If it is necessary to temporarily remove the safety device or lose its function, obtain permission from the business operator in advance.

③ If you have obtained the permission to remove the safety device or lose its function, restore it to the current state immediately after it is no longer necessary.

④ If it is found that the safety device, etc., has been removed or has lost its function, promptly notify the business operator.

Businesses requiring special education (related to Article 36 of the Safety and Health Regulations) (Textbook page 190)

Special education must be provided when a business operator sends a worker to the next job,

⑩ -5 Operation of an aerial work platform with a work platform height of less than 10 meters.

㊶ Works related to operation performed using full harness type toppling prevention equipment in places where it is difficult to provide a work platform at the height of 2 meters and above.

Qualifications for employment restrictions (related to Article 41 of the Safety and Health Regulations) (Textbook page 191)

(Safety Ordinance Article 20 No.15) The following persons can be engaged in the work of driving aerial work platforms with a work platform height of 10 meters or more (excluding driving on a public road).

① Those who have completed the high-altitude work vehicle driving skill training.

② Persons specified by the Ministry of Health Labor and Welfare.

Reissuance of certificate of completion of skill training, etc. (related to Article 82 of the Safety and Health Regulations) (Textbook page 192)

① When the person who has been issued a skill training certificate lost or damaged his/her skill training certificate, the person must submit an application for re-issuance of the skill training certificate to the registered training institution that issued the skill training skill certificate.

② When the person who has been issued a skill training certificate changes his/her name, he/she must submit a skill training certificate replacement application to the registered training institution that issued the skill training certificate.

Matters to be managed when working with aerial work platforms.

(1) Work plan (related to Article 194-9 of the Safety and Health Regulations) (Textbook page 194)

① When working with an aerial work platform, the business operator shall determine in advance a work plan that adapts to the situation of the place related to the work, the type and capacity of the aerial work platform, etc., and the work plan must be performed.

② The work plan must show how to work with the aerial work platform.

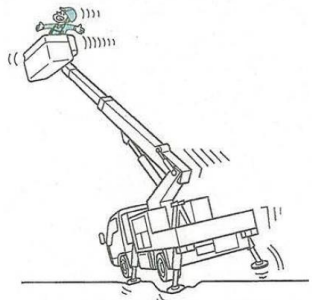
③ When the business operator establishes a work plan, he/she must inform the workers concerned about the method of working with aerial work platform.

(2) Work conductor (related to Article 194 -10 of the Safety Regulations) (Textbook page 194)

- When carrying out work using an aerial work platform, the business operator must appoint a commander of the work and have the person direct the work based on the work plan of (1).

(3) Prevention of toppling, etc. (related to Article 194-11 of the Safety and Health Regulations) (Textbook page 194)

- When working with an aerial work platform, the business operator must take necessary measures such as the danger of workers toppling from the aerial work platform, overhanging outriggers, and preventing uneven subsidence of the ground and preventing shoulder collapse.



Implementing overturning measures when working in uneven ground

(4) Signal (related to Article 194-12 of the Safety and Health Regulations (Textbook page 194)

・ When the business operator work using an aerial work platform and operates the work platform in a place other than the work platform, to ensure the communication between workers on the work platforms and those who operate the work platform outside the work platform, necessary measures such as setting a certain signal and pointing a person who gives the signal needs to be taken.

Matters to be managed when driving aerial work platforms.

(1) Measures when moving away from the driving position (related to Article 194-13 of the Safety and Health Regulations) (Textbook page 195)

① The operator of the aerial work platform must take the following measures when leaving the driving position for traveling (except when the worker is at work or is about to work)

(a) Place the work platform in the lowest descent position.

(b) In order to prevent the work platform from running away, maintain the holding position by stopping the prime mover and applying the brakes.

② As for driving the aerial work platform, the operator of the aerial work platform must take measures listed in (1) when moving away from the driving position.

③ In the case where a worker rides on the work platform of an aerial work platform or is about to perform the work, the business operator must take measures such as applying the brakes to keep the aerial work platform stopped must be performed when the operator leaves the driving position for traveling.

④ The operator of the aerial work platform must take the measures written on (3) when leaving the driving position for traveling the aerial work platform.

(2) Boarding restrictions (related to Article 194-15 of the Safety and Health Regulations) (Textbook page 195)

・ When working with aerial work platforms, the business operator must not put workers in any place other than the passenger seats and work platform.

(3) Restrictions on use (Article 194-16 of the Safety and Health Regulations) (Textbook page 196)

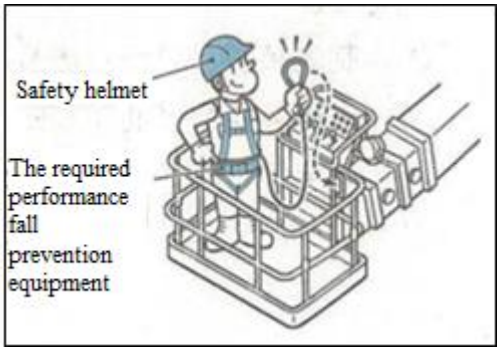
・ For aerial work platform, the operator has a load capacity (meaning the maximum load that can be carried by a person or load on the work platform, depending on the structural materials of the aerial work platform) and does not use beyond its capabilities.

(4) Restriction on use other than the main purpose (related to Article 194-17 of the Safety and Health Regulations) (Textbook page 196)

- The business operator shall not use the aerial work platform for any purpose other than the main purpose of the aerial work platform, such as lifting a load. However, this shall not apply when there is no risk of causing danger to workers.

(5) Required performance use of toppling prevention equipment, etc. (related to Article 194-22 of the Safety and Health Regulations) (Textbook page 197)

① When working with aerial work platforms (excluding those with a structure in which the safety hat work platform rises or toppling perpendicular to the ground area) The business operator of an aerial platform (the work platform safety hat rises or toppling only perpendicular to the ground), workers on the work platform of the aerial work platform must be made to use the required toppling prevention equipment.



② Workers on the work platform of aerial work platforms must use the required performance toppling prevention equipment.

Matters concerning self-inspection of aerial work platforms

(1) Periodic self-inspection (related to Article 194-23 and Article 194-24 of the Safety and Health Regulations) (Textbook page 197)

① The business operator must regularly conduct a self-inspection for aerial work platforms once every year. However, this does not apply to the aerial work platform that is not used for a period of more than one year.

② The business operator must regularly inspect the following items for aerial work platforms once every month. However, this does not apply to the aerial work platform that is not used for a period of more than one month.

③ The business operator must conduct a self-inspection on the matters listed in (2) when resuming the use of aerial work platforms that will not be used for a period of more than one month.

(2) Record of regular self-inspection (related to Article 194-25of the Safety and Health Regulations) (Textbook page 198)

- When conducting a self-inspection, the business operator shall record the following items and keep them for 3 years.
  - ① The date of the inspection
  - ② Inspection method
  - ③ Inspection point
  - ④ Inspection result
  - ⑤ The name of the person conducted the inspection
  - ⑥ The details when repairs or other measures are taken based on the result of the inspection.

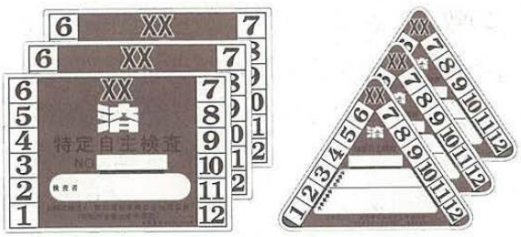
(3) Specified voluntary inspection (related to Article 194-26 of the Safety and Health Regulations) (Textbook page 199)

① The specific self-inspection for aerial work platforms shall be the self-inspection listed in ① of (1).

② The provision of Article 151-24, paragraph 2 of the Occupational Safety and Health Regulations shall apply mutatis mutandis to workers who are qualified as specified by the Ordinance of the Ministry of Health, Labor and Welfare, Article 45, paragraph 2 of the Act on aerial work platforms. In this case, the term “forklift” in article 151-24, paragraph 2, item 1 of the Occupational Safety and Health Regulations shall be deemed to be replaced with “aerial work platform”

③ If the business operator inspects the aerial work platforms used for operation (limited to those subjected to Article 48, paragraph 1 of the Road Transport Vehicle Law) based on the provisions of the same paragraph. It is not necessary to carry out the self-inspection of ① of (1) for the part that has been inspected.

④ Regarding the application of the provisions of the (2) when a specific voluntary inspection of aerial work platforms is carried out by an inspection company, (2) The “name of the person who conducted the inspection” in ⑤ is the “name of the inspector”.



⑤ When a business operator conducts a self-inspection on an aerial work platform, the business operator must attach an inspection sticker that clarifies the specific voluntary inspection date on an easily visible part of the aerial work platform.

(4) Pre-work inspection (related to Article 194-27 of the Safety and Health Regulations) (Textbook page 199)

- When working with aerial work platforms, the employer must inspect the functions of the braking device, operating device before starting the work of the day.

(5) Repairs, etc. (related to Article 194 -28 of the Safety and Health Regulations) (Textbook page 199)

- When the business operator finds an abnormality in the case of ① of (1) or (2) self-inspection or (4) inspection, he/she must immediately take repairs and other necessary measures.

Matters concerning prevention of danger due to crashes, flying objects or collapses, etc.

(1) Installation of work platforms, etc. (related to Article 518 of the Safety and Health Regulations) (Textbook page 201)

① When working at the height of 2 meters or more (excluding the edges of the work platform, openings, etc.), the business operator may assemble scaffolding if there is a risk of danger to workers due to a crash. A work platform must be provided by the method.

② When it is difficult to provide a work platform according to the provisions of (1), the business operator shall take measures to prevent the danger of workers due to a toppling, such as installing a net and having workers use the required performance toppling prevention equipment.

(2) Enclosures such as openings (related to Article 519 of the Safety and Health Regulations) (Textbook page 201)

① The business operators shall enclose handrails, cover, etc. at the edges of work platforms with a height of 2 meters or more, openings, etc. where there is a risk of danger to workers to a toppling (hereinafter referred to as “enclosure”, etc.) must be provided.

② According to the provisions of (1), when it is extremely difficult to provide an enclosure, etc., or when the enclosure, etc., is temporarily removed due to work needs, the employer shall put up a net and have workers use the required performance toppling prevention equipment. Measures must be taken to prevent the danger of workers due to crashes.

(3) Required performance use of toppling prevention equipment, etc.(related to Article 520 of the Safety Regulations) (Textbook page 201)

- Workers must use the required performance toppling prevention equipment, etc. when ordered to use them in the cases of ① of (1) and ② of (2).

(4) Required performance installation equipment for toppling prevention equipment, etc. (related to Article 521 of the Safety Regulations) (Textbook page 202)

① When the business operator works at a place where the height is 2 meters or more and the worker is to use the required performed toppling prevention equipment, etc., the equipment for safety installing the required performance toppling prevention equipment, etc., must be provided.

② When making workers use the required performance toppling prevention equipment, etc., the employer shall inspect the required performance toppling prevention equipment, etc., and their installation equipment for any abnormalities at any time.

(5) Prohibition of work in bad weather (related to Article 522 of the Safety and Health Regulations) (Textbook page 202)

- When the business operator works at a place with a height of 2 meters or more, due to bad weather such as strong winds, heavy rain, and heavy snow, workers shall not be engaged in the work when danger is expected in carrying out the work.

(6) Maintaining illuminance (related to Article 523 of the Safety and Health Regulations) (Textbook page 202)

- When working at the height of 2 meters or more, the business operator must maintain the illuminance required to carry out the work safely,

(7) Installation of equipment for elevation (related to Article 526 of the Safety and Health Regulations) (Textbook page 202)

① When working at a place where the height or depth exceeds 1.5 meters, the business operator shall install equipment for the workers engaged in the work to safely move up and down. However, this does not apply when it is extremely difficult to provide equipment for elevation safely due to the nature of the work.

② Workers engaged in the work of (1) must use the equipment, etc., for safely ascending and descending according to the provisions of the main clause of the same paragraph.

(8) Prohibition of Entry (related to Article 530 of the Safety and Health Regulations) (Textbook page 202)

- The employer shall not allow workers other than authorized workers to enter the places where crashes may cause danger to the workers.

(9) Prevention of danger due to dropping objects from high places(related to Article 536 of the Safety and Health Regulations) (Textbook page 202)

① When dropping an object from a height of 3 meters or more, the business operator must install appropriate dropping equipment and take measures to prevent danger by assigning a guard.

② Workers must not drop objects from a height of 3 meters or more, unless the measures prescribed in ① have been taken.

(10) Prevention of danger due to falling objects (related Article 537 of the Safety and Health Regulations) (Textbook page 203)

・ When there is a risk of falling objects to the workers, the business operator must take measures to prevent the risk by installing net protection and setting an entry area.

(11) Prevention of danger due to flying objects (related to Article 538 of the Safety and Health Regulations) (Textbook page 203)

・ When there is a risk of flying objects to the workers, the business operator must install equipment to prevent flying objects and take measures to prevent danger by having workers wear protective equipment.

(12) Wearing safety helmet (related to Article 539 of the Safety and Health Regulations) (Textbook page 203)

① The employer shall, when carrying out the work near a building berth, at a high-rise structure construction site, etc. over which other workers are carrying out other works, have the worker engaging the said workwear a safety helmet in order to prevent workers from dangers due to flying or falling objects.

② Worker engaged in work ① must wear a safety helmet.

高所作業車運転技能講習
試験問題集

Aerial Work Platform Vehicle Operation Skill Training

Exam Questions

英語版 English Version

Aerial Work Platform Vehicle Operation Skill Training

Exam Questions

Chapter 1　Questions regarding basic knowledge about aerial work platform vehicles

■Question No. 1 (Qualifications to drive an aerial work platform vehicle)

Choose one of the following four explanations about the qualifications to drive aerial work platform vehicles that is incorrect.

① To drive an aerial work platform vehicle with a work floor height of 10m or more, it is necessary to have a certificate of skill training completion.

② In addition to those who completed the skill training, those who completed the special education can also drive an aerial work platform vehicle with a work floor under10m.

③ Those who have completed the special education can also drive an aerial work platform with a "work floor height" of 10m or more when working in a place less than 10m.

④ Only those who completed the skill training can drive an aerial work platform vehicle for "work floor height" of 10m or more even when the work is done on a work floor under 10m.

■Question No. 2 (Types of aerial work platform vehicles, working equipment)

Choose one of the following four explanations about the work equipment of the aerial work platform vehicles that is incorrect.

① Work equipment of the aerial work platform vehicle refers to equipment in which the work floor is lowered or lifted by a lifting device or other equipment.

② Work equipment of the aerial work platform vehicle has 4 types: telescopic boom type, refraction boom type, mixed boom type, and truck type.

③ Work equipment of the aerial work platform vehicle has 4 types: telescopic boom type, refraction boom type, mixed boom type, and vertical lifting type.

④ The telescopic boom type work equipment extends and retracts the boom where the work floor is mounted, being able to approach the working position in a straight line, and the positioning of the working floor is easy.

■Question No. 3 (Types of aerial work platform vehicles, traveling device)

Choose one of the following four explanations about the traveling device of the aerial work platform vehicles that is incorrect.

① A device that uses an engine and can self-propel to an unspecified location is called a traveling device.
② There are 2 types of traveling devices: truck type and self-propelled.
③ The truck type is attached to a truck and can be driven on public roads.
④ The self-propelled is a traveling device type that is not attached to a truck and can be driven on public roads.

■Question No. 4 (Terms related to aerial work platform vehicles, work floor)

Choose one of the following four explanations about the work floor that is incorrect.

① The work floor is the equipment where loads are placed, and people cannot be.
② The work floor is the equipment where loads and people are placed.
③ Basket-shaped caged floors and enclosures are called basket.
④ Floors and enclosures of integral construction are called bucket

■Question No. 5 (Terms related to aerial work platform vehicles, equilibrium device etc.)

Choose one of the following four explanations about the aerial work platform vehicle terms that is incorrect.

① The equilibrium device of an aerial work platform vehicle is a device that maintains the working floor in equilibrium at all times.
② Operating device an aerial work platform vehicle is a device that operates the work equipment and the traveling equipment.
③ The boom device of an aerial work platform vehicle is a device that swivels the work equipment
④ The swivel device of an aerial work platform vehicle is a device that swivels the work equipment.

■Question No. 6 (Terms related to aerial work platform vehicles, outrigger)

Choose one of the following four explanations about the outrigger that is correct.

① Outrigger is a device that raises and lowers the work floor vertically.
② Outrigger is a device that swivels the work device.
③ Outrigger is a device that supports the work floor and can raise and lower, undulate, etc.
④ Outrigger is a device that secures the stability of the vehicle body with a jack

■Question No. 7 (Terms related to aerial work platform vehicles, load capacity etc.)

Choose one of the following four explanations about the aerial work platform vehicle terms that is incorrect.

① Load capacity is the maximum load that can be lifted with a person or load on the work floor.
② Work floor height is the vertical height from the ground to the floor surface when the work floor is raised to its highest point.
③ Work floor height is the vertical height from the ground to the floor surface when the work floor is raised vertically to an arbitrary height.
④ Working radius is the horizontal distance from the swing center to the leading edge of the inner surface of the work floor.

■Question No. 8 (Terms related to aerial work platform vehicles, work range)

Choose one of the following four explanations about the Work range that is incorrect.

① A diagram showing the range in which aerial work platforms can work safely is called a work range diagram.
② The working range is constant regardless of the capacity of the aerial work platform.
③ The work range changes according to the capacity of the aerial work platform.
④ The capabilities of aerial work platforms that affect the work range include load, lift load, boom length, work radius, and outrigger overhang.

Chapter 2 Structure and handling of work equipment, etc. for aerial work platform vehicles

■Question No. 9 (Work equipment structure of aerial work platform vehicles)

Choose one of the following four explanations about the boom-type aerial work platform vehicle terms that is incorrect.

① The work equipment of the aerial work platform is operated by hydraulic equipment such as a hydraulic motor and a hydraulic cylinder.
② An electric motor operates the work equipment of the aerial work platform.
③ In order to work safely, it is important to understand the structure of work equipment and safety equipment.
④ In order to proceed with work safely, it is important to operate the work equipment and safety equipment correctly.

■Question No. 10（Work equipment for boom-type aerial work platforms）

Choose one of the following four explanations about the work equipment of the boom-type aerial work platform that is correct.

① There are three types of boom-type aerial work platforms, telescopic type, refraction type, and vertical elevating type, depending on the structure of the boom.
② There are three types of boom-type aerial work platforms, telescopic type, vertical elevating type, and crawler type, depending on the structure of the boom.
③ There are three types of boom-type aerial work platforms, telescopic type, refraction type, and mixed type, depending on the structure of the boom.
④ There are three types of boom-type aerial work platforms, refraction type, mixed type, and truck type, depending on the boom structure.

■Question No. 11（Work floor balancing equipment）

Choose one of the following four explanations about the work platform equalizer equipment that is incorrect.

① The work floor equalizer equipment is a device that prevents the worker from falling from the work floor.
② The work floor equalizer equipment is a device that always keeps the work floor in equilibrium regardless of the undulation or refraction operation.
③ The work floor equalizer equipment is installed on all aerial work platforms.
④ The work floor equalizer equipment is installed on all aerial work platforms except the vertical lift type.

■Question No. 12（Cylinder type balancing equipment）

Choose one of the following four explanations about the cylinder type balancing equipment that is incorrect.

① The cylinder-type balancing equipment is composed of a lower balancing cylinder and an upper balancing cylinder.
② A hose or a pipe connects the lower balancing cylinder and the upper balancing cylinder.
③ The lower and upper balancing cylinders are independent and not connected.
④ The oil extruded from the lower equilibrium cylinder expands and contracts the upper equilibrium cylinder, and the balance of the work floor is always maintained.

■Question No. 13（Outrigger Part 1）

Choose one of the following four explanations about outriggers that is incorrect

① Outriggers are devices that stabilize aerial work platforms.
② Outriggers include H-type outriggers and A-type outriggers.
③ The H-type outrigger is a device that extends the outrigger arm to the side and holds it to the ground.
④ The A-type outrigger is a device that extends the outrigger arm to the side and holds it to the ground.

■Question No. 14（Outrigger Part 2）

Choose one of the following four explanations about outriggers that is incorrect

① H-type outriggers are often used for relatively large aerial work platforms with 12 m or more work floor height.
② Type A outriggers are often used for relatively large aerial work platforms with 12 m or more work floor height.
③ The hydraulic cylinder for jacks is equipped with a check valve to prevent the cylinder from shrinking when the hydraulic hose is damaged.
④ Wheel-type aerial work platforms and crawler-type aerial work platforms are often not equipped with outriggers.

■Question No. 15（Outrigger Part 3）

Choose one of the following four explanations about outriggers that is incorrect

① The H-type outrigger consists of four outrigger arms attached to the front, rear, left, and right sides of the vehicle body, an arm overhanging cylinder, a jack post, a jack cylinder, and the like.
② The A-type outrigger has no outrigger arm and has a structure in which the jack is projected diagonally.
③ The H-type outrigger has the advantage of not requiring a large installation space.
④ Type A outriggers are often used for relatively small aerial work platforms.

■Question No. 16（Operation device and operation method）

Choose one of the following four explanations about the operating device and operation method that is incorrect.

① The operating device includes a PTO (Power Take-Off) switching operating device, an outrigger operating device, a lower operating device for operating the working device, an upper operating device, and the like
② The PTO switching operation device is installed in truck-type aerial work platforms.
③ The PTO switching operation device is a device for operating the outrigger.
④ The operation method includes electric control (switch control), lever control, electromagnetic proportional control method, and the like.

■Question No. 17（PTO switching operation device）

Choose one of the following four explanations about the PTO switching operation device that is incorrect.

① The PTO switching operation device is installed in the driver's cab of the truck.
② The PTO switching operation device may be driven in the "ON" state.
③ The PTO switching operation device is used to transmit the prime mover's power to the work device.
④ There are two types of PTO switching operation devices: lever and switch types.

■Question No. 18（Outrigger operating device）

Choose one of the following four explanations about the outrigger operating device that is incorrect.

① Outrigger operation devices are installed on the front or left and right sides of the vehicle body.
② The outrigger operating device is used to operate the outrigger arm and jack cylinder.
③ The outrigger operating device is electrically controlled or lever controlled.
④ Some outrigger operating devices are equipped with a lamp that displays the amount of slides of the outrigger arm.

■Question No. 19（Lower operating device）

Choose one of the following four explanations about the lower operating device that is incorrect.

① The lower operating device is mainly equipped for pre-work inspection and emergency use.
② The lower operating device is installed near the swivel base and the lower traveling body.
③ There are two operation methods for the lower control device: lever and switch methods.
④ The switch-type lower control device has excellent fine movement operability.

■Question No. 20（Upper operating device）

Choose one of the following four explanations about the upper control device that is incorrect.

① The upper operating device is installed at the rear of the vehicle body.
② The upper operating device is a device for bringing the work floor closer to a position that is easy to work.
③ In addition to the lever type and switch type, the upper control device has increased with the electromagnetic proportional control type in recent years.
④ Some upper operating devices are equipped with a running operation and steering device (self-propelled), a lifting device, a work floor swing device, an emergency pump, an engine starter, switches such as an accelerator, levers, pedals, gauges, lamps, etc.

■Question No. 21（Work equipment for vertical elevating-type aerial work platforms）

Choose one of the following four explanations about the work equipment of the vertical lift type aerial work platform that is incorrect.

① Vertical lift type aerial work platforms can be classified into four types, scissors-type, mast type, sigma type, and X type, depending on the structure of the lift arm.
② The scissors, sigma, and X types include engine and battery types.
③ The scissors-type, sigma type, and X type are used both indoors and outdoors.
④ Most mast types are mostly using engine type and are often used indoors.

■Question No. 22（Safety device for aerial work platforms）

Choose one of the following four explanations about the aerial work platform safety device that is incorrect.

① Aerial work platforms are equipped with various safety devices to help workers work safely and with peace of mind when working at heights.
② Some aerial work platform safety devices are provided to enable safer work. Based on the invention of the aerial work platform structure standard and the uses side and manufactures side of the aerial work platform.
③ The aerial work platform safety devices do not change over time.
④ It is important to read the instruction manual carefully before using the aerial work platform safety device.

■Question No. 23（Boom operation control device）

Choose one of the following four explanations about the boom operation control device that is correct.

① The boom operation regulator device is a device that automatically stops the operation of the boom or emits an alarm when the work floor tries to exceed the set work range.

② The boom operation regulator device is a device that automatically stops the operation of the work floor or emits an alarm when the work floor tries to exceed the set work range.

③ The boom operation regulator device is a device that automatically stops the operation of the work floor or emits an alarm when the boom tries to exceed the set work range.

④ The boom operation regulator device is a device that automatically stops the operation of the boom or emits an alarm when the boom is about to exceed a set working range.

■Question No. 24（Telescopic boom type）

Choose one of the following four explanations about the telescopic boom type that is incorrect.

① The telescopic boom type operation control device electrically detects the undulation angle and extension amount of the boom, the turning angle, and the overhang width of the outrigger.

② The telescopic boom type operation control device mechanically detects the undulation angle and extension amount of the boom, the turning angle, and the overhang width of the outrigger.

③ The telescopic boom type operation control device is for stopping undulations, the extension of the boom, and turning from the vehicle's center when the boom is about to exceed the working range.

④ A work range diagram that clearly displays the work range of the boom is called a work range diagram.

■Question No. 25（Telescopic boom-type boom operation control device）

Choose one of the following four explanations about the telescopic boom type boom operation control device that is incorrect.

① There are two types of telescopic boom type boom operation control devices, one that detects an increase or decrease in the load on the work floor and one that does not.

② For those that detect an increase or decrease in the load on the work floor, the work range also changes depending on the load on the work floor.

③ Those that detect an increase or decrease in the load capacity in the work floor, even if the load capacity in the work floor increases or decreases, the work range does not change.

④ For those that do not detect an increase or decrease in the load capacity in the work floor, even if the load capacity in the work floor increases or decreases, the work range does not change.

■Question No. 26（Telescopic boom-type boom operation control device）

Choose one of the following four explanations about the telescopic boom type boom operation control device that is incorrect.

① Telescopic boom-type boom operation control devices that do not detect an increase or decrease in the load capacity in the work floor, if the load exceeds the load and is loaded on the work floor, there is a risk of not only damaging the machine but also tipping over.

② Telescopic boom-type boom operation control devices that do not detect an increase or decrease in the load capacity in the work floor, if the load exceeds the load and is loaded on the work floor, the machine may be damaged, but there is no risk of it tipping over.

③ Many platform types detect an increase or decrease in load.

④ Many basket types do not detect an increase or decrease in load.

■Question No. 27（Emergency stop device）

Choose one of the following four explanations about the emergency stop device that is incorrect.

① The emergency stop device immediately stops the operation when the driver feels a danger while the boom is operating, or the self-propelled aerial work platform is running.
② The emergency stop device is generally a yellow button switch.
③ Some engines stop when the emergency stop device is pressed, and some do not stop, but the oil pressure is released.
④ Another way to use the emergency stop device is to prevent the machine from suddenly operating against the will of the work platform (vehicle) during work.

■Question No. 28（Travel warning device）

Choose one of the following four explanations about the driving alarm device that is incorrect.

① The travel warning device is a device that automatically emits an alarm (buzzer) during travel.
② The travel warning device is switched on in conjunction with the traveling operation lever (sousa reba).
③ The travel warning device is attached to the self-propelled aerial work platform.
④ The travel warning device is attached to a truck-type aerial work platform.

■Question No. 29（Safety valves, check valves）

Choose one of the following four explanations about safety valves and check valves that is incorrect.

① If an overload or impact load is applied during operation, abnormally high pressure may be generated in the hydraulic circuit and damage the machine.
② Check valves are installed in the hydraulic system of aerial work platforms to prevent damage to the machine due to overload and impact load.
③ If the pipes and hoses are damaged, or their connecting parts are disconnected, the pressure inside the cylinder drops abnormally, and the work floor etc., will drop sharply.
④ In order to prevent an abnormal drop in pressure inside the cylinder, Check Valves are provided in each cylinder for jacks, undulations, expansion, and contraction, balancing, refraction, and vertical elevation.

■Question No. 30（Outrigger interlock device）

Choose one of the following four explanations about the outrigger interlock device that is incorrect.

① The outrigger interlock device prevents the driver from forgetting the jack set and operating the boom.
② The outrigger interlock device is a device that electrically controls and stops all boom operations when the jack is not under the specified load.
③ The outrigger interlock device is a device that mechanically controls and stops all boom operations when the jack is not under the specified load.
④ The outrigger interlock device is attached to the aerial work platform equipped with outriggers.

■Question No. 31（Handling and precautions of work equipment and traveling equipment）

Choose one of the following four explanations about handling and precautions of work equipment and traveling equipment that is incorrect.

① According to the use, the aerial work platforms have been improved or have various functions.
② In order to prevent accidents caused by aerial work platforms, it is important to understand their characteristics well and to operate the work equipment and traveling equipment appropriately.
③ The operation method of the work equipment is the same regardless of the manufacturer, model, etc., of the aerial work platform.
④ It is important to carefully check the operation method of the work equipment in the instruction manual, etc.

■Question No. 32（Installation of outriggers on slopes Part 1）

Choose one of the following four explanations about installing outriggers on slopes that is incorrect.

① Be sure to position the aerial work platform toward back downward.
② Apply the parking brake.
③ Place pawls on the lower slope of all wheels and ensure that they are in contact with the tires.
④ Maximize the outriggers. (For H-type outriggers)

■Question No. 33（Installation of outriggers on slopes Part 2）

Choose one of the following four explanations about the outrigger installation on slopes that is incorrect.

① Use a large floorboard.
② The maximum number of floorboards should be 3 on the front jack.
③ The floorboard should be within 20 cm in height.
④ The floorboard should be at a height that fits between the outrigger float and the ground in front of the jack set.

■Question No. 34（Installation of outriggers on slopes Part 3）

Choose one of the following four explanations about outrigger overhanging procedures on slopes that is incorrect.

① Be sure to do it in order, from the back jack to the front jack.
② Be sure to do it in order, from the front jack and the back jack.
③ The jack should be extended on the left and right at the same time.
④ Make fine adjustments by operating each jack.

■Question No. 35（Installation of outriggers on slopes Part 4）

Choose one of the following four explanations about the matters that must be strictly observed when the-vehicle body cannot be leveled when installing outriggers on slopes that is incorrect.

① Be sure to work with the boom facing uphill.
② Make sure that the left and right directions of the vehicle body are horizontal.
③ If the turning work is going uphill, move the vehicle.
④ In the case of the telescopic boom type, use it facing uphill and within 45 ° to the left and right.

■Question No. 36（Installation of outriggers on slopes Part 5）

Choose one of the following four explanations about the after-work outrigger storage procedure that is incorrect.

① Return the boom to the running position.
② Check the position of the pawl.
③ Be sure to return from the back side of the jack.
④ Operate the jack separately on the left and right.

■Question No. 37（Basic operation manual for telescopic boom type）

Choose one of the following four explanations about the basic operation manual for telescopic boom type that is incorrect.

① Remove boom in extended condition from the cradle by hoisting device.
② Determine the target position to a certain degree by turning operation.
③ Bring close to the target position by hoisting to a certain degree.
④ Approach to around 1 m from the work position by the telescopic motion operation (extending).

■Question No. 38（Transporting the aerial work platform vehicle）

Choose one of the following four explanations about transporting the aerial work platform vehicle that is incorrect.

① Transporting aerial work platforms vehicle is conducted by self-propellent or truck and other transport dedicated vehicles.
② The truck-type aerial work platforms vehicle is mainly transported to the aerial-work site by propelling itself.
③ Self-propelled aerial platforms vehicles, such as wheel and crawler types, are mainly transported by propelling themselves to the work site.
④ Follow the relevant laws and regulations such as the Road Traffic Law when propelling itself.

■Question No. 39（Precautions when driving truck-type aerial work platforms due to its characteristics）

Choose one of the following four explanations about precautions when driving truck-type aerial work platforms due to its characteristics that is incorrect.

① There is a risk of falling if there is a sudden handle operation when driving due to the work platform being on the upper side and the center of gravity (jyuushin) position tending to be higher.
② In order to broaden the working range and measure to stabilize, it is preferable to start from speed (gear) 2 when driving due to the vehicle's lower body being equipped with many weights and the vehicle mass itself being heavy.
③ The braking range is longer because the vehicle weight is heavier than an unladen ordinary cargo truck. Therefore, it is important to keep sufficient distance between vehicles.
④ There is a risk of collision with the guard's lower part when driving if the vehicle height is not known due to the work device being placed higher than the driving cabin.

■Question No. 40（Precautions when transporting self-propellent aerial work platform vehicles）

Choose one of the following four explanations about precautions for when transporting self-propellent aerial work platform vehicles that is incorrect.

① Driving it on public roads is not allowed for self-propellent aerial work platform vehicles such as wheel type and crawler type.
② It is allowed to transport it by propelling itself on the public road when necessary without permission.
③ Perform the necessary curing since there is a risk of damage on the pavement from crawler-type work platform vehicles.
④ Shrink the boom the shortest length and level it with the work surface when driving.

■Question No. 41（Aerial work platform vehicle inspection/examination and maintenance part 1）

Choose one of the following four explanations about aerial work platform vehicle inspection/examination and maintenance that is incorrect.

① It is important to properly perform daily inspection and maintenance and always maintain the aerial work platform vehicles in the optimum condition, not only for improving workability but also to prevent occupational hazards.
② Ordinance on Industrial Safety and Health also stated that aerial work platform vehicles be inspected, examined, and maintained.
③ Thoroughly performing the daily inspection and maintenance, it is important to keep the aerial work platform vehicles in their best condition for use.
④ There is no necessity to repair immediately or other necessary measures even if an abnormality is found in the self-inspection and examination.

■Question No. 42（Aerial work platform vehicle inspection/examination and maintenance part 2）

Choose one of the following four explanations about aerial work platform vehicle inspection/examination and maintenance that is incorrect.

① The inspection before work start is performed by the business operator designated worker.
② The periodic self-inspection is performed by the business operator designated worker.
③ Special self-inspection is performed by the business operator designated worker.
④ Special self-inspection is performed by a qualified person designated the Ministry of Labor, Health, and Welfare.

■Question No. 43（Precautions when driving the clutch type aerial work platform vehicle）

Choose one of the following four explanations about precaution when driving the clutch-type aerial work platform vehicles that is incorrect.

① Before driving, confirm that the outrigger is fully retracted.
② Confirm that the work platform is in retracted condition.
③ Driving while the worker is in the worker platform.
④ Confirm that the PTO switch is in OFF position.

■Question No. 44（Precautions for self-propelled type aerial work platforms vehicle when climbing or descending hills, slopes, and step Part 1）

Choose one of the following four explanations about precaution for self-propelled type aerial work platforms vehicle when climbing or descending hills, slopes, and steps that is incorrect.

① It is not necessary to apply a turn-lock when climbing or descending a steep hill.
② There is a risk of falling when changing directions or steering in the middle of the slope. Thus, climb down to the level ground before performing the act.
③ Turn the counterweight toward the hill's top and climb up and down the slope at a right angle.
④ Never perform boom turning operation in the middle of the slope as there is a risk of falling.

■Question No. 45（Precautions for self-propelled type aerial work platforms vehicle when climbing or descending hills, slopes, and step Part 2）

Choose one of the following four explanations about precaution for self-propelled type aerial work platforms vehicle when climbing or descending hills, slopes, and steps that is incorrect.

① There are occasions where the aerial work platform vehicle's angle may change suddenly when climbing up steps (slope). Therefore, pay attention to the building on the platform's upper and lower sides.
② There are occasions where the aerial work platform vehicle's angle may change suddenly when climbing down steps (slope). Therefore, pay attention to the building on the platform's upper and lower sides.
③ There is a risk of falling over if driving the vehicle with the work platform raised (e.g., boom's hoisting angle is raised) and meet a slight unevenness, steps, or steep slope.
④ There is no risk of falling over if driving the vehicle with the work platform raised (e.g., boom's hoisting angle is raised) and meeting a slight unevenness, steps, or steep slope.

■Question No. 46（Precautions for working Safety rule part 1）

Choose one of the following four explanations about precaution for working Safety Rule that is incorrect.

① Workers must wear safety helmets and fall prevention equipment.
② After boarding the work platform, immediately apply the fall prevention equipment's hook.
③ It is allowed to lift the load with boom if the load weight is less than the maximum capacity.
④ Strictly adhere to the work floor's load capacity.

■Question No. 47（Precautions for working Safety rule part 2）

Choose one of the following four explanations about precaution for working Safety Rule that is incorrect.

① Do not move to other buildings, etc., from the work platform.
② Do not use fire with the FRP-type buckets since it's combustible.
③ Do not abroad to other than the work platform.
④ It is allowed to work by climbing the work platform railing.

■Question No. 48（Precautions for working Safety rule part 3）

Choose one of the following four explanations about precaution for working Safety Rule that is incorrect.

① It is allowed to use a ladder, stepladder, etc., in the work platform.
② Avoid dropping anything from the work platform.
③ Lower work platform to 50 cm or less from the ground when climbing in and out for the self-propelled type aerial work platform vehicles.
④ Always use the designated route or step when climbing in and out of the aerial work platform vehicles.

■Question No. 49（Precautions for working Thoroughly confirm the safety part 1）

Choose one of the following four explanations about confirmation points when working near overhead wires that is incorrect.

① Confirm that there are enough space and distance.
② Confirm the electric transmission.
③ Confirm that electric shock prevention measures are sufficient.
④ Confirm that the supervisor is arranged.

■Question No. 50（Precautions for working Thoroughly confirm the safety part 2）

Choose one of the following four explanations about the standard for canceling work due to bad weather that is incorrect.

① If the average wind speed for 10 minutes is over than 10m/s.
② If the rainfall amount in one time is more than 50mm.
③ If the rainfall amount in one time is more than 25cm.
④ If the temperature is more than 25 degrees.

■Question No. 51（Precautions for working Thoroughly confirm the safety part 3）

Choose one of the following four explanations about confirming safety when working that is incorrect.

① Always pay attention to the surrounding buildings, etc.
② Always follow the signaler's cue when driving if working in a location that is hard to see from the driver.
③ It is not necessary to check for obstacles in the targeted direction.
④ Check for obstacles in the turning range and carefully turn when turning.

■Question No. 52（Precautions for working Safety operation for working guideline）

Choose one of the following four explanations about precautions for working Safety operations for working guidelines that is incorrect.

① When loading materials to the work platform, prepare measures such as placing or fixing the material to prevent it from touching the operation lever (sousa reba).
② Never operating the lever suddenly.
③ Perform driving operation when closing to the self-propellent aerial work platform vehicle's work position.
④ Activate the vehicle body inclination control device, and do not raise the work platform if the alarm sound is turned on.

■Question No. 53（Precautions after the work is finished）

Choose one of the following four explanations about precautions after the work is finished that is incorrect.

① Return the work platform to the retracted position.
② Apply the run preventer device such as the parking brake.
③ Do not jump down from the work platform.
④ Keep the key locked in case of emergency.

Chapter 3 Knowledge related to motor

■Question No. 54（Motor and its variant）

Choose one of the following four explanations about motor and its variant that is incorrect.

① Motor is a device that converts various energy into force.
② Typical motors include internal combustion engines and electric motors (referred to as "motor").
③ The internal combustion engine is divided into diesel and gasoline based on their ignition methods.
④ Household power supply motors are often utilized for aerial work platform vehicles that are frequently used indoors, where it is necessary to consider engine noise and exhaust gas.

■Question No. 55（Diesel engine ignition method）

Choose one of the following four explanations about the diesel engine ignition method that is correct.

① Diesel engines can be divided into "6-cycle engines" and "2-cycle engines".
② Diesel engines can be divided into "6-cycle engines" and "4-cycle engines".
③ Except for the large ship that uses a low-speed "4-cycle engine", diesel engines are mostly "2-cycle engines".
④ Except for the large ship that uses a low-speed "2-cycle engine", diesel engines are mostly "4-cycle engines".

■Question No. 56（The 4 stroke of diesel engine）

Choose one of the following four explanations about the 4 strokes of the diesel engine that is incorrect.

① Air intake stroke: a stroke that only takes air to the cylinder's inside when the piston goes down.
② Compression stroke: a stroke that compresses the fuel and air when the piston goes up to the upper dead point.
③ Combustion step: a stroke that injects and combusts the fuel inside the high-pressure cylinder and pushes down the piston to the bottom dead point due to the combusted gas (explosion stroke).
④ Exhaust step: a stroke that the combusted gas is pushed out of the cylinder when the piston goes up due to inertia.

■Question No. 57（4-cycle diesel engine structure）

Choose one of the following four explanations about the 4-cycle diesel engine structure that is incorrect

① Lubrication device is a device that supplies lubrication oil (engine oil) to reduce wear in the friction or rotating part of the engine's metal part such as cylinder and crankshafts that is caused by the up and down movement of the piston for thousands of times per minute.
② It is required to use standard engine oil specified in the machine's manual, check the oil condition constantly, and change it if necessary.
③ The fuel device comprises a fuel tank, injection pump, injection nozzle, fuel filter, governor, etc.
④ The fuel filter filters the fuel, removes foreign substances in the fuel such as dust, and supplies water.

■Question No. 58（How the engine oil work）

Choose one of the following four explanations about how the engine oil work that is incorrect.

① Lubricate the bearings, piston ring, cylinder, etc.
② Engine heat retention.
③ Sealing the gap between piston and cylinder
④ Have anti-rust inside the engine, etc.

■Question No. 59（Electric motor characteristic）

Choose one of the following four explanations about an electric motor characteristic that is incorrect.

① Electric motors are often utilized as a power source for aerial work platform vehicles that are frequently used indoors, where it is necessary to consider engine noise and exhaust gas.
② The self-propelled aerial work platform vehicles use batteries for industrial vehicles and mainly use the DC motor as the electric motors, while AC motors are not used.
③ The self-propelled aerial work platform vehicles use batteries for industrial vehicles and often use not only DC motors but also AC motors.
④ In the power transmission device of battery type for aerial work platform vehicles, since the power transmission engine of wheel type and crawler type aerial work platform vehicles is replaced to battery-powered electric motor, the power transmission system for wheel type and crawler type is much the same.

■Question No. 60（Hydraulic system advantage）

Choose one of the following four explanations about hydraulic system advantage that is incorrect.

① Small and light weight.
② Overload prevention is easy.
③ Stepless transmission is easy.
④ Remote operation is not possible.

■Question No. 61 （Hydraulic system disadvantage）

Choose one of the following four explanations about hydraulic system disadvantage that is incorrect.

① Complex pipping.
② Hydraulic oil leaks may occur.
③ Machine efficiency is affected by hydraulic oil temperature.
④ Machine efficiency is affected by hydraulic oil amounts.

■Question No. 62 （The principle of the hydraulic device）

Choose one of the following four explanations about the principle of hydraulic devices that is correct.

① The principle of the hydraulic device is the application of Pascal's principle, which is "to transmit the pressure evenly to all parts of the rest liquid from the pressure added to one part of the liquid in the sealed container."
② The principle of the hydraulic device is the application of Pascal's principle, which is "to transmit the pressure evenly to the liquid's surface that is rest from the pressure added to one part of the liquid in the sealed container."
③ The principle of the hydraulic device is the application of Pascal's principle, which is "to transmit the pressure evenly to all parts of the rest liquid from the pressure added to one part of the liquid in the container with an opening."
④ The principle of the hydraulic device is the application of Pascal's principle, which is "to transmit the pressure evenly to all parts of the rest solid substance from the pressure added to one part of the solid substance in the sealed container."

■Question No. 63 （Hydraulic device mechanism）

Choose one of the following four explanations about hydraulic device mechanisms that is incorrect.

① The hydraulic oil is pressurized by the driving force from the hydraulic pressure pump resulting from the engine or electric motor power in the hydraulic device.
② In the hydraulic device, the hydraulic driven device, such as the hydraulic motor and hydraulic cylinder, is activated by the pressurized hydraulic oil coming from the hydraulic pump.
③ In the hydraulic device, the used hydraulic oil whose pressure has dropped is returned to the hydraulic tank through the low-pressure circuit.
④ The used hydraulic oil whose pressure has dropped is disposed to the outside of the hydraulic device in the hydraulic device.

■Question No. 64（The function of apparatus that construct hydraulic device）

Choose one of the following four explanations about the function of apparatus that construct hydraulic device that is incorrect.

① The hydraulic generator (pump) is a device that draws hydraulic oil from the hydraulic tank, applies pressure, and sends it to the circuit.
② The hydraulic controller (valve) is a device that controls the direction, flow rate, and pressure of the hydraulic oil discharged from the pump.
③ The hydraulic driving device (actuator) is a device that converts the high-pressure hydraulic oil energy into rotary motion or rectilinear motion force.
④ The hydraulic driving device (actuator) has a hydraulic motor that performs rectilinear motion.

■Question No. 65（Hydraulic device main components）

Choose one of the following four explanations about the hydraulic device's main components that is incorrect.

① The main components of a hydraulic generator are a hydraulic pump and a hydraulic motor.
② The main components of a hydraulic generator are a hydraulic pump.
③ The main components of a hydraulic generator are the direction control valve, flow rate control valve, pressure control valve.
④ The main components of a hydraulic generator are a hydraulic motor and a hydraulic cylinder.

■Question No. 66（Hydraulic generator device Hydraulic pump）

Choose one of the following four explanations about the hydraulic pump main components that is incorrect.

① The hydraulic pump is a device that supplies high-pressure oil to the hydraulic driving device (actuator) by drawing hydraulic oil from the tank and driven by the engine or electric motor.

② The hydraulic pump's structure can be classified as gear pump, piston pump (plunger pump), vane pump, screw pump, etc.

③ The gear and piston pump are often used as hydraulic pumps devices for boom telescopic motion, hoisting, turning, etc., of the aerial work platform device.

④ Vane pump and screw pump are often used as hydraulic pumps devices for boom telescopic motion, hoisting, turning, etc., of the aerial work platform device.

■Question No. 67（Gear pump characteristics）

Choose one of the following four explanations about gear pump characteristics that is incorrect.

① Small and light weight.

② Complex mechanism.

③ Few breakdowns.

④ Easy to maintenance.

■Question No. 68（Hydraulic driving device）

Choose one of the following four explanations about hydraulic driving devices that is incorrect.

① Actuator is a device that converts hydraulic oil sent from the hydraulic pump into mechanical motion (energy).

② Based on the motion method, actuator can be divided into hydraulic cylinders and hydraulic motors.

③ The hydraulic cylinder movement is linear motion, while the hydraulic motor is rotary motion.

④ The hydraulic cylinder movement is rotary motion, while the hydraulic motor is linear motion.

■Question No. 69（Hydraulic cylinder mechanism）

Choose one of the following four explanations about the hydraulic cylinder mechanism that is incorrect.

① The single-cylinder mainly has ports on the head side and only sends pressure oil in one direction. For the opposite direction operation, the operation is performed by tare or load weight, spring, and other cylinders.
② The single-cylinder is used in the vertical hoisting-type aerial work platform vehicles.
③ The double cylinder is used for boom, outrigger, etc.
④ Special cylinder (telescopic type) is used when a small stroke is needed.

■Question No. 70（Hydraulic control device mechanism）

Choose one of the following four explanations about hydraulic control device mechanism that is incorrect.

① The direction control valve is an important valve that controls the switch in hydraulic oil pressure, activates and changes the direction of the hydraulic driving device (actuator), stop, etc.
② The flow rate control valve is a control valve that controls hydraulic oil floe amount and actuator speed.
③ The pressure control valve is a valve with the purpose of adjusting the hydraulic oil pressure ejected from the pump, discharging the generated secondary pressure, and preventing mechanical damage.
④ The pressure control valve has an important function in determining the actuator torque and thrust.

■Question No. 71（Hydraulic oil）

Choose one of the following four explanations about hydraulic oil that is incorrect.

① The hydraulic oil is pressurized by the high pressure in the hydraulic pump, then passed the pipeline to move the hydraulic driving device, and repeatedly performs the work device operation.
② The hydraulic oil deterioration (oxidation) and contamination of foreign substances are unavoidable as the hydraulic oil becomes hot, in contact with metal and air, and severely agitated.
③ Using oil that deteriorated or contained foreign substances will not cause hydraulic device damage.
④ It is important to check the hydraulic oil and manage it appropriately regularly.

■Question No. 72（Method and measure to distinguish hydraulic oil）

Choose one of the following four explanations about method and measure to distinguish hydraulic oil that is incorrect.

① The hydraulic oil is still usable if the hydraulic oil is transparent and light in color.
② Change the hydraulic oil if it turns into milky white color.
③ Change the hydraulic oil if it turns into dark brown color.
④ Change the hydraulic oil if bubbles can be seen from it.

■Question No. 73（Truck type vehicle）

Choose one of the following four explanations about truck-type vehicles that is incorrect.

① The truck-type aerial work platform vehicle is a vehicle equipped with a work device on the truck sash upper part.
② The truck-type aerial work platform vehicle's travel gear and operating device are different from the regular truck.
③ A driving license specified for the truck-type aerial work platform vehicle is required when driving it on a public road.
④ Following the Road Traffic Law is necessary when driving the truck-type work platform vehicle on a public road.

■Question No. 74（Truck-type vehicle's power transmission and brake）

Choose one of the following four explanations about truck-type vehicle's power transmission and brake that is incorrect.

① The truck-type aerial work platform vehicle's transmission device is typically front engine-rear drive type, and the rear wheels are driven by the engine at the front.
② The truck-type aerial work platform vehicle's brake use types such as foot brakes that slowed down or stopped the running vehicle and a parking brake that is used when parking.
③ The truck-type aerial work platform vehicle's brake has a structure that directly stops the rear wheels.
④ The parking brake will not work if one of the rear wheels floats from the ground, and the rear wheels will easily rotate although the side brake is applied due to the structure of truck-type aerial work platforms.

Chapter 4 Necessary knowledge of mechanics and electrification for driving

■Question No. 75（Three elements of force）

Choose one of the following four explanations about three elements of force that is correct.

① The three elements of force are “supporting point (fulcrum), “direction”, “size”.
② The three elements of force are “point of application, “direction”, “inclination”.
③ The three elements of force are “point of application, “direction”, “size”.
④ The three elements of force are “point of application, “height”, “size”.

■Question No. 76（Force composition and decomposition）

Choose one of the following four explanations about force composition and decomposition that is incorrect.

① When two or more forces are applied to an object, replacing these two or more forces with the same force with the same effect as the given force is called ‘composition’.
② The force replaced in the composition of forces and two or more forces that acted on the object is called ‘combination force.’
③ When one force is divided into two, it is called ‘decomposition of force’.
④ The divided force from the decomposition of force is called ‘components force’.

■Question No. 77（Moment of force）

Choose one of the following four explanations about moment of force that is incorrect.

① The force used for turning an object is called ‘moment of force’.
② The size of the moment of force can be represented with ‘force x distance’.
③ When the moment of force is the same, if the distance to apply the force is two times from the rotation axis, then the tightening will also be doubled.
④ The aerial work platform vehicle will fall if the turnover moment is larger than the stable moment.

■Question No. 78（Mass (shitsuryo) and center of gravity (juushin)）

Choose one of the following four explanations about the mass and the center of gravity (juushin) that is incorrect.

① The mass of an object differs depending on the material even if the volume is the same.
② "Mass per unit volume" is called "density (mitsudo)".
③ The unit of mass is generally used t.
④ The mass can be determined by "mass per unit volume" times "area".

■Question No. 79（Center of gravity (juushin)）

Choose one of the following four explanations about the center of gravity (juushin) that is incorrect.

① The Center of gravity (juushin) is "the point where all the applied gravity of each part is concentrated, and the working point of the force", it can also be said simply as the "center" of the object's weight.
② A specific object's center gravity (juushin) is inherent to itself; the position of the center of gravity (juushin) does not change even if the object's position or placement changes unless the object's body is changed.
③ The object's center of gravity (juushin) exists inside the object.
④ The center of gravity (juushin)'s position is important to consider when hoisting the objects or for the aerial work platform vehicles' turnover.

■Question No. 80（Center of gravity (juushin) and stability）

Choose one of the following four explanations about the center of gravity (juushin) and stability that is incorrect.

① When the object placement is "good", it means that there is no risk of falling and is stable.
② When the perpendicular line passes through the center of gravity (juushin) of the base that supports the object, its placement is well and stable. But on the contrary, if the perpendicular line misses the base, the object is unstable and will fall.
③ In order to keep the object in stable condition, it is critical to position the center of gravity (juushin) lower, and the base area is wide.
④ In order to keep the object in stable condition, it is critical to position the center of gravity (juushin) higher, and the base area is small.

■Question No. 81（Inertia）

Choose one of the following four explanations about inertia that is incorrect.

① An object has a characteristic where as long as there is no force applied from the outside, "it will stay still and keep the condition continue, and when moving it will keep moving." This characteristic is called "inertia".
② The applied force on an object caused by inertia is called 'inertia force'.
③ Inertia force will increase if the acceleration increases and the mass decreases.
④ If the work platform of an aerial work platform vehicle is turned and stopped suddenly while a person rides it, the person will be flown to the rotation direction even if the work platform stops, and the person will continue the rotation movement due to "inertia".

■Question No. 82（Friction and aerial work platform vehicle's stability）

Choose one of the following four explanations about friction and aerial work platform vehicle's stability that is incorrect.

① It is possible to reduce and stop speed with a foot brake because the brake's friction force is working.
② The parking brake is effective because the frictional force is at work.
③ The aerial work platform vehicle can be kept in stop condition when the brake is applied because of the friction force between the road and the work platform.
④ It is possible to keep the aerial work platform vehicle in a stable condition when the outrigger is installed due to the friction force at work between the jack, jack base, and road surface.

■Question No. 83（Classification based on the load (force) usage condition）

Choose one of the following four explanations about classification based on the load (force) usage condition that is incorrect.

① Dynamic load is a constant load that is unaffected by the magnitude or direction applied to the object and stays still regardless of the changes in time.
② Repeated load is a load that is repeatedly applied in the same direction, and the load magnitude changes with time.
③ If a repeated load is applied even with a small load, the material will experience fatigue and become the cause of damage.
④ Impact load is a large load that is applied momentarily.

■Question No. 84（Classification based on load distribution condition）

Choose one of the following four explanations about classification based on the load distribution condition that is incorrect.

① A concentrated load is a force applied at a single point on an object's surface.
② The load exerted by the aerial work platform vehicle's outrigger on the ground is a concentrated load.
③ Distributed loads are forces that are distributedly applied on the object's surface.
④ The load exerted on the ground by the aerial work platform vehicle's crawler is a concentrated load.

■Question No. 85（Knowledge related to ground strength）

Choose one of the following four explanations about knowledge related to ground strength that is incorrect.

① It is necessary to pay adequate attention to overturning since the center of gravitation (juushin) position changes with the aerial work platform vehicle's work platform change (the changes in height and work radius used by the work platform's boom or lifting device).
② The ground strength for wheels, crawlers, and outriggers, that serves as a supporting point is not an important element for measures against the aerial work platform vehicle's overturning.
③ There is a risk of overturning due to the supporting ground subsidence when working with the aerial work platform is established in the unpaved ground.
④ It is important to check the ground bearing capacity in advance and recuperate it with iron plates to prevent the wheels, outriggers, etc. from sinking when performing work with the aerial work platform vehicle established on unpaved ground.

■Question No. 86（Outrigger installation pressure）

Choose one of the following four explanations about outrigger installation pressure that is incorrect.

① The ground pressure applied to the outrigger float changes significantly depending on the boom direction, hoisting, and telescopic motion for the aerial work platform vehicles with outriggers, such as truck-type.

② The subsidence of the outrigger float during work, even if it is slight, is amplified and transmitted to the work floor located at the tip of the boom, leading to the danger of aerial work platform vehicle overturning.

③ When establishing the vehicle on unpaved ground, it is unnecessary to check the outrigger's ground pressure.

④ It is important to prevent uneven subsidence by recuperating the ground with iron plates to disperse the ground pressure when establishing the vehicle on unpaved ground.

■Question No. 87（Electric shock）

Choose one of the following four explanations about the electric shock that is incorrect.

① "Electrification" refers to the damage received by the human body due to the flow of electric current, and it is also called electroshock or electric shock.

② There are various causes of electric shocks, such as touching the transmission line and power line, electric leakage due to improper use of the aerial work platform vehicle, and poor maintenance.

③ The human body has low electrical resistance, especially when the body is wet with water. The risk is high because the current easily flows.

④ In mild cases, "electrification" may be causing temporary pain or numbness; even in severe cases, it will not lead to electrocution.

■Question No. 88（The risk factors and impacts of electric shock）

Choose one of the following four explanations about the risk factors and impact of electric shock that is incorrect.

① The bigger the flowing current, the higher the risk.
② The longer the current flow time, the higher the risk.
③ When a current of about 50 mA flows through the human body, it will result in a tingling sensation.
④ When a current of about 100 mA flows through the human body, it will cause a deadly injury.

■Question No. 89（Precautions when working near overhead wire）

Choose one of the following four explanations about precautions when working near an overhead wire that is incorrect.

① There are not many electrification accidents due to contact with overhead wires such as transmission and power lines when working with aerial work platform vehicles.
② In the case of a high-voltage transmission line, there is a risk of electric shock just by being near the transmission line without direct contact with workers or the aerial work platform vehicle's boom.
③ In the case of high-voltage transmission lines, it is necessary not to approach them within the specified distance (minimum distance), take necessary protective measures, and assign a supervisor when performing the work.
④ In summer, the electrification accidents increase due to many parts of the body being exposed and wet with sweat.

■Question No. 90（The fundamental of electric shock prevention measures）

Choose one of the following four explanations about the fundamental of electric shock prevention measures that is incorrect.

① Consult the construction company in advance.
② Keep the safe distance from the transmission line.
③ Assign supervisor.
④ Protect the charged circuit as necessary.

Chapter 5 Related Laws and Regulations

■Question No. 91（Matters to be followed by workers regarding safety devices, etc.）

Choose one of the following four explanations about matters to be followed by workers regarding safety devices, etc., that is incorrect.

① Do not take off or inactivate the safety devices.
② Ask the business operator's permission if it is necessary to remove temporarily or inactivate the safety devices.
③ When receiving permission to take off the safety devices or inactivate their functions, immediately recover the safety device functions after the mentioned affair is finished.
④ If it is discovered that the safety device has been removed or its function has been inactivated, leave it as it is.

■Question No. 922（Matters to be managed when working with the aerial work platform vehicles）

Choose one of the following four explanations about matters to be managed when working with the aerial work platform vehicles that is incorrect.

① Business operators must establish a work plan that accommodates the conditions of the worksite, type, and capacity of the aerial work platform vehicle and perform the work following the plan when working with an aerial work platform vehicle.
② Business operators are required to establish the work plan, but it is unnecessary to inform the related workers about the working method with the said aerial work platform vehicle.
③ Business operators are required to assign work supervisors, and the assigned worker must provide direction following the work plan when performing work with the aerial work platform vehicle.
④ Business operators must establish necessary measures to prevent overturning and workers falling, such as expanding the outriggers, preventing uneven ground subsidence, preventing road shoulder collapse, etc., when performing work with aerial work platform vehicles.

■Question No. 93（Matters to be managed when driving the aerial work platform vehicles）

Choose one of the following four explanations about matters to be managed when driving the aerial work platform vehicles that is incorrect.

① The aerial work platform vehicle's driver must implement measures to prevent the vehicle from running such as, lowering the work platform to the lowest position and stopping the motor, and applying the brake to maintain the stop condition when leaving the driver position for driving the aerial work platform vehicle.

② The aerial work platform vehicle's driver must implement measures to prevent the vehicle from running such as applying the brake to maintain the stop condition when leaving the driver position for driving the aerial work platform vehicle

③ Business operators are allowed to board workers in locations other than the passenger seats and work platforms when working with an aerial work platform vehicle.

④ The workers on the work platform of the aerial work platform vehicle are required to wear the required performance personal fall-arrest system, etc.

■Question No. 94 （Matters related to prevention of dangers due to falls, flying objects, collapse, etc.）

Choose one of the following four explanations about matters related to the prevention of dangers due to falls, flying objects, collapse, etc., that is incorrect.

① For work in places higher than 2 meters (excluding the edges and openings of the work platform), workers must wear the required performance fall prevention system when instructed, when it is difficult to provide a work platform, or when it is difficult to enclose the edges and openings of the work platform.

② Workers must use the designated facility when working in places higher or deeper than 2 meters and are provided with facilities to climb up and down safely.

③ Business operators are prohibited from allowing workers other than related workers to enter the place where it poses a risk to the worker due to falling.

④ Workers who work in the shipway vicinity, high-rise buildings, or where other workers working above it must wear a safety helmet.

Correct answers

Chapter 1 questions regarding basic knowledge about aerial work platforms

■Question No. 1（Qualifications to drive an aerial work platform vehicle） …… : ③
■Question No. 2（Types of aerial work platform vehicles, working equipment） …… : ②
■Question No. 3（Types of aerial work platform vehicles, traveling device） …… : ④
■Question No. 4 (Terms related to aerial work platform vehicles, work floor） …… : ①
■Question No. 5 (Terms related to aerial work platform vehicles, equilibrium device etc.） …… : ③
■Question No. 6 (Terms related to aerial work platform vehicles, outrigger） …… : ④
■Question No. 7 (Terms related to aerial work platform vehicles, load capacity, etc.） …… : ③
■Question No. 8 (Terms related to aerial work platform vehicles, working range） …… : ②

Chapter 2 Structure and handling of work equipment, etc. for aerial work platform vehicles

■Question No. 9（Work equipment structure of aerial work platform vehicles） …… : ②
■Question No. 10（Work equipment for boom-type aerial work platforms） …… : ③
■Question No. 11（Work floor balancing equipment） …… : ③
■Question No. 12（Cylinder type balancing equipment） …… : ③
■Question No. 13（Outrigger Part 1） …… : ③
■Question No. 14（Outrigger Part 2） …… : ③
■Question No. 15（Outrigger Part 3） …… : ③
■Question No. 16（Operation device and operation method） …… : ③
■Question No. 17（PTO switching operation device） …… : ③
■Question No. 18（Outrigger operating device） …… : ③
■Question No. 19（Lower operating device） …… : ④
■Question No. 20（Upper operating device） …… : ①
■Question No. 21（Work equipment for vertical lift-type aerial work platforms） …… : ④
■Question No. 22（Safety device for aerial work platforms） …… : ③
■Question No. 23（Boom operation control device） …… : ①
■Question No. 24（Telescopic boom type） …… : ②
■Question No. 25（Telescopic boom-type boom operation control device） …… : ③
■Question No. 26（Telescopic boom-type boom operation control device） …… : ③
■Question No. 27（Emergency stop device） …… : ②
■Question No. 28（Travel warning device） …… : ④
■Question No. 29（Safety valve, check valve） …… : ②
■Question No. 30（Outrigger interlock device） …… : ③
■Question No. 31（Handling and precautions of work equipment and traveling equipment） …… : ③
■Question No. 32（Installation of outriggers on slopes Part 1） …… : ①
■Question No. 33（Installation of outriggers on slopes Part 2） …… : ②
■Question No. 34（Installation of outriggers on slopes Part 3） …… : ①
■Question No. 35（Installation of outriggers on slopes Part 4） …… : ③

Chapter 3　Knowledge related to motor

Chapter 4 Necessary knowledge of mechanics and electricity for driving

Chapter 5　Related Laws and Regulation