Lift Truck Operator Certification

Student Manual

Second Edition (Version 2)

July 11, 2019

Saga Universal Training Corp. is dedicated to reducing deaths caused by illness and injury. This student manual follows the guidelines, principles and recommendations established by the Alberta Occupational Health and Safety Code (2009) Part 19. The goal of this program is to ensure operators have the basic knowledge and skills required for the safe operation of their equipment and its attachments. However, due to the different types of lift trucks, certain statements in this program may not apply.

Job and/or familiarization of operators for particular machines or specialized equipment used in specific workplace environments are in addition to this training. It is expected that an employer will take the fundamentals of this training and apply them to their specific machine and workplace.

Readers should not assume that reviewing this manual alone constitutes complete lift truck operator training.

For further information contact:

Saga Universal Training Corporation

E: mail – info@sagatraining.ca

Web Page – www.sagatraining.ca

Saga Universal Training Corp. wishes to acknowledge the efforts of all the people who contributed to the writing, editing, and layout of this manual. It is our hope that this manual and the resulting training program will aide in the reduction of preventable injuries and property damage with the necessary knowledge, skills and confidence to operate lift trucks safely.

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Introduction

Program overview

This course follows the guidelines and principles outlined in Part 19 of the Alberta Occupational Health and Safety Code as well as those established by the Canadian Standards Association and recommendations by the Canadian Centre for Occupational Health and Safety (CCOHS). It provides the minimum requirements for the training of operators for Powered Mobile Equipment (PME) and is intended to supplement a company's larger Health & Safety Management System. It is the employer's responsibility to ensure that its workers are competent to perform the duties requested of them. The goal of this program is to ensure operators have the basic knowledge and skills to operate a lift truck in a safe manner.

The information contained in this manual is intended to supplement the specific information that is contained in the manufacturers' operating manual(s).

Although every effort is made to ensure the accuracy, currency and completeness of the information, Saga does not guarantee, warrant, represent or undertake that the information provided is correct, accurate or current. Saga is not liable for any loss, claim, or demand arising directly or indirectly from any use or reliance upon the information.

This program includes a theory section as well as a practical component. At the end of the theory there will be a multiple choice, open-book exam of which, at least 80% correct must be achieved.

In addition to the theory portion, students must demonstrate their ability to safely operate their equipment and use the attachment in a way it was intended to be used.

Certification:

Successful students will receive a certificate of training for the equipment they are trained on. Certificates of training issued by Saga Universal Training Corp. must be recognized by the employer and are valid for 3 years from the date of completion.

It is recommended that an operator evaluation occur 18 months from the date of training to further ensure the operators competency.

Recommended pre-requisites:

- Risk hazard assessment training.
- Basic use of fire extinguisher training.
- Awareness of company specific safety policies, procedures and emergency response plans.
- Familiarity with operator manual for the specific powered mobile equipment and its attachments to be used on the job.

Objectives

After successfully completing this course an operator:

- Should understand Occupational Health and Safety Legislation including employer and employee requirements regarding the operation of powered mobile equipment.
- Should understand the basics of their equipment including its turning dynamics, capacities, functionality, stabilities, load handling, and its limitations.
- Should understand the operator's station and its controls, gauges and components.
- Should understand the importance of the operator's manual. Specifically, the Safety, Operation and Maintenance sections.
- Must demonstrate their ability to safely operate the equipment with its attachment.

Legislation

Canada Labour Code Part II

Federal health and safety legislation are found in Part ll of the Canada Labour Code and Regulations. The Canada Labour Code applies to employees of the Federal Government, the Post Office, airports, banks, canals, highway transport, pipelines, radio and television broadcasting, railways, shipping services, and many more.

All Provinces and Territories must meet the minimum requirements of the Canada Labour Code and Regulations in their own legislation and are certainly encouraged to exceed them.

Provincial Occupational Health and Safety

Approximately 90% of the Canadian workforce falls under the OH&S legislation of the province or territory in which they work. In Alberta, Occupational Health and Safety legislation applies to every occupation, employment and business except for:

- ***family*** operated farming and ranching operations,
  and
- work in, to or around a private dwelling or its' connected land.

Workplaces must meet the minimum requirements of OH&S legislation but are also encouraged to exceed them. Whether the workplace simply meets or chooses to exceed the minimum of the Provincial legislation, the employer should document their rules and regulations into the company's safe work policies and procedures manual.

Exposure to Harm

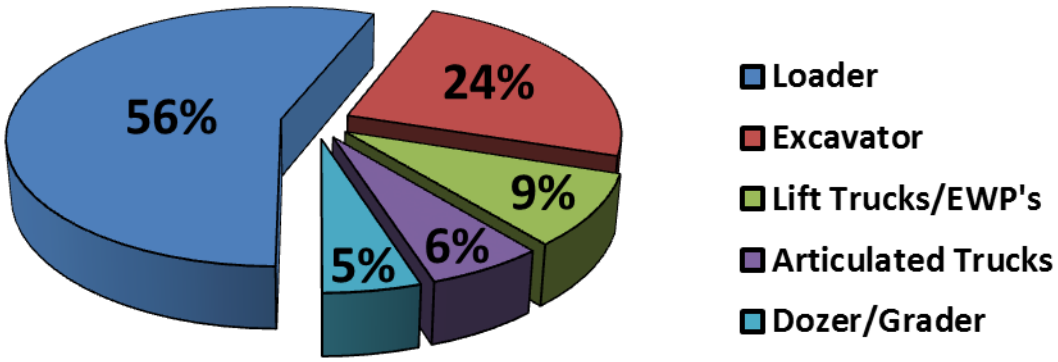
Of the millions of workers in Alberta, one worker is exposed to a harm causing injury or illness on average, every 3 minutes. Most are new workers within their first year of work.

Of all the workers in Alberta who have been exposed to harm causing injury or illness, one worker will die from that exposure on average, every second day. Most will succumb later in life due to an exposure that occurred earlier in their life.

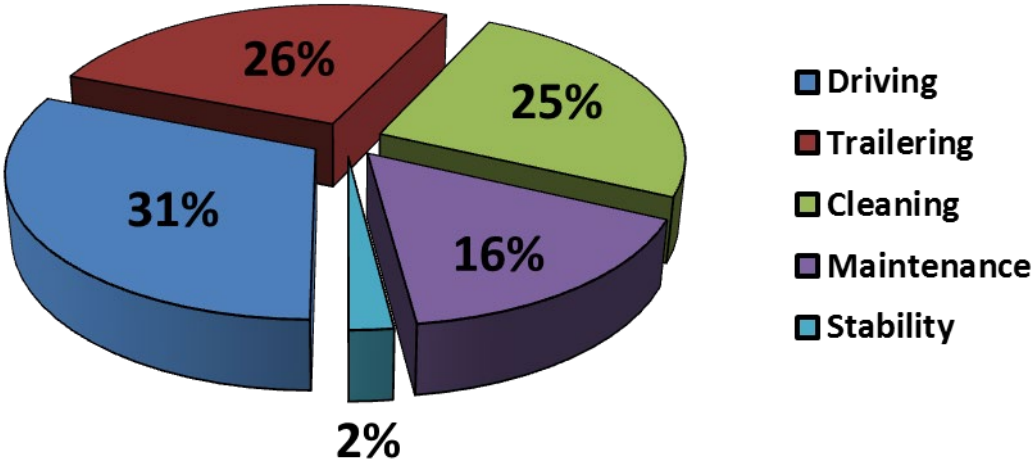
Of all the workers dying from a workplace exposure, the majority were workers attempting to rescue others. Many of them did not have the proper training, equipment, or support to perform the rescue, but felt a moral obligation. If a worker is not trained to perform rescue, the worker should be trained ***not to attempt.***

Operating powered mobile equipment can be one of the most dangerous jobs a worker can have. The following charts refer to incidents involving powered mobile equipment.

Incidents according to Equipment



Incidents according to Activity



Univ.-Prof. Dr.-Inghabil. H. Tudeshki
- DiplIng. M. Könnecke

Employer Responsibilities

The primary purpose of OH&S laws is to keep workers safe. Under Occupational Health and Safety laws, employers are ultimately responsible for **all** persons on their worksite. Occupational Health and Safety legislation requires employers to develop safe work policies and procedures to enforce compliance of the law for its workers.

Examples of safe work policies and procedures may include:

- Hazard Assessment, Elimination and Control
- Operating PME
- Lifting and handling loads
- Communication
- Accountability Procedures
- Personal Protective Equipment
- Fall Protection
- Ground Disturbance
- Working Alone
- Emergency Actions

In addition, employers must ensure that its workers have access to Alberta's OH&S Act, Code and Regulations, as well as the company's safe work policies and procedures. Developing a company Health & Safety Management System provides an organized approach to worker safety. The key elements of a health and safety program for PME operators are:

1) Training, Information and Auditing
2) Management, Supervision and Internal Responsibility
3) Job Planning and Hazard Assessments
4) Safe Operating Procedures
5) Prevention of Injuries
6) Equipment Maintenance and Modifications
7) Facility Design

Additional safety training may include First Aid, WHMIS, Transportation of Dangerous Goods, Spill Containment, Ground Disturbance, Fire Safety, etc.

Under the Alberta OHS Code, further requirements the employer must comply with:

- Specifications and Certifications (for equipment).
- Chemical Hazards, Biological Hazards and Harmful Substances.
- General Safety Precautions i.e. securing equipment and materials.
- Lifting and Handling Loads.
- Powered Mobile Equipment.
- Fork-mounted work platforms.

Employers must:

- Ensure that its workers have access to Alberta's OH&S Act, Code and Regulations, as well as the company's safe work policies and procedures.
- Provide safe workplaces.
- When providing equipment, consider the capacities and specifications that will be required for the work being performed. They should also consider the operating area for the equipment.
- Make operator manuals available to equipment operators.
- Maintain all equipment used at the work site in accordance to the manufacturer of the equipment.
- Ensure any modifications are done in accordance with the manufacturer's specifications or by a certified engineer following current engineering practices.
- Keep records on file.
- Ensure workers are familiar with and can readily access the information pertaining to the work they are responsible for including, logbooks, maintenance records, load charts and capacity plates.
- Create Safe Work Procedures or a company Health and Safety Management System.
- Ensure that work is arranged so that elevated loads do not pass over workers.
- Ensure workers are using appropriate PPE.

Employee Responsibilities

Under OH&S laws, employees have responsibilities too. Employees must, while at work, make all reasonable efforts to ensure the safety of all persons at the worksite. This includes other workers, traffic and pedestrians.

Employees have the obligation to refuse to work on a job or in any workplace, or to operate any equipment if they have reasonable grounds to believe that it would be unsafe or unhealthy to do so.

Workers must:

- Wear appropriate PPE.
- Co-operate with their employers for the purposes of protecting the health and safety of themselves and other workers while at work.
- Participate in a hazard assessment, and the control and elimination of hazards which affect them at their workplace.
- Follow company safe work procedures.
- Follow company rules and regulations.
- Not be under the influence of drugs or alcohol.

Power Mobile Equipment Operator Requirements:

Workers must not operate powered mobile equipment unless they are:

- Trained to safely operate the equipment.
- Operating the equipment safely.
- Familiar with the equipment's operating instructions.
- Authorized by their employer to operate the equipment.
- Certain workers are protected from injury before moving the equipment.
- Certain that they or a ground crew understand how to operate emergency controls and devices for their equipment.
- Transport the equipment safely.

All Parties

As per Alberta Occupational Health and Safety legislation, all employers, employees, suppliers and contractors have an obligation to ensure the health and safety of themselves and other persons present at the work site.

All parties must use the knowledge they've received and participate in company policy and procedures. It is in the best interests of all parties to understand their responsibilities and duties outlined in the Alberta Occupational Health and Safety Legislation.

All parties must cooperate with the inspection or investigation of a workplace by an OH&S compliance officer. This includes providing access to documents kept by the employer under its requirements. Documents may include hazard assessments, safe work procedures, inspections and maintenance documents, and training certificates.

It is illegal to interfere with an officer's investigation.

To show **due diligence**, one must be able to prove they have done everything reasonable to ensure the health and safety of themselves and everyone else.

Training and Information

Although it is the employers' responsibility for the provision of training, employees are responsible to use that knowledge and participate in any company procedures regarding the safe operation of their equipment.

Remember! No one can make you a safe operator. That is a choice that you make every time you operate equipment.

Operators should follow these basic safety practices:

- Always use the operator restraint system.
- Operate the equipment from the operator's compartment only.
- Use the equipment for its intended purposes only.
- Obey safe operating policies.
- Maintain a clear path of travel.
- Travel in reverse if forward vision is blocked or use spotters if they are available.

Notify your supervisor immediately if you are involved in an incident which results in personal injury or damage to the equipment.

Emergency Actions

An employer must establish an emergency plan for responding to emergencies at the workplace. The plan should be known and understood by all employees and trained so that they can react appropriately to the incident.

The plan should include:

a) The identification of potential emergencies;
b) Procedures for dealing with identified emergencies;
c) The identification, location, and use of emergency equipment;
d) The emergency response training requirements;
e) The location and use of emergency facilities;
f) The fire protection requirements;
g) The alarm and emergency communication requirements;
h) The first aid services required;
i) Procedures for rescue and evacuation;
j) The designated rescue and evacuation workers.

Training should also include understanding the procedures to follow in the event of an incident involving dangerous goods or controlled products.

Management, Supervision and Responsibility

For a company' Health and Safety Management System to be truly effective, there must be acceptance by the company's management and workers. The company ought to have a Mission Statement proclaiming its dedication to health and safety. The mission statement should be documented and posted in a conspicuous location for others to see. The company should have easily accessible safe work procedures or "codes of practice" for the workplace.

It is generally understood that adults who take training tend to forget much of what they learned within a short period after the training. Therefore, it is incumbent upon the employer to provide effective supervision by a competent worker to ensure the worker is in fact performing their work according to the training they've taken.

One of the largest areas of employer responsibility involves worker training as well as on-going skills auditing. Employers must ensure that workers are trained in the safe operation of the equipment they are required to operate.

The safety training program for the operation of equipment should include:

- Legislative and manufacturers requirements.
- Company policy and procedures.
- Selection, use and limitations of appropriate equipment.
- Demonstrating safe operation of the equipment.
- Loading and unloading of the equipment if doing so is a job requirement.
- On-going skills testing.

Competency Requirements

In addition to the objectives listed previously, it is expected that an employer will apply the fundamentals of the general learning outcomes to the specific equipment and job that the company performs.

It is the employer's responsibility to ensure that its workers are competent to perform the duties requested of them. A competent operator understands the OH&S requirements that come with operating equipment; the basics of the machine;attend, the operator's station and its controls, gauges and components and finally, the Safety, Operation, and Maintenance of their machine by using the operator's manual.

A worker who is not yet competent must be directly supervised by another competent worker to ensure their health and safety.

Job Planning and Hazard Assessment

Job Planning

Every worker should attend daily crew (or "**tail-gate**") meetings at the beginning of their shift. The purpose of the tail-gate meeting is to discuss and plan the work assignments for the day, and complete necessary documentation. It also allows workers an opportunity to ask questions regarding their assigned tasks.

It is critical that all affected workers attend, participate and contribute to the discussions at these meetings. Planning the job before you begin pays dividends. Taking the time to plan the job will save time and money. "Failing to plan is planning to fail".

It is the worker's responsibility to ensure that they have a clear understanding of assigned tasks including any hazards associated with the task.

Look at the 'Big Picture'.

- Discuss the over-all project and your role within it.
- Take note of power lines, temporary roads, traffic patterns, pedestrian paths, material storage, equipment lay-down areas, and where other equipment is working.
- Consider how your task may affect others. If others could be impacted by your assigned task discuss the issues with them and/or their foreman/supervisor.
- What other vehicles, mobile plant or work equipment could be close by?
- Look at where the other trades will be working later that day, week or month.
- Decide where you will work. Where you will pile, load and place materials.
- Walk the jobsite. Look for outbuildings, racks, and other obstructions that could interfere with your ability to operate safely.
- Ensure that Alberta First Call has been notified and have marked underground services prior to disturbing the ground.

It is important to note that Alberta First Call doesn't locate any private services that might have been installed by the property owner or the municipality. Water shutoffs and such might need be located by a private utility locater service.

Select proper equipment, material and tools.

- Determine what equipment, tools and materials your task will require.
- Ensure there are no conflicts with others' tasks. If there are, alert your supervisor/foreman, so alternate arrangements can be made.
- If transporting the equipment, determine whether a pilot vehicle(s) will be required and, if so, arrange for such.

It is expected that a Hazard Identification and Assessment process will begin as daily tasks are assigned. It is the employer's responsibility to ensure a hazard assessment is completed prior to starting work but it is the worker's responsibility to ensure they have a clear understanding of assigned tasks including any hazards associated with the task.

Know your powered mobile equipment.

Make sure your equipment is ready for the job it must do.

- Read and understand the Operator's Manual before using the equipment. If the manual is not on the machine – get one!
- Know the purpose of all the controls, gauges, and dials.
- Know the rated capacity, speed range, braking and steering characteristics, turning radius, and operating clearances.
- Read, understand and follow the Danger, Warning, Caution and other safety signs on your equipment.
- Know where fire extinguishers, first-aid, and emergency equipment are kept and where to get help if needed.
- Know the weight of your loads and do not, at any time, exceed the rated capacity of the machine.
- Has the equipment been examined, inspected, maintained and daily checks carried out?

Hazard Assessment

According to OH&S laws, hazard assessments must be conducted to identify existing or potential hazards before work begins on the worksite. A report must be filled out listing the results of the hazard assessment and the methods used to control or eliminate the identified hazards. As an equipment operator, it is important to look for potential hazards to you and others before work begins. Both the operator and the supervisor should be involved in the hazard identification process.

Each job site has its own unique operating hazards and site considerations. Every equipment operator should take the time to assess every job site every time work begins for the day, shifts to a new location, or when a new job on the same site commences.

Once a hazard has been identified, a worker is required to follow safe work procedures to avoid causing damage or injury at the worksite.

Participate and Contribute to Discussions:

- Ask questions of task assignment and how your job fits in with overall job.
    - Discuss your role with supervisor/foreman and co-workers.

- Develop a work plan that accounts for others' tasks and reduces or eliminates risks to others that could be created by your task's hazards.

Assess and discuss specific task and/or site hazards; introduce new information as needed.

- Consider impact of site-specific stationary hazards such as:
  - Slopes and inclines
  - Ground conditions
  - Moisture
  - Soil stability
  - Debris
  - Loose gravel
- Consider impact of other site-specific hazards such as:
  - Traffic
  - Pedestrians
  - Other people and equipment working in the area
  - Other PME
  - Animals
  - Fog or mist near lakes and ponds
- Be alert for changes that may impact your task or those of your co-workers. If any significant changes are noted, inform your co-workers.

Check the Work Area

Check the ground or floor over which you will travel and work. Look for obstructions;

- Holes, debris, obstacles, drop offs or rough spots.
- Weak spots or covers on ramps and floors.
- Oil spills, wet spots, slippery surfaces, soft soil and standing water.
- Soft, uneven surfaces or anything that might make you lose control or cause you to tip over.

Assess weather conditions.

- If working outdoors, a detailed weather forecast should be accessed each morning. It is critical that weather is discussed during the planning sessions.
- Be prepared to adjust tasks, people and/or equipment if weather changes. If a weather change is expected, discuss the potential impact with the crew.
- Rain, snow, ice, etc., can change the operating characteristics and capabilities of your equipment and require extra caution during operation.

Check Overhead

- Check the clearances overhead and of doorways and canopies. Also, check clearances when transporting your equipment on a truck or trailer. Know exactly how much clearance you have around electric power lines. Never move equipment closer than 3 m (10ft) plus twice the line insulator length to overhead wires.
- **DANGER**: **Maintain specified distance from electrical lines and apparatus**. Never approach power lines with any part of your machine unless all local, provincial and federal (OSHA) required safety precautions have been taken. Use extreme caution.

Contact with energized power lines can and will cause DEATH or serious injury to persons in the equipment and those on the ground in contact with or near the machine.

You MUST know your electrical safety zones

M.S.A.D. = MINIMUM SAFE APPROACH DISTANCE (SEE TABLE BELOW)

MAINTAIN M.S.A.D. FROM ALL OTHER ENERGIZED LINES AND PARTS AS WELL AS THOSE SHOWN.

Minimum safe approach distances (M.S.A.D.) to energized (exposed or insulated) power lines and parts.
DANGER: DO NOT maneuver machine or personnel inside PROHIBITED ZONE.
ASSUME all electrical parts and wiring are ENERGIZED unless known otherwise.

VOLTAGE RANGE (Phase to Phase)	MINIMUM SAFE APPROACH DISTANCE (Feet)	(Meters)
0 to 300V	AVOID CONTACT	
Over 300V to 50KV	10	3.05
Over 50KV to 200KV	15	4.60
Over 200KV to 350KV	20	6.10
Over 350KV to 500KV	25	7.62
Over 500KV to 750KV	35	10.67
Over 750KV to 1000KV	45	13.72

Safe Operating Procedures

Machine specific safe operation

The Equipment Operator's Manual contains instructions for the model of equipment that you will be operating. It is important that you take the time to read the manual and understand the controls and functions of the specific machine that you will be operating.

It is the operator's responsibility to follow all the safety rules and instructions in the operator's manual.

Using the equipment for anything other than what it was intended to do is unsafe and dangerous.

The following are some basic safety rules that apply to most worksites and work situations, but they may not cover every situation. Operators must become familiar with the policies and procedures to be practiced at their individual work sites and for their specific job.

General Operation

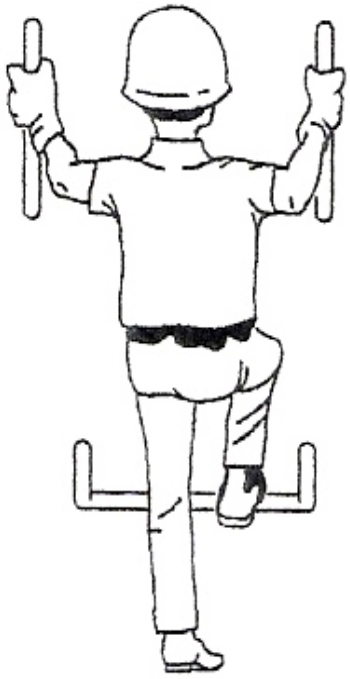
- Never operate equipment that is not working properly. If a malfunction occurs, shut it down.
- Never slam a control switch or lever through neutral to an opposite position.
- Always return switch to neutral and stop before moving the switch to the next function.
- Operate controls with slow and even pressure.
- Hydraulic cylinders, other than the outrigger cylinders, should never be left at end of travel (fully extended or fully retracted) before shutdown or for long periods of time. Always 'bump' control in opposite direction slightly when function reaches end of travel. This applies to both equipment in operation and in the stowed position.
- Never use the equipment to push or pull another vehicle except as approved by the manufacturer.

Mounting and Dismounting Equipment

The only safe place to operate equipment is from the operator's station. Only operate the controls while driving from within the confines of the cab.

Mounting

Take care climbing into/onto the equipment. Squarely face the vehicle and use the three-point contact method for mounting and dismounting; two feet and a hand or two hands and one foot.



- Be sure hands and feet are free of excess debris, grease and oil.
- Never use equipment controls as handholds when mounting or dismounting. Because of the play in the levers, you could lose your balance and slip or cause the equipment to move.
- Use extra care when mud, snow, or moisture present slippery conditions.
- Keep steps clean and free of grease and oil.
- Use handrails, ladders or steps (as provided) when mounting the machine.
- Never step on foot controls when mounting or climbing off.

Dismounting

Never dismount from a *moving* machine. Observe proper shutdown practices before dismounting.

Before dismounting the equipment, make sure the attachment is firmly on the ground, the vehicle is in neutral, and the parking brake is on.

Dismount carefully using three-point contact and face the machine. Check for slippery steps. Keep your feet and hands away from the controls. Never jump off the machine.

Seat Belts

Seat belt use is mandatory with powered mobile equipment. Without seat belts, you can be thrown from the cab in a roll-over. Even if you are not thrown from the cab, you can be tossed around inside the cab and suffer serious injuries. Some manufacturers require that nylon seat belts be replaced every three years because they are continually exposed to the deteriorating effects of use, weather, sunlight, oil, and grease.

Do not operate the machine from anywhere but the operator's seat with the seat belt fastened.

Starting and Testing

Look Out for Others

Before starting, walk completely around the equipment. Make sure no one is under it, on it or close to it. Let other workers and bystanders know you are starting up and don't start until everyone is clear of the machine.

Follow Recommended Starting Procedures

Follow the starting procedures recommended by the manufacturer of your equipment. Check all instruments, gauges and indicator lights.

Check for instructions in the operator’s manual for cold weather starting.

Follow the manufacturer's instructions for use of starting fluids. Don't carry loose cans of starting fluid in the machine. **WARNING**: Starting fluids are highly flammable.

When starting your equipment in an enclosed space, make sure there is enough ventilation.

Do not start or drive the equipment into confined areas such as refineries where flammable gases may be present. Check with plant safety personnel before entering any questionable area. **WARNING**: Exhaust fumes can kill.

Test the Controls

After starting, recheck all gauges and lights. Check the audible and/or visual alarms (if provided). Make sure everything is functioning correctly. If the equipment does not respond correctly when each control is operated, do not use the machine until it is fixed.

WARNING: Ensure you can control machine functions, speed and direction before moving.

Move slowly until you are certain everything is operating properly. Recheck the steering, right and left. Be certain you have full travel and automatic brake control. Be certain you can lower attachments.

Safe shutdown procedures

Correct shutdown is important to safe operation. Refer to your manufacturer's manuals. Follow these general steps;

Park Safely

When parking or leaving the equipment for any reason,

- Park your machine in a designated area or out-of-traffic and only on level ground.
- Come to a full stop.
- Place and lock controls in neutral.
- Engage the parking brake.

- Lower or secure all attachments.
- Idle engine for gradual cooling.
- Block the wheels.
- Shut off engine or electrical power.
- Take necessary steps to prevent unauthorized use in accordance with the operator's manual.
- Never override any hydraulic, mechanical or electrical safety device.

Follow these same precautions before leaving the operators seat or exiting the machine.

Should something break, loosen or malfunction on your machine, stop work, shut off the engine and seek qualified assistance to correct the condition. Do not operate the machine until the condition has been corrected by authorized personnel.

Personal Protective Equipment (PPE)

Personnel Protective Equipment is mandatory; it can prevent injuries and even save your life. Before inspecting or operating your equipment, you may be expected to wear:

- High visibility clothing
- Close fitting clothing
- Hard hat
- Safety glasses
- Steel-toed shoes
- Gloves
- Body Holding device (harness) and connector (lanyard)

Communications

Companies are required to have a policy regarding communication amongst workers on the job site. The communication system can include the use of radios, hand signals, lighting signals, audible signals, and so on.

In some cases, companies use spotters to guide equipment operators. A communication system must be developed and understood where spotters/signalers are used. It is the operators' responsibility to ensure effective communication protocols are in place for all workers near operating equipment.

Radio communication and hand signals must be discussed and fully understood amongst all workers that will be utilizing them. Always keep signal person in view. An example of common hand signals is outlined in the following figures:

Moving the Equipment

PROCEED SLOWLY

FORWARD

Always face palms
in direction of desired travel.

BACKWARD

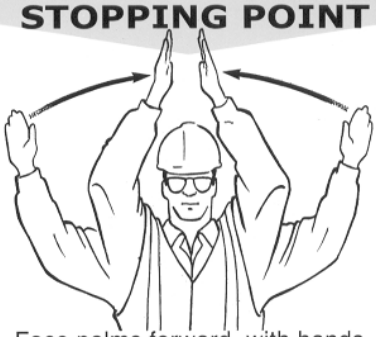
Then bend both arms repeatedly
toward head and chest,
and then extend.

TURNS

Point one arm
to indicate
the direction to turn.

Bend monitoring arm
repeatedly toward head to
indicate continued turning.

DISTANCE TO STOPPING POINT

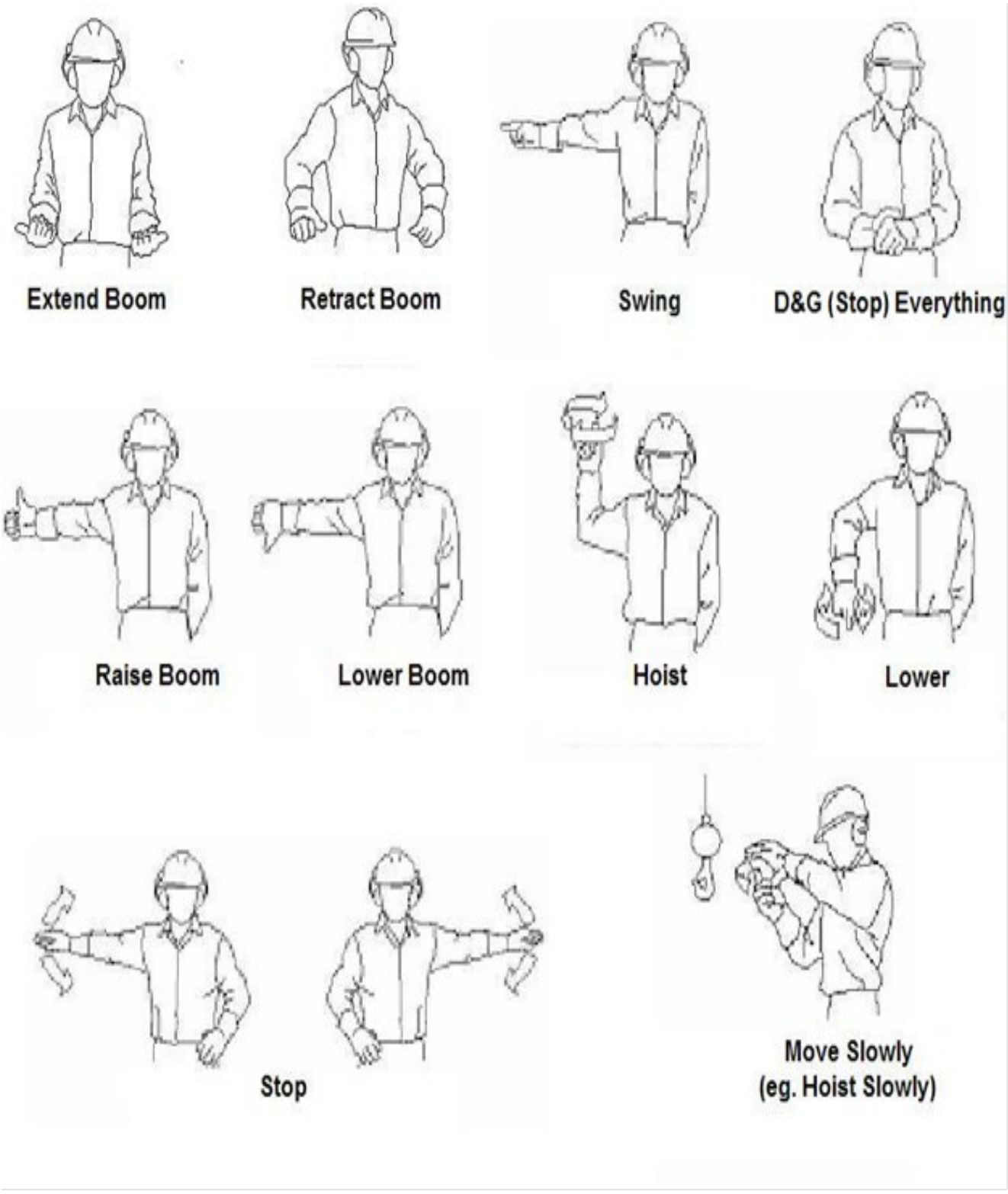


Face palms forward, with hands
above head. Bring elbows
forward and hands together.

STOP

Cross both arms above head.

Moving the Attachment



Prevention of Injuries

Essential Qualities of an Equipment Operator

A good operator has a combination of skills and qualities that contribute to overall competency. Essential qualities of an operator include the following:

The operator will have **knowledge** of:

- Federal and Provincial legislation, company rules and safe operating procedures.
- Principles of operation, features, selection and limitations of the equipment.
- Workplace conditions and environment, and activities that pose a danger to worker health and safety.
- Emergency procedures.
- The equipment's specifications.
- Momentum, leverage, and stability principles, and capacity as well as the forces affecting the equipment and its loads stability.

The operator will have **skills** that include:

- Operating experience and knowledge of the equipment they operate.
- Good decision-making ability when judging operating conditions.
- The proper selection, security and integrity of various loads.
- Proper and safe refueling and recharging practices.

The operator will have a **good attitude** that includes:

- A safety-first philosophy.
- No need to prove himself or to show off.
- Not being pushed beyond safe limits by production schedules or peers.
- Exercising self-control.
- Being cooperative, courteous and considerate of others.

The operator will have **physical qualities** that include:

- Good reflexes and coordination.
- Good vision and depth perception.
- Good physical conditioning.
- Quick thinking.

Rules for Equipment Operators

New employees must receive an orientation on the specific equipment at the workplace and be trained or evaluated on the specific equipment prior to operating it.

- Immediately report unsafe working conditions or malfunctioning equipment to your supervisor.
- Know the equipment's lifting capacities and never exceed them.
- Inspect all equipment before beginning operation.
- Do not leave or store garbage, tools, parts, ropes, or chains in the cab.
- Always operate the equipment in a safe and courteous manner with absolutely no stunt driving or horseplay.
- No passengers are allowed on the equipment.
- Never allow anyone to walk or stand under an elevated load.
- Ensure there are adequate clearances for the work in progress.
- Workers must operate the equipment safely, which includes watching for moving parts that may endanger a worker.
- An operator must not leave the controls of the equipment unattended unless it is secured against unintentional movement.
- Avoid contact with gas lines and water lines. Call utility location services to identify all underground utilities before digging.
- Prepare the work site properly. Avoid operating near structures or objects that could fall onto the equipment.
- Operate only on solid footing with strength sufficient to support the machine. Be especially alert working near embankments, excavations and on slopes.
- Avoid working under over-hanging embankments or stockpiles that could collapse under or on the equipment.
- Keep everyone clear of working equipment. Never permit anyone to stand or pass under a raised load. Make certain everyone is clear of the machine before you begin lowering a load.
- Never drive your equipment up to someone standing in front of a fixed object.
- Limit the height of the attachment and any load as much as possible while travelling. Raising the load reduces machine stability, especially on side slopes or an unstable surface.
- Maintain a clear path of travel.
- Know and understand manufacturer's restrictions regarding travel of machine
    - Position of stabilizers and/or outriggers,
    - Traversing or elevating on slopes and grades.
- Be extremely cautious when the attachment has been raised.
- Avoid sudden stops, starts, turns or changes in direction.

- Never alter, remove or substitute any item which could reduce the overall weight or base stability of your machine; such as counterweights, foam filled tires, batteries, etc.

Pedestrian Traffic

- Give pedestrians the right of way.
- Never allow pedestrians to enter the work area.
- Signal pedestrians to stop when in the middle of a job.
- Pedestrians often take short cuts and back-up alarms are sometimes ignored. Pedestrians can also become complacent and conditioned to the sound of back-up alarms.
- When passing pedestrians, sound horn, establish eye contact and stay clear.
- Wave them on only when it is safe for them to pass.
- If a pedestrian does enter the immediate work area, lower your attachment to the ground and stop operating. If the pedestrian gets too close to your machine, shut it off and remove residual energy from hydraulic system.
- Use a signal person if moving equipment in congested areas or where visibility is restricted.
- Slow down and sound horn at blind corners when working in the yard and maintenance areas.
- Check convex mirrors placed at blind corners if available.
- Follow normal traffic patterns.

Load Handling

- Movement of loads shall be conducted in such a manner so as to ensure the safety of all workers and pedestrians near the operation. If there exists, the potential for a suspended load to shift, barricades must be put in place to reduce a person’s exposure to the danger of falling objects.
- Any load which may tip, fall or endanger a person must be secured.
- Only properly approved work platforms may be used to support, raise or lower workers. Travel restraint should be worn by the persons in the work platform.
- Stacked pallets of materials must be stable and not easily moved or knocked over.
- Prior to lifting a load, the load weight information should be provided to the operator for review.
- If the load to be moved is unsafe, the operator must refuse to move the load until their concerns can be appropriately addressed.

Re-Fueling Safety

Follow the guidelines below for safe refuelling operations:

- Turn off all equipment before refuelling.
- Lower attachments to the ground to provide an electrical ground in case of accidental sparking.
- Don't refuel while another machine is starting or running in the area.
- Wear PPE.
- Locate firefighting equipment at the re-fueling station. Follow company emergency procedures in the event of a fire.
- Review location of manual shutoff valves and switches and all emergency shutdown procedures.
- Use correct type and grade of fuel.
- Notify proper personnel and follow company requirements in the event of a spill.
- DO NOT SMOKE!

Safe Operation

Working in Mud and Wet Conditions

- Wet conditions cause sideways slippage of the machine on any slope.
- Consider chaining the wheels – front and back.
- Feather the controls; avoid sudden starts and stops as machine will slide.
- Keep wheels cleaned. Mud will build up inside wheels and then harden around valve stems. Causes the valve stems to break or become unseated.
- Keep inside of tracks clean. Excess material will cause excess wear and tear, or possible cause a track to slip off.

Rough Terrain

- Ensure beacon and hazard lights are working.
- Go slow – save the machine. It will rattle the machine and break components.
- Carry less material.
- If possible, smooth out rough terrain in the area that you will be operating in.
- Understand your travel paths.
    - Reverse, forward, obstructions, clearances, ruts, bumps, and traffic patterns should all be given consideration.
    - Fill in ruts.
    - Pad concrete curbs and sidewalks with soil. This will save on tires and the equipment operators back.
    - Build ramps over finished work, temporary lines and pipes.
- Time pressures.

    - Both supervisors and customers will pressure the operator. You are in control, slow and steady usually wins the race.
- Ensure your load is secure.
- Carry the load “Low and Slow”. Keep the center of gravity of the load as low as possible.

Speeding

Precautions:

- Never speed with the machine.
- High range should only be used when “roading” the vehicle.
- Keep a safe distance between you and other machines.
- Always keep your machine under control.

Consequences:

- Operator control is reduced significantly at high speeds.
- Hitting an object at high speed could cause loss of steering and control, and significant injury to the operator and damage to the equipment.

Ground Obstructions

- Always watch for ground obstructions that affect vehicle stability.
- For smooth terrain keep the attachment 4-6 inches above the ground, for rough terrain keep the attachment 12–16 inches above the ground.
- If obstacles must be crossed, slow to a safe speed and raise the attachment further to avoid contact with the object.
- Be alert; the machine could side spin at any time as you move over a large obstacle.
- Never operate too close to a drop off or ditch, sliding soil, and crumbling banks.

Crossing Railway Tracks

- Ensure load is secure.
- Watch for railroad traffic anytime you are working on or near tracks.
- Use regular track crossings whenever possible or risk damaging the tracks.
- Ensure permission to cross tracks has been given by track operator.
- Greasy or slippery tires can make travel over tracks more difficult.
- Tracks may cut tires.
- Never park closer than 8 feet to center of railway tracks.

Moving Pipe

- Use a pipe grapple attachment.
- Could insert forks into end of pipes.
    - Be sure weight is within rated load capacity.

    - Be careful when inserting forks into pipes. Don’t damage pipe or forks.
    - Consider principles of leverage when load center extends beyond normal.

Working at Night

- Walk around the machine more often.
    - At night, it is more difficult to see fluid leaks.
    - Look for loose parts, leaking components and damage.
- Walk the jobsite.
    - The area will look different when working under artificial light.
    - Dust will cause more visibility issues at night under artificial light.
    - Look for dips, drop-offs, and marked utilities.
- Clear away trash and debris. Pick up anything that might puncture a tire. Make sure aisles, ramps, doorways and passages are clear.

Transport the Equipment Safely

If your equipment is to be transported, refer to the manufacturer's manual for the procedures to prepare and load the equipment for transport. When transporting the equipment on a truck or a trailer, the prudent operator must know the overall height of transport vehicle with the equipment on board to avoid contacting overhead obstructions such as bridges, underpasses, electrical power lines and such.

"Trailering" must be considered a potentially very hazardous operation. The operator of a truck & trailer combination has care and control of 2 vehicles, the tow vehicle and the trailer. The trailer presents a far greater potential hazard than the tow vehicle for 2 reasons:

1. The trailer can present a very large mass to the world by its cargo capacity.

2. The trailer is un-powered; it is controlled through the movement of the tow vehicle.

The connection between tow vehicle and trailer and, therefore, the control of the trailer by the operator, is completely dependent upon the hitch mechanisms. Failure of this connection presents enormous potential risk of injury or damage to the public, the environment, and of course, the tow vehicle driver. Do not tow a machine without referring to the manufacturer's manual for specific towing instructions.

Considerations for trailering equipment:

- Ensure truck and trailer is registered for the combined weight and can haul the load.
- Place trailer on firm flat surface.
- Block the tires on both the truck and trailer.
- Ensure that the trailer is blocked underneath to prevent it from lifting at the front when the machine is driven onto it.
- Check truck and ramp capacities and grade of any expected inclines.
- Use spotter.
- Back onto trailer only after ensuring that the trailer is properly connected to tow vehicle (Back onto the trailer and drive forward off it).
- Position machine so that the weight is slightly ahead of and over top of axles.
- Lower the attachments.
- Apply down pressure.
- Set park brake.
- Shut off machine.

After it has cooled down:

- Cap exhaust stack.
- Use proper tie down procedures.
- Securely chain all four corners.
- Tie down any attachments.
- Use only inspected chain and angle it slightly away from machine. Chain attachment as well as machine. Tie down boomer handles.
- Know overall height, weight and width.

Lifting and Tie Down Points for a lift truck

Improper lifting or tie-downs can allow the load to shift and cause injury or damage. Install the steering frame lock link before lifting.

Note: The machine shipping weight that is listed is the weight of the most common configuration of the machine. If attachments have been installed on your machine, the weight of your machine and the center of gravity of your machine may vary.

Reference: Refer to Operation and Maintenance Manual, "Specifications" for the dimensions and weight of the machine.

Lifting Point - To lift the machine, attach the lifting devices to the lifting points.

Tie Down Point - To tie down the machine, attach the tie-downs to the tie down points.

Use properly rated cables and properly rated slings to lift the machine.

Operator Safety

People have been injured while operating their equipment with body parts outside the operator’s cab. Do not operate the machine from anywhere but the operator’s seat with the seat belt fastened.

- Keep all loose clothing and machine parts away from pinch points.
- Keep extremities inside the protective screens.
- Never reach outside of cab.
- Never attempt to operate controls from outside cab.

Maintenance and Modifications

Operational Inspection

Equipment operators must ensure that their machine is in safe operating condition. Regular equipment maintenance is an essential element of any safety program. In addition to regular maintenance of the equipment, the operator is also required to

perform regular operational inspections of the equipment and attachments they operate.

If necessary, a PME operator may be required to perform pre, mid, and post operational inspections. The pre-operation inspection is a visual inspection performed by the operator prior to each work shift. The inspection is designed to discover if anything is apparently wrong with a machine before the operator performs the function tests. Do not operate the machine until deficiencies are corrected and all systems are in good operational condition.

In addition to the pre-operational inspection, the operator may be required to perform mid and post operational inspections too. The operator's manual outlines the frequency of inspections and maintenance for equipment. These inspections reveal necessary equipment repairs or replacements. A worker should never operate equipment or an attachment that is damaged and needing repair. Lock-out and tag-out unsafe equipment to prevent further use.

Operators need to be able to recognize and record equipment problems and report unsafe equipment to the employer immediately. In addition to the equipment and attachments to be operated, inspections could also include damaged racking, dock-boards, loading ramps, straps, chains and cables and other equipment.

It is not expected that the equipment operator performs mechanical duties such as changing oil, changing fan belts, or making repairs etc.

However, it is expected that operators will:

- Perform a visual check of all major components of the equipment.
- Make a thorough walk-around inspection before mounting the machine to start the engine.
- Check functions and alarms.
- Top up fluids, grease the machine and keep it clean.
- Look around the machine for loose bolts, trash build up, oil or coolant leaks, and broken or worn parts.
- Inspect the condition of the attachments and the hydraulic components.
- Change blades.
- Change attachments.

Caution! Do not walk underneath any suspended attachments unless they are mechanically supported and secure.

There are many manufacturers of lift trucks with various methods of inspection. Always refer to the machine specific operator’s manual for the procedures to follow.

Repairs to the equipment must be made by a qualified service technician, according to the manufacturer's specifications. After repairs are completed, the operator must perform a pre-operation inspection again before going on to the function tests.

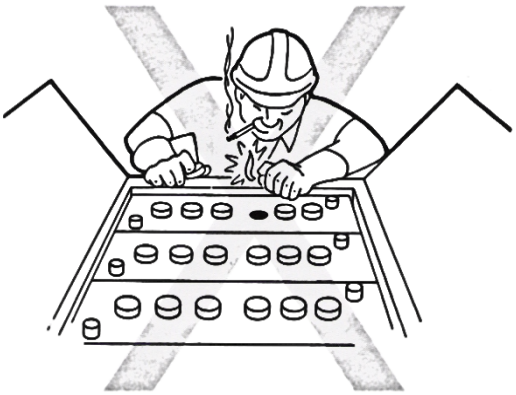
Only routine maintenance items specified in this manual may be performed by the operator.

The items that need to be checked are found in the inspection and maintenance section of the operator’s manual. Be sure that the operator' safety and responsibilities manuals are complete, legible and in the storage container located on the equipment.

Avoid Battery Hazards

Charge batteries only in a well-ventilated area. Refer to manufacturer’s manuals for charging procedure.

Warning Lead-acid batteries produce flammable and explosive gases. Never allow smoking, flames or sparks around batteries.



Checklists

Checklists should be used by the operator to ensure that a proper inspection of their equipment is completed. Inspections are usually part of a company policy; this ensures the employer that equipment is inspected on a regular basis. The operator should be able to recognize record and report any items requiring replacement or repair to their employer.

Some of the key elements on an operational checklist include:

- Date & time when the inspection was performed.
- Number of hours operated.
- Repairs and modifications performed.
- Inspections performed.
- Incidents that may affect the operation of the equipment.
- Certification records.
- Records the person doing the work.

The importance of an operator thoroughly reading the operators manual for the equipment they will, or currently do operate cannot be stressed enough.

The operator's manual for should always be consulted prior to starting the equipment. The following procedures are general guidelines to follow while completing an operational inspection.

The following checklist can be used as a tool to ensure the equipment is inspected according to the manufacturer's requirements.

Inspection Checklist

On approach to the vehicle:

ITEM	DESCRIPTION	Yes	No
Look around the equipment for obstructions, debris, other equipment and people.			
Look for vehicle traffic and other equipment in the area.			
Check that equipment is sitting level, on level ground.			
Look for fluid underneath the machine and its attachments.			

At the vehicle, with the key in the "OFF" position, check for:

ITEM	DESCRIPTION	Yes	No
Exterior	Check body, safety guards for damage		
The equipment attachments and locking devices	Check condition, defective parts		
Mast or main lifting arm assembly	Check condition, defective parts		
Pins and bushings	Check condition		
Windows	Check cleanliness, wiper fluid level		
Mirrors	Check cleanliness and adjustment		
Tires	Check pressure and wear		
Wheel bolt studs	Check tightness		
Coolant	Check level		
Fuel	Check level		
Engine oil	Check level		
Air cleaner	Un-obstructed		
Seals	Leaks at oil, water and hydraulic lines		
Hydraulic cylinders, hoses and fluid	Leaks, and level		
Transmission fluid	Check level		
Battery	Check electrolyte level and terminals		
Air ventilation filter	Clean		
Fuel pre-filter	Drain water		
Air intake hoses	Check connections		
Fire Extinguisher	Present, secure, and charged		
First aid kit	Present, secure, and stocked		

With the key in the "ON" position, check for:

ITEM	DESCRIPTION	Yes	No
Instrument gauges	Functioning normally		
Operating, running, signal and emergency lights	Clean, operating and adjusted		
Warning devices and alarms	Good working order		

Starting the Engine

Once you have performed all pre-operational procedures, you are ready to start the machine and test all functions. Before you start the engine:

- Adjust the operator seat and secure seat belt.
- Ensure all controls are in neutral.
- Look completely around the equipment before attempting start-up.

With the engine running, check for:

ITEM	DESCRIPTION	Yes	No
Instrument Gauges	Warning alarms and lights are off		
RPM indicator and hour meter	Are working normally		
Fuel gauge	Level		
Drive forward and reverse	Working normally		
Steering	Working normally		
Service and park brake	Working normally		
Load handling devices	Working normally		
Odours, sounds, feel	Unusual or suspicious		
Safety interlock system	Working normally		
Foot pedal movement	Brake and throttle pedals are smooth		
Comments			
Supervisor's receipt:			
Operator signature:	**Date:**		
Vehicle Identification:	**Hour Meter:**		

PERIODIC MAINTENANCE SCHEDULE				
ITEM	**EVERY 10 HOURS**	**DESCRIPTION**	**Yes**	**No**
Check tire pressure and wear				
Drain water from air tank				
Inspect engine belts				
ITEM	**EVERY 50 HOURS**	**DESCRIPTION**	**Yes**	**No**
Fasten the connecting bolts on the front & rear drive shafts				
Check oil level in the brake booster pump				
Check and lubricate throttle control, parking brake and transmission control system				
Grease fan shaft, articulation points, drive shaft, and oscillating suspension				
Comments				
Operator signature:				
Supervisor's receipt:				

If You Find Problems

If you find problems while performing the operational inspection, determine whether the problem affects the safe operation of the equipment or not. If so,

- Fit the machine with a “DO NOT OPERATE” tag. Follow company lock-out policy.
- Submit your operational inspection report to your supervisor for follow-up.

Otherwise, continue working but ensure the necessary repairs are carried out before the problem does have an affect on the safe operation of the equipment.

Many mechanical conditions or design features increase the risk for PME incidents, below is a list of the more common areas of concern.

- Malfunction of brakes.
- Malfunction of steering.
- Malfunction of clutch, shift linkage, or transmission.
- Malfunction of attachment assembly.
- Emissions from equipment.
- "Blind spots" or obstructions blocking driver's view.
- Poor layout of controls and displays.

Lockout Switch

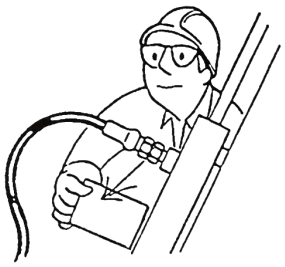
Lock-out / Tag-out procedures are used to ensure that any unsafe equipment is rendered inoperative until such time that it is repaired to the manufacturer’s safe operation specifications.

Equipment Integrity

Operating capacities are determined by certified engineers on behalf of the equipment manufacturer. This is done for newly manufactured equipment. However, due to the wear and tear that occurs to the equipment under normal operating conditions, it is expected that, over time, the equipment will deteriorate with use and therefore the equipment's capacity could decrease as well.

Companies who follow the maintenance and service requirements of the equipment's operator manual including Non-Destructive Testing, can reasonably expect that the equipment will remain in good operating condition. This also gives the operator the confidence to operate the equipment to its capacity knowing that they have a reliable piece of equipment.

We recognize the employer's responsibility to maintain equipment and we also recognize the operator's responsibility in inspecting and maintaining their equipment too.



If the equipment is not inspected and maintained according to the manufacturer's requirements and an incident occurs, the liability may lay primarily with the employer, but also with the operator.

Housekeeping

Housekeeping is essential to preventing problems. The purpose of housekeeping is to keep the equipment clean and free of debris and loose objects that could cause problems. Before attempting to clean a machine, be sure to wear personal protection equipment as required, lower attachments and turn off the engine.

- Remember to blow down or wash the equipment regularly. It is the equipment operator's responsibility to ensure that the equipment they are operating is cleaned and ready for the next operator and/or next shift.
- Clean steps, railings, ladders, and floor. Remove grease or oil. Brush away dust or mud. In the winter, scrape away snow and ice.
- Replace slip-resistant tape or paint, as required. Remember-slippery surfaces can be hazardous.
- Keep the cab clean & free of loose objects and debris.
- Remove or put away tools, ropes, and hooks. Remember-loose items on the floor could cause an accident.
- Maintain the fire suppression system.

Facility Design

Workplace Requirements

Workplaces facilities must be designed to operate equipment safely. The equipment operator should:

- Ensure there are adequate overhead clearances.
- Ensure that alleyways, and yards have adequate spacing to permit the safe operation of the equipment while engaged in work.
- Designated walkways, barriers, warning signs and other safeguards should be utilized to prevent the occurrence of a collision between a person and equipment.
- In the absence of designated walkways, safe work procedures must be in place for pedestrians walking near operating equipment.
- Watch for ponds that have steam rising obscuring visibility in the field.
- Be aware of wet conditions that could lead to uneven and soft ground.

Ventilation must be adequate to remove toxic gases created using internal combustion engines while indoors. Workplace design should identify walkways for pedestrians and workers not engaged in equipment operation.

Racks and other storage units should be of adequate strength to ensure they can safely store the intended loads.

Floors, aisles and passageways should be kept clear of debris and other potential hazards.

The creation of safe work zones for the equipment being used is an important aspect of keeping other workers and people safe. This is typically calculated at 1.5 times the over-all length of the equipment extending completely around the furthest outside edge of the equipment. The following image represents the machines safe operating zone. This concept would be applied to any PME as a company policy.

Lift Trucks

There are many manufacturers of lift trucks with many styles and shapes. Some are relatively small and designed to operate in restricted areas handling small loads, while others are massive machines intended to work in large open areas handling very heavy loads. Many lift trucks are intended for specialized jobs that don't entail the use of standard attachments such as forks making the task potentially more complicated than it would have otherwise.

Lift trucks are, as the name implies, machines intended to lift and truck (or carry) various types of loads. With that said, manufacturers design the equipment to withstand the forces involved with having to lift and truck. It is most important for operators of lift trucks to understand not only the types of loads their lift truck is intended to carry, but also to understand the terrain and the operating conditions for which their machine is intended to operate under. Equally important, the operator also needs to understand the limitations for which the machine will operate under.

Due to the nature of work being performed using the equipment, associated hazards to the operator as well as those workers working in proximity to the machine exist. Operators must understand the responsibility they have while operating a lift truck. For example, small to average sized lift truck can have a combined weight of machine and load of 5,000 – 7,000 lbs under their control. While some of the larger machines can have a gross weight of over 30,000 lbs.

The weight combined with the lack of training that so many operators have, contribute to become one of the most dangerous operations found in workplaces today.

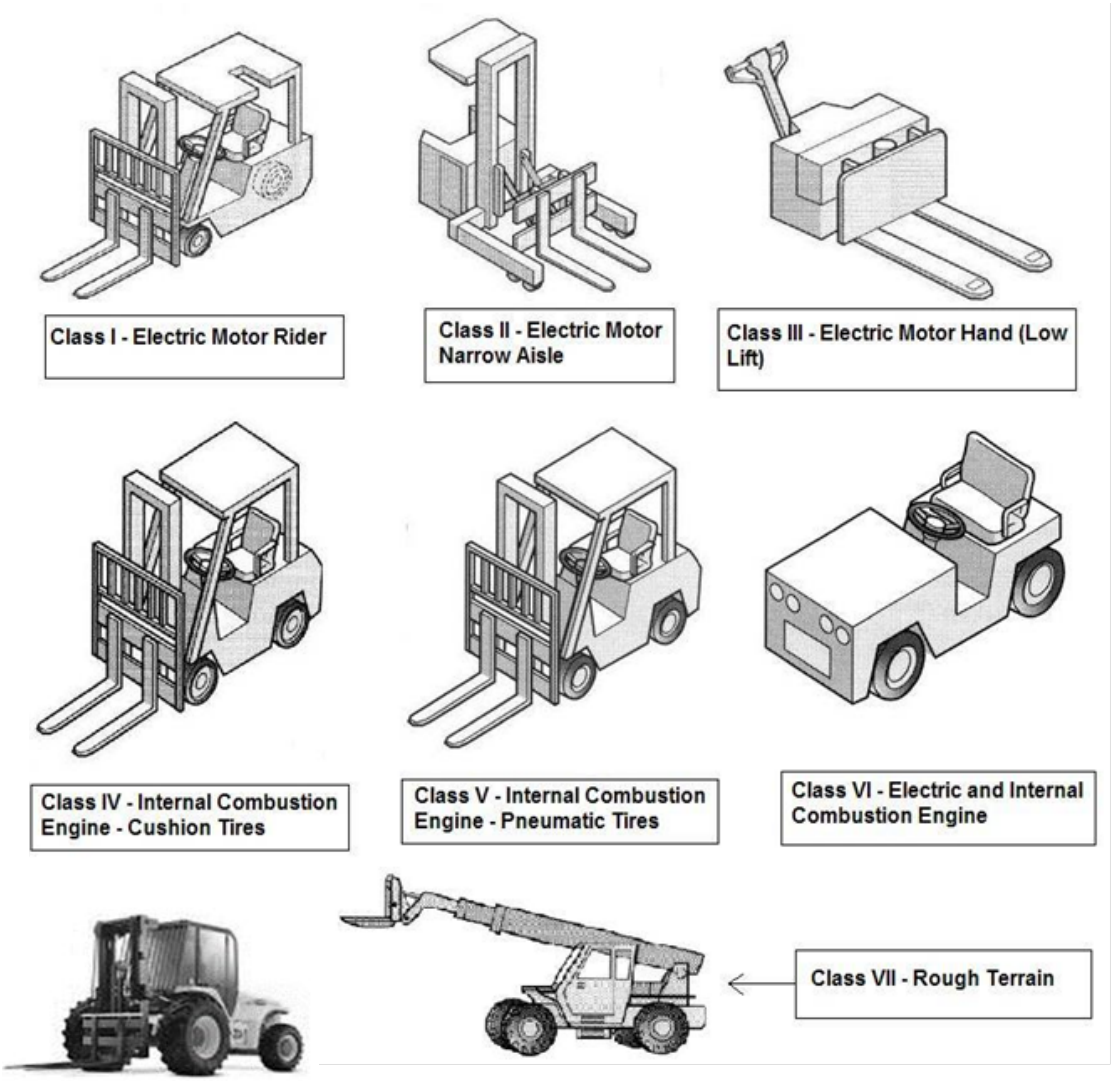
The purpose of this section is to have the operator understand the basics of the lift truck including the lift truck's drive, steering modes and turning dynamics, its strike points, its stability shape and centres of gravity, and attachments. We'll also look at the various forces applied to the lift truck while it is doing its work.

Classifications of Lift Trucks

Lift trucks meet the definition of “Powered Mobile Equipment” under Occupational Health & Safety legislation. In addition, the International Industrial Truck Association (IITA) recognizes seven classifications of lift trucks.

The classifications of lift trucks are as follows:

Class 1: Electric motor rider trucks
Class 2: Electric motor narrow aisle trucks
Class 3: Electric motor-driven hand trucks
Class 4: Internal combustion engine lift trucks – cushion tires
Class 5: Internal combustion engine lift trucks – pneumatic tires
Class 6: Electric and internal combustion engine tractors
Class 7: Rough terrain lift trucks



Operator's Position

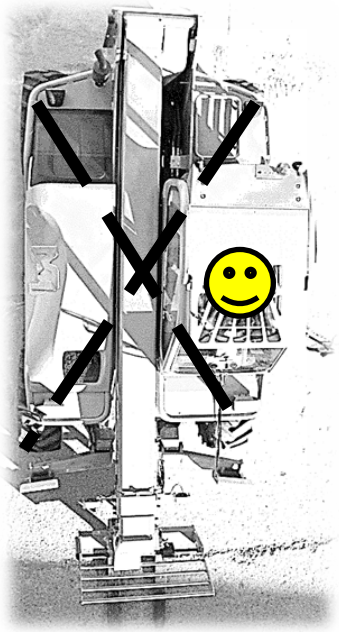
There is a large variety of lift trucks in use today performing a multitude of tasks in a variety of locations and operating terrain. Lift trucks have over-all specifications that vary from one piece of equipment to another. Lift truck operators need to understand the machine they're operating; especially from the operator's cab. The cab is usually located in a position most convenient for the safe operation of the lift truck. Lift trucks have limited visibility from the operator's cab and extra caution must be taken when reversing and turning the equipment.

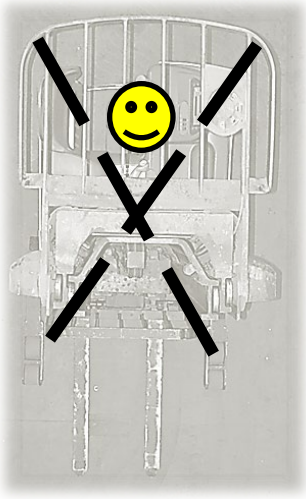
The operator should understand where the cab is situated in relation to the machines outside perimeter. Lift trucks have limited visibility from the operator's cab and extra caution must be taken when reversing and turning the lift truck.

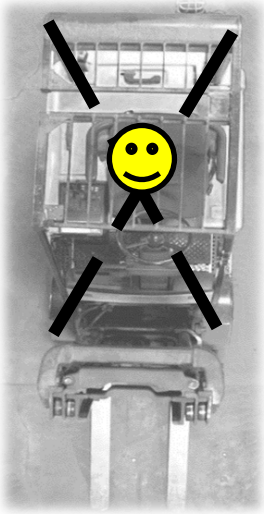
Centre of Machine

The centre of lift trucks can be determined by locating the point at which diagonally intersecting lines from the furthest outside corners of the lift trucks meet.

The following images are examples of common lift trucks showing the centre of the equipment; this is also where the operators cab is usually stationed.







Drive

PME is driven through an engine or motor and transmission. Independent of how it is powered, if the lift truck is of the wheeled type intended for rough terrain, it will usually operate in a low range gear with low speed using four, or all-wheel drive. Some are hydrostatically driven.

If ever the lift truck needs to travel between one work location and another, many machines can shift into a higher range gear for higher speeds that involves 2-wheel drive operating at higher speed. When equipment is traveling in 2–wheel drive, typically the front wheels provide the drive as the rear axle is disengaged while in 2-wheel drive.

Wheels, other than drive wheels, would include load bearing wheels; including castor wheels, steering wheels, or a combination drive and steer wheels.

Tires

If the lift truck is designed to operate in rough terrain, it will usually have tires appropriate for the terrain. Just because a tire has good tread does not necessarily mean the lift truck was intended to be operated in rough terrain; it could simply mean it was intended to operate outdoors.

Rough terrain tires are the standard tires used on lift trucks intended to operate in rough terrain. These tires have an aggressive tread intended to help climb and descend slopes; however, they are not as aggressive a tread used for side slope. Lift trucks driven on tires in rough terrain tend to concentrate the weight of the vehicle over smaller areas and therefore providing the risk of sinking or bogging down in soft terrain.

Tires could be filled with air or nitrogen, filled with foam or liquid ballast, or completely solid. Solid tires are known as cushion tires even though they feel very rough because they are solid. However, while under load, cushion tires become quite soft.



Tires intended for smooth terrain, will have light tread or smooth “slicks” tires. These “slicks” provide for a smoother, quieter ride with less vibration placed upon the machine and operator than those with tread, especially when used indoors.

Steering and Turning Dynamics

The lift truck is intended to lift, carry and place heavy loads; often in workplaces that have rough terrain and limited space. All lift trucks have a means of steering and turning side to side. With that, all lift trucks will have pivot points on which they turn. It's important for the operator to understand the pivot points of the lift truck they're operating because the vehicles pivot points are what the operator should use to judge where and when to turn the vehicle to avoid hitting obstructions and clearing the corner they're turning.

Lift trucks driven on wheels may have front wheel steer, rear wheel steer, all wheel steer, crab-style steer, and articulating steering.

Equipment using the front wheels to steer, use the rear wheel as pivot points; and for equipment that using the rear wheels to steer, use the front wheels as the pivot. Remember, because the pivot point is not the steering point, use the steering wheels to direct the pivot wheels. The pivot point is reversed when the vehicle is reversed. If the lift truck has tandem load wheels, the centre of the tandem acts as the pivot point.

Front wheel steer typically has the largest turning radius of all the steering types. Two-wheel steer (front tires only) is used when traveling on public roads or on flat terrain.

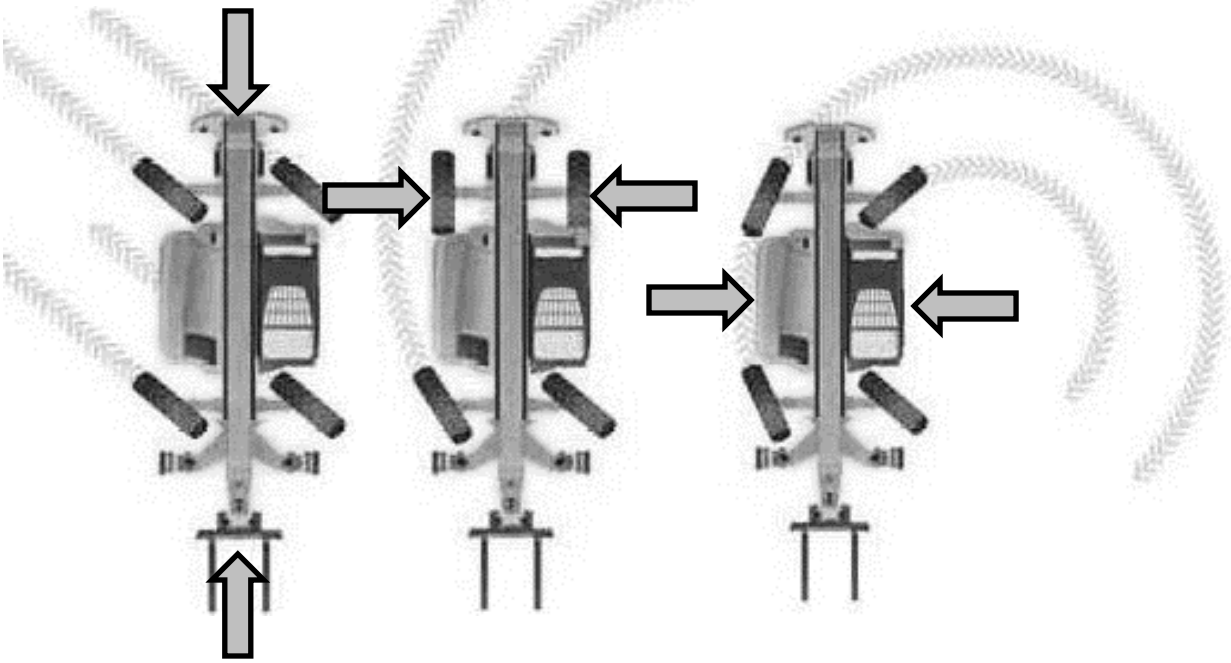
Lift trucks that has either all wheel steer or articulating steering uses a much smaller turning radius that allows the operator to turn within tighter corners and is often used on uneven ground where traction is limited. Some lift trucks can turn in a zero-radius circle.

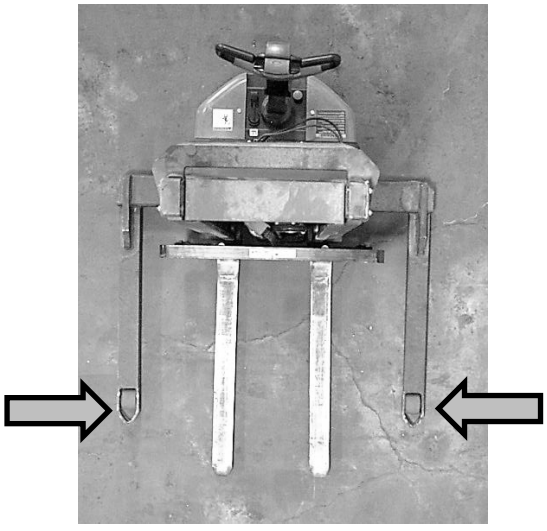
Crab steering is used to turn all wheels in the same direction, which allows for lateral movement with no change to the longitudinal alignment of the machine. For equipment that uses crab-style steering, it's the centre at the front and rear of the vehicle that acts as the pivot points.

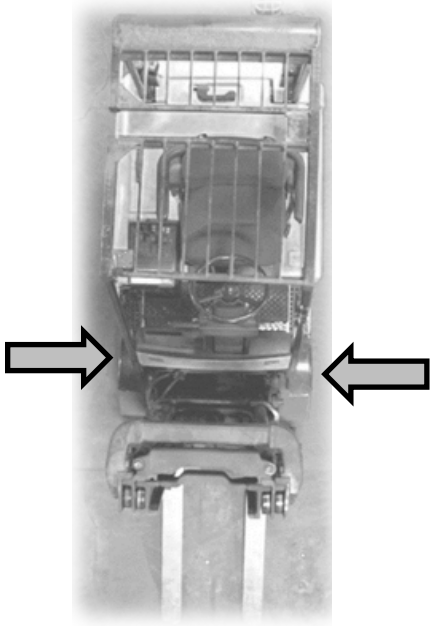
Because lift trucks are intended to lift and carry load at the front end of the equipment, manufacturers design the lift truck with a steering mode that does not include the use of the front wheels for steering. Lift truck manufacturers avoid putting the heavy load over the steering axle to avoid damage that could occur to the steering mechanisms caused by the heavy load the lift truck is carrying. For this reason, lift trucks intended to lift and carry heavy load over the front wheels typically have rear wheel or articulating steering modes.

If we look at on overhead view of several pieces of lift trucks, we can see the location of the wheels in relation to the pivot points the machine uses to turn a corner with. The operator needs to understand the lift truck's turning dynamics and pivot points and be constantly aware of these things to avoid striking something.

Pivot points







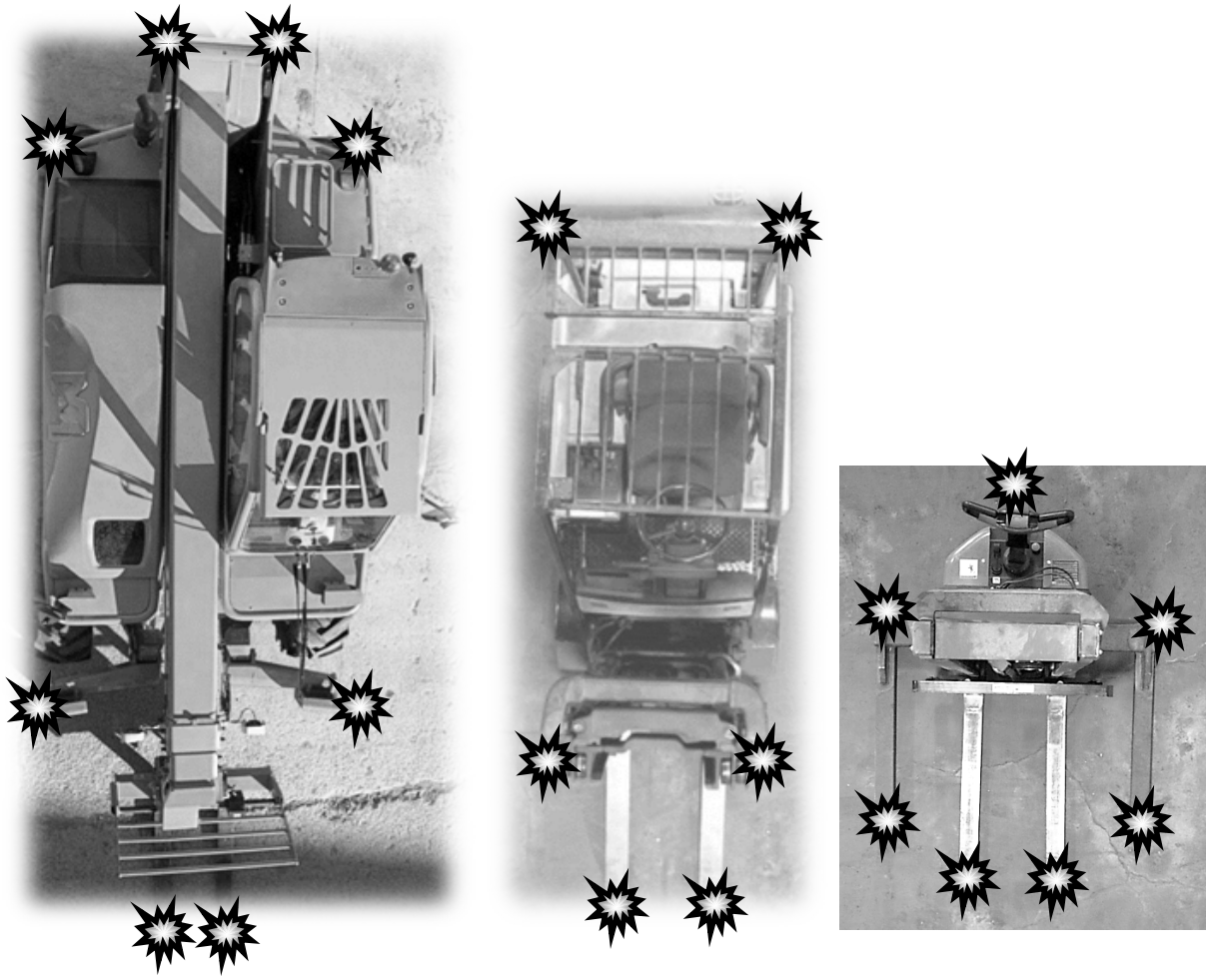
Strike Points

Whether the lift truck is of the smallest size, or the largest size, they are all capable of causing damage to property or injury and even death to workers if not operated safely. One of the primary issues an operator should keep in mind to avoid causing damage or injury is to know where the lift truck is most likely to strike something. Incidents usually involve driving forward or backwards and striking something it shouldn't.

Due to the various steering modes of lift trucks, the most likely area the equipment will strike an object or person is in the forward most right and left corners of the attachment as well as the rear right and left sides of the counterweight.

The following images show the primary strike points of various lift trucks.

Strike points



Stability Shape

Powered Mobile Equipment (PME) manufactured to lift and/or carry load are designed to be stable while performing the duties the PME was intended to perform, if the PME is operated within the range and scope intended by the manufacturer.

Ironically, even though lift trucks are designed to lift and carry loads under various conditions, Equipment is most stable while it is stopped, sitting level in a neutral position, with its load placed low to the ground close to the machine. Therefore, the stability of the machine will be affected by the forces placed upon the machine while it's performing its duties.

Every operator needs to understand the principles of force, the types of forces, and the affects these forces have upon the stability of the machine they're operating. Otherwise, the effects could be quite hazardous to the machine and its operator. To do this, the operator needs to know the safe operating parameters in which the PME can operate.

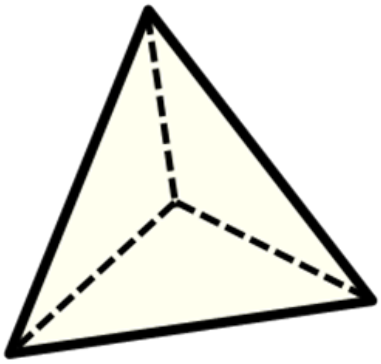
As shown earlier, the operator is typically stationed to operate their equipment near the middle of the machine and as a result, would sit centralized within the stability shape of their equipment. The operator needs to determine what type of stability shape the lift truck operates under and where the centre of gravity lies within that shape.

To do this, we first need to identify the points of contact the machine has with the ground. Most powered equipment has at least four direct points of contact with the ground, while other equipment has three wheels connecting with the ground. These points of contact with the ground could be through the machine's wheels, or out-riggers.

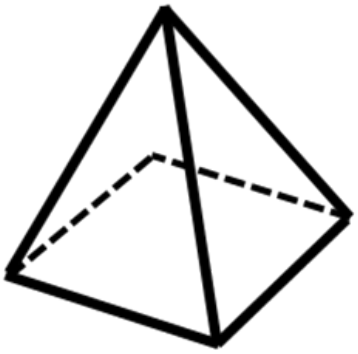
The bottom dead-centre of the wheels is where we determine the actual contact to be made. These points outline what we use to determine the centre of the machine, for which the centre of gravity needs to remain within or risk roll-over.

Where there are double load bearing wheels, the centre of the load wheels is determined to be where the ground contact is concentrated; this is also the pivot point.

If the machine has three points of contact with the ground plus a point located near the top of the load at maximum height, we're looking at the shape of a tetrahedron. However, if the machine has four points of contact with the ground plus a point located near the top of the load at maximum height, we're essentially looking at the shape of a pyramid.



Stability Tetrahedron



Stability Pyramid

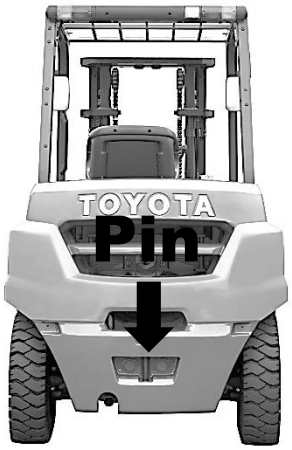
The top point with a lift truck is where the centre of mass of the load is expected to be while at maximum height. For example, the top point on a lift truck is 24 inches above the forks while at maximum height.

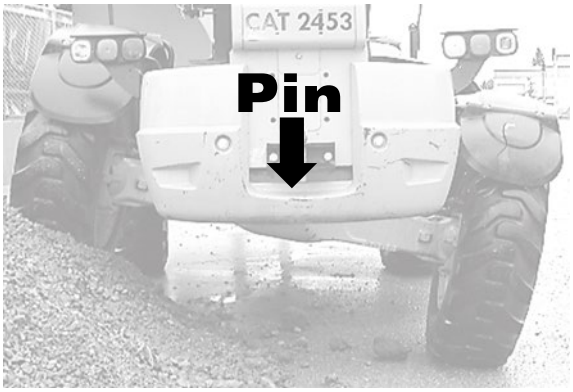
The basic rule is; if there are three points that contact the ground, we're looking at a tetrahedron stability shape, and if we're looking at a lift truck that has four points of contact with the ground, we're looking at a pyramid stability shape.

Where the lift truck is equipped with an oscillating axle, the oscillating point is the point at which all the weight is concentrated. Therefore, when we determine how many "true" points are made with the ground, we calculate 3 points rather than 4.

Most counterbalance and variable-reach lift trucks have their rear axle connected to the frame on a centre pin.

To determine whether the specific lift trucks is truly under the stability shape of a tetrahedron or a pyramid, one will need to determine whether one of the axles oscillates or not. Due to an oscillating axle, we calculate using only three points of contact with the ground.

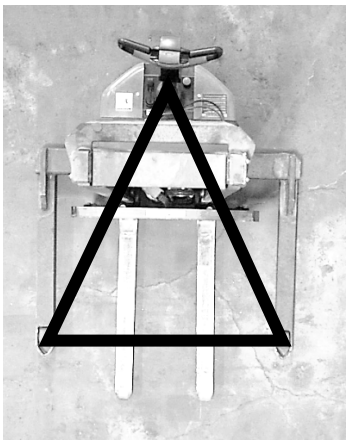


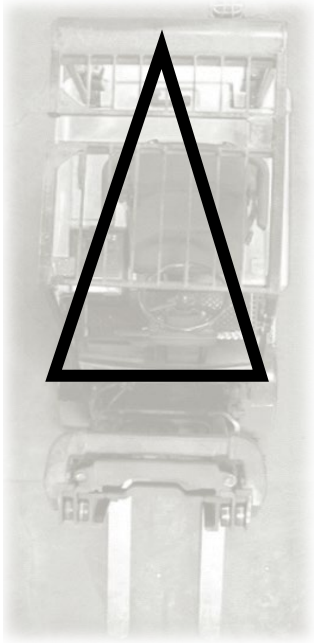


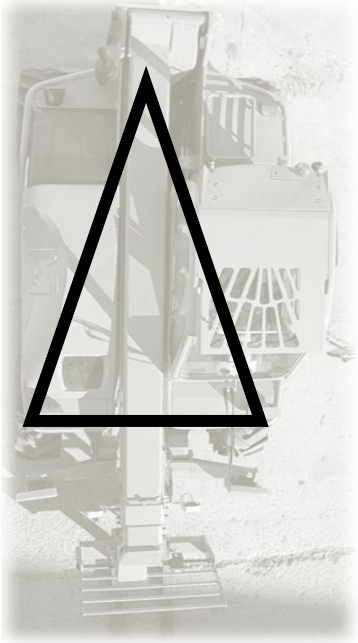
Stability Triangle

These three points of contact connect to create the shape of a triangle. The triangle is measured from the bottom dead centre of the ground contact. The points that connect the front wheels are much broader than the single narrow point on the rear axle of the lift truck.

This concept is illustrated in the images below.







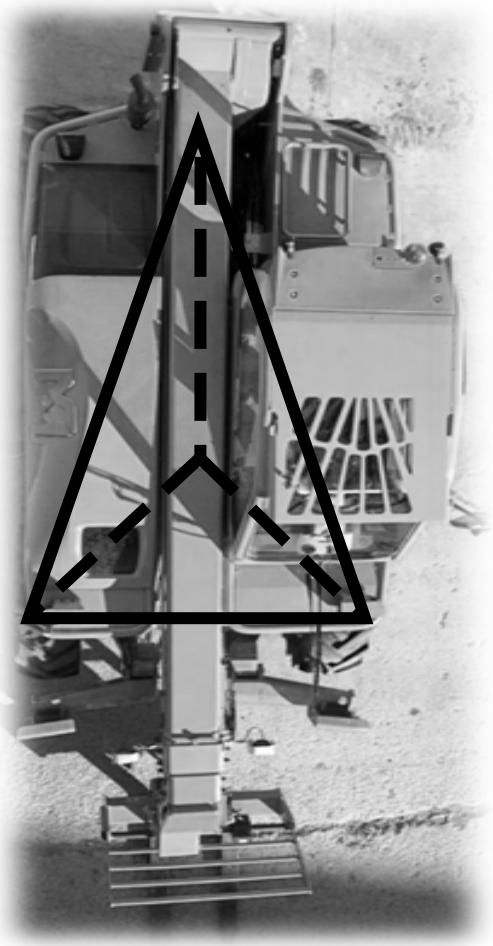
Combining the strength and breadth of the front axle makes the machine more stable in the front than the rear. The front axle will pivot on a fulcrum forward and back much easier than it will side to side. Because the rear axle oscillates on a single large pin, the rear axle is less stable than the front axle.

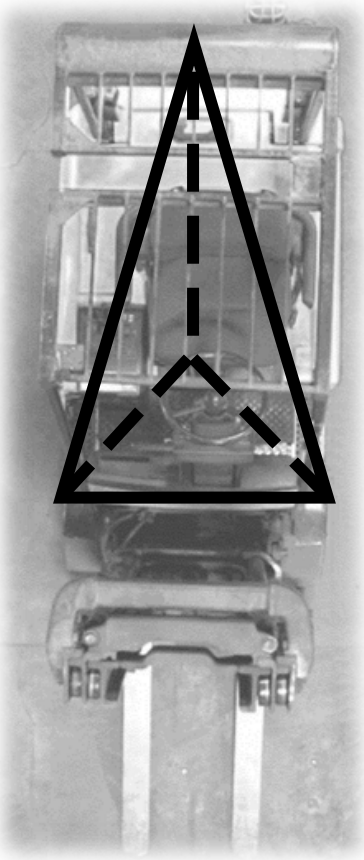
Stability Tetrahedron

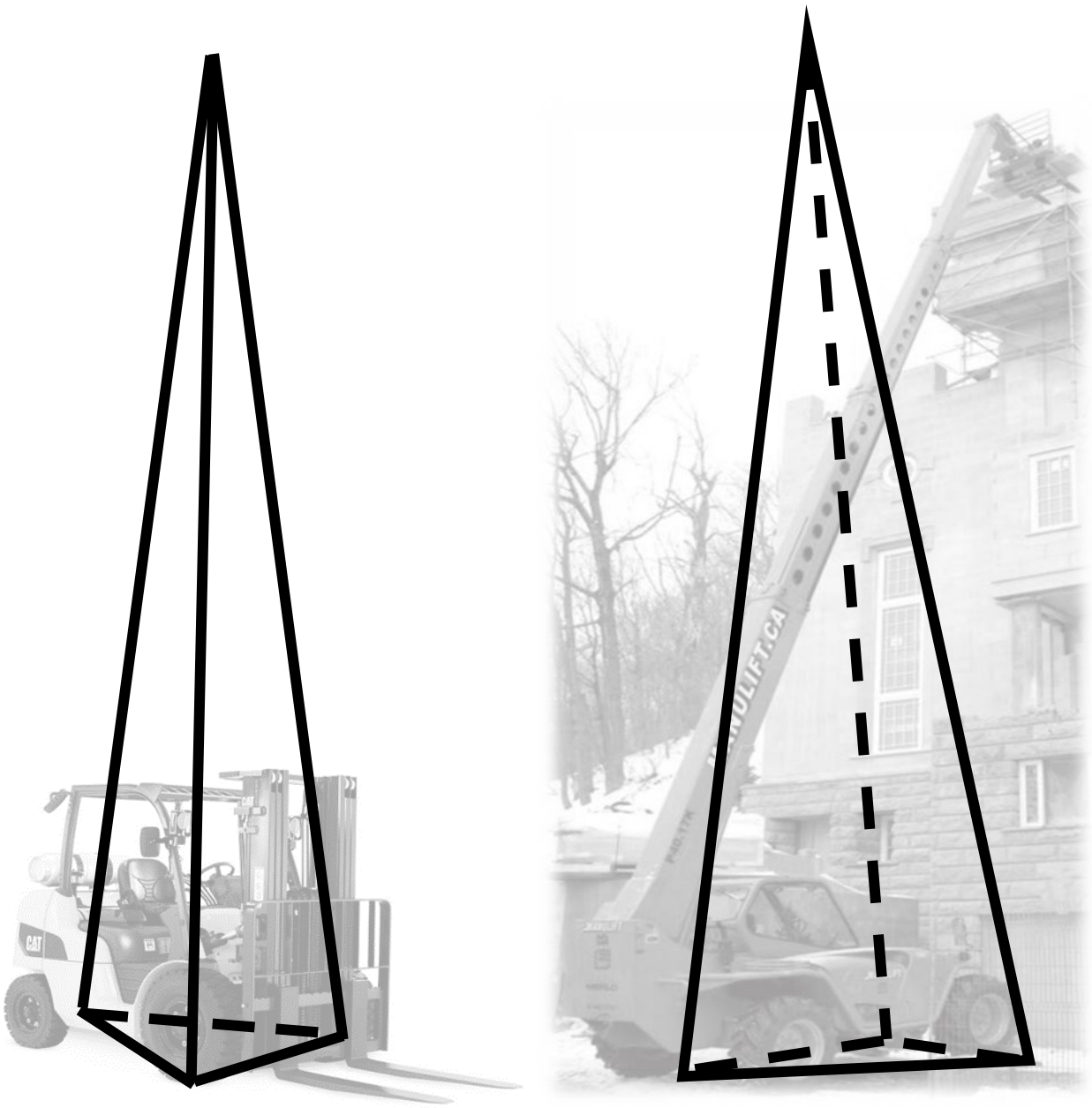
Now that we understand the stability triangle, we need to remember the fact that some lift trucks are intended to lift their load. Therefore, we need to consider the lifting height of the lift truck and how height influences the stability of the lift truck.

To do this, we need to determine the maximum height the centre of gravity of the load may elevate to, and then intersect that height with the centre of the lift truck thus determining the top-centre point of the lift truck. Next, we connect the point at top centre of the machine with the points that outline the stability triangle.

This will create a shape we refer to as the “Stability Tetrahedron”. This concept is illustrated in the following images.



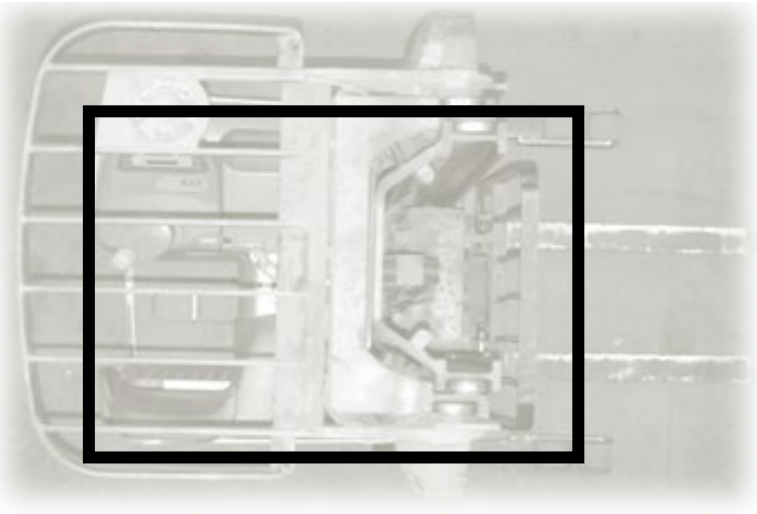




Stability Rectangle

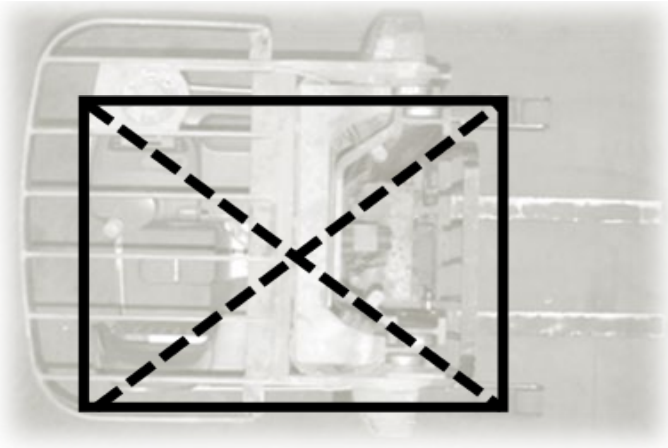
Unlike other lift trucks that have an oscillating axle, there are many styles of lift trucks that do not. Examples include narrow aisle or class 2 lift trucks.

The bottom dead-centre of the four wheels is where we determine true contact to be made with the ground. These four points of contact connect to create the shape of a rectangle.



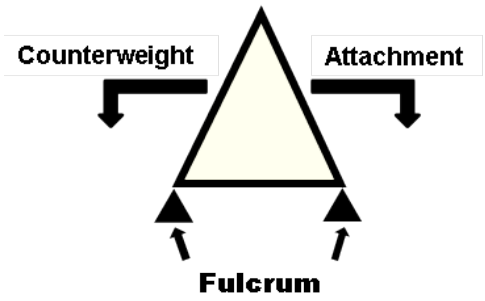
Stability Pyramid

As we did with the stability tetrahedron, we need to determine the maximum height the centre of gravity of the load may elevate to, and then intersect that height with the centre of the machine determining the top-centre point of the machine. Next, we connect the point at top centre of the loader with the points that outline the stability rectangle. This will create a shape we refer to as the “Stability Pyramid”.

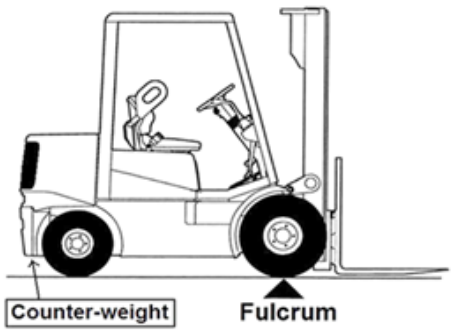


Fulcrum

Lifting loads with a lift truck utilizes the theory of balancing a weight over a fulcrum. The forward fulcrum on lift trucks with load runs through the centre of the front plane of the lift truck's stability shape. The other fulcrums are represented on the other planes of the stability shapes.



An example of the fulcrum is a "see-saw" or the "teeter-totter" effect. If too much weight is on the front of the lift trucks attachment, the lift truck can tip forward. Or, if the machine approaches an incline with the center of gravity facing downslope, the machine becomes unstable To counteract this problem, lift truck designers add a counterweight at the rear of the lift truck. The following image illustrates a side view of the front and rear fulcrums for both the shape of the tetrahedron and the pyramid.



Stabilizers / Outriggers

Although we talk about the support each independent axle provides to the machine, we need to look at the lift truck as a complete unit on a solid supporting frame.

Variable reach lift trucks quite often use stabilizers, otherwise known as outriggers. Outriggers play an important function to keep your lift truck stable. Outriggers permit the variable reach lift truck to increase the load capacity by moving the fulcrum further on a longitudinal axis, and sometimes depending on the design of the outriggers, may also provide a wider lateral axis.

When outriggers are used, the fulcrum shifts from the front wheels to the centre of the outriggers. When raising loads, it is always best that you use your stabilizers to increase the stability of your machine. It is not always required for use unless the load chart says to but will keep the machine more stable especially on rough terrain.

Out riggers/Stabilizers

Center of Gravity of Machine

All lift trucks have a centre of gravity. Once the centre of the machine is located, we need determine where the equipment's centre of gravity lays within its stability shape. Remember, the closer the centre of gravity lies to the centre of the lift truck, the more the lift truck becomes stable. Conversely, the further the centre of gravity gets away from centre of the lift truck, the less stable it becomes.

Operators need to pay special attention to the center of gravity on their lift truck. The center of gravity can shift outside the stability tetrahedron causing instability.

Looking at the stability tetrahedron, we can see that the centre of gravity falls well inside of it. Because the center of gravity (depicted by the solid circle) lies within the stability tetrahedron, the machine remains within its range of stability.

All lift trucks have a Centre of Gravity located somewhere within the lift truck's stability shape. Consider these "balance points" or "fulcrums" to be the outside of the lift truck's stability shape". Operators need to pay special attention to the center of gravity on their

lift trucks because it can shift outside the stability shape causing instability and possible roll-over.

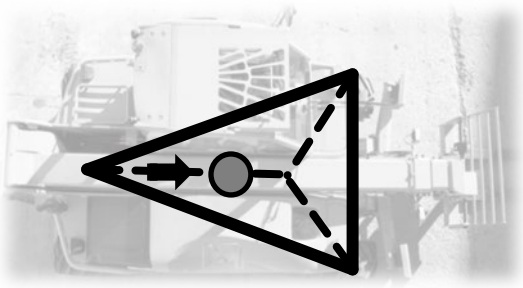
Lift trucks are stable, if operated as intended by the manufacturer. PME is most stable while stopped, level, with load low to the ground and close to the equipment. It is under these conditions that maximum capacity can be attained.

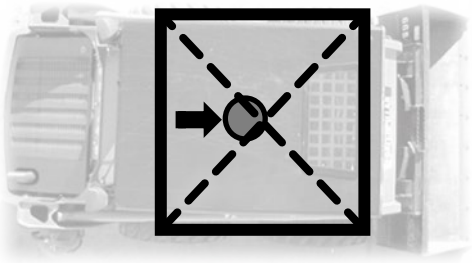
For machines intended to lift and carry load, the purpose of a counterweight is to offset the potential load to be carried. The counterweight is designed to offset the maximum capacity of the machine lifting the load.

The operator needs to keep in mind that although the load may come and go, the counterweight is always with the lift truck. As such, the centre of gravity will change as the machine loads and unloads. On level ground, 70% of the machines centre of gravity sits over the rear fulcrum due to the counterweight. Whereas, when the lift truck is with load at its maximum capacity, 70% of the weight ends up over the forward fulcrum of the lift truck. If the lift truck were to ever become loaded beyond capacity, the likelihood of the lift truck tipping forward increases.

As a load is placed on the attachment, the lift truck's centre of gravity shifts towards the front fulcrum of the lift truck. This will occur because most of the weight is now in the front of the machine. The heavier the load carried, or the further the load extends, the more the centre of gravity will shift toward the fulcrum. If the load exceeds the capacity of the lift truck, the center of gravity will shift beyond the fulcrum and tip it forward.

The following images illustrate how the centre of gravity sits while load is placed on the attachment.





As a load is lifted, the center of gravity moves up along the pyramid where the pyramid becomes narrower. It can be clearly seen that the higher the load is lifted the less room you have within the stability shape. If the center of gravity falls outside the pyramid the equipment will become unstable and risk tipping over.

The following images illustrate where the centre of gravity sits while the machine is stationary and at height.

Static vs. Dynamic Stability

Stability is defined as the ability to maintain equilibrium. Operators should know how the center of gravity of the lift truck with and without load, as well as how an incline or slope of the surface expected to operate on influence the lift truck they're operating.

Newton's law states, "Every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it".

Now that we understand the principles of stability, we need to consider the effect of motion on the lift truck's stability. When an object is ***stationary*** (not moving), it is said to be in a state of **static equilibrium.**

When an object is in *motion* it is said to be **dynamic,** or constantly changing its stability. It is important to understand the difference between the two because it greatly influences the stability of the lift truck while in use.

The easiest way to look at these forces is to consider the pendulum effect of objects in motion. Consider a pendulum hanging inside the stability shape, if we were to accelerate the lift truck (in a forward direction) what do you think would happen to the center of gravity? Initially the pendulum ball would stay static relative to the ground, however, as the lift truck moves forward, which in turn (relative to the lift truck) would move the pendulum ball towards the rear point of lift truck's stability shape. Theoretically it is possible to move the pendulum ball past this point resulting in lift truck tip-over. Fortunately, Lift truck design restricts this from happening.

For example, if we looked at a motorcycle the same theory would apply. If a motorcyclist accelerates too fast, it would flip backwards injuring the operator. The opposite effect happens when you stop or slow down too quickly, the pendulum swings forward towards the forward fulcrum. If lift trucks were to stop too fast while loaded, the pendulum could swing beyond the fulcrum and cause the lift truck to tip forward, most likely dumping the load and injuring the operator.

Lateral and Longitudinal Stability

Lateral Stability involves stability from the side to side plane of the lift truck.

Maximum stability is achieved if the lift truck is level. If stabilizers are available, use them to keep the inclinometer in the level position. You should never drive with a load raised across a slope or grade; there is a high chance that the lift truck could lose lateral stability. If stabilizers are not available, consider repositioning your machine to more level ground. It is important to check tire pressures to avoid upsetting the lateral stability of the machine. Remember it is easier to become laterally unstable because of the narrower points of contact with the ground.

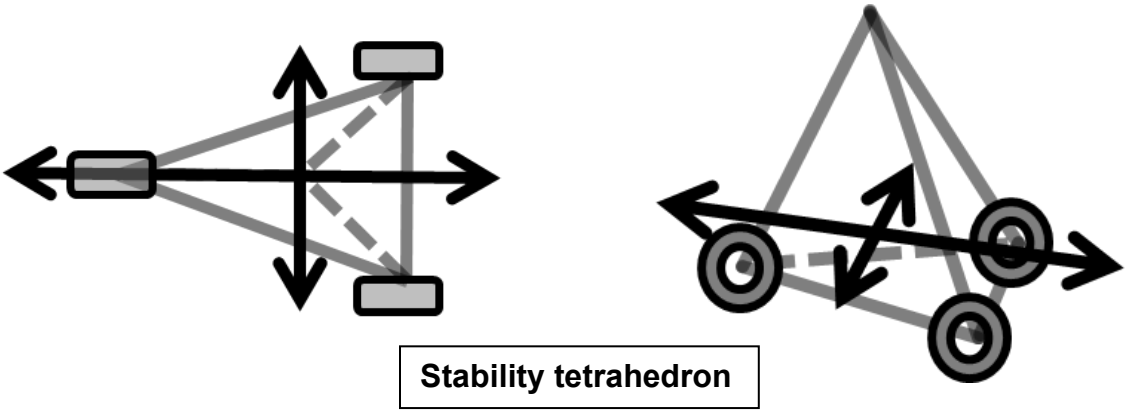
Longitudinal Stability involves stability from the front-to-back plane of your lift truck. It is always best to keep the machine perpendicular to a building to keep it longitudinally stable.

Operators should remember, if the machines lateral plane is shorter than its longitudinal plane, it will be less stable side to side. The same is true if your lift truck has a shorter longitudinal plane, it will be less stable end-to-end. Stability will be highest while under load.

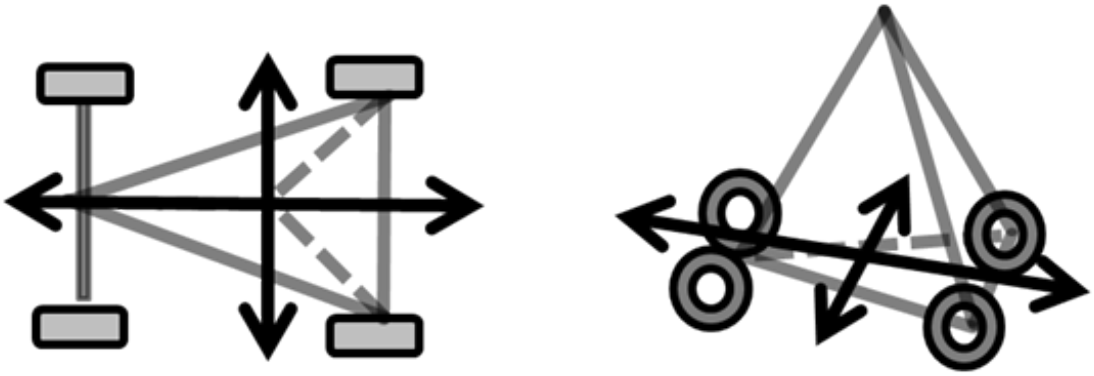
For lift trucks with the stability shape of a tetrahedron the operator should realize that lateral stability decreases without load, especially at height due to the narrow points at the rear of the tetrahedron. Lift trucks with the stability shape of a pyramid is more stable at the rear than the rear of lift trucks using the tetrahedron.

The following illustrate both the lateral and longitudinal axis from the top and side view of the machine's stability shape.

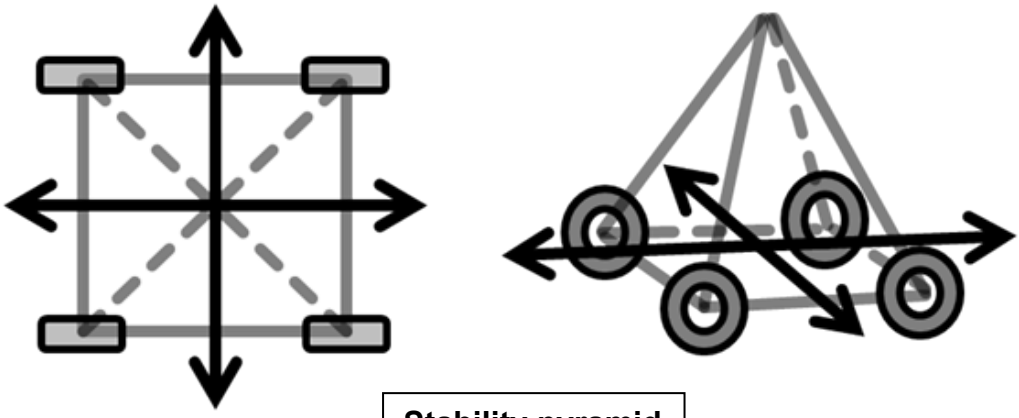
Top view **3 dimensional views**



Stability tetrahedron



Stability tetrahedron



Stability pyramid

Factors effecting Stability

Understanding the principles of stability allow operators to understand the factors that can influence the lift truck's stability. No matter where the lift truck is operating, there will always be a variety of forces acting against the stability of it.

Factors to consider while operating the lift truck include the effect of leverage with and without load, centrifugal and centripetal force while cornering, wind force upon the machine and its load, as well as the terrain the lift truck operates on.

Lift trucks designed to work in a variety of conditions including rough, uneven and sloping terrain which will subject the equipment to forces affecting both the longitudinal and lateral stability of the machine. Understanding longitudinal and lateral stabilities of your lift truck is especially important when operating on slopes and inclines.

Leverage

Operators need to consider the effect of leverage upon their lift truck while lifting and carrying loads. The lift truck's stability shape will indicate that if the lift truck is without load, its centre of gravity will be located towards the back of the lift truck, or rear fulcrum. Once load has been placed upon the lifting attachments, the force of leverage will drive the centre of gravity from the rear fulcrum of the lift truck towards the front fulcrum. This is further compounded when the load is elevated.

Operators need to remain aware of the leverage effect while operating; the consequences of a roll-over could be disastrous. As the centre of gravity shifts forward upon the fulcrum, the machine will tip over frontwards. To prevent this from happening, lift truck manufacturers restrict the lift truck's operating capacity to be less than the machine's tipping capacity.

Maximum Reach

For equipment designed to lift and carry loads, a counterweight is added to offset the potential load to be carried. The counterweight is designed to offset a load at the maximum capacity as designed by the equipment's engineers.

The operator needs to keep in mind that although the load may come and go, the counterweight is always with the machine. As such, the centre of gravity will change as the load comes and goes. With the attachment of the counterweight and while the machine is without load, approximately 70% of the total weight is over the rear axle.

Whereas, when the machine is with load at its maximum capacity, 70% of the weight ends up over the front axle. If the machine were to ever become loaded beyond capacity, the likelihood of the machine tipping forward increases.

When the attachment is raised to a position level with the horizon and extended to its maximum distance from the machine, the attachment will be at its furthest point away

from the nearest fulcrum, or balance point; this point is known as the maximum reach. It only makes sense that this will be the most dangerous place to hold a load.

Operators should always travel with the load as close to the machine and as close to the ground as possible while still being able to clear any ground obstructions.

The following images show examples of lift trucks at maximum reach with load.

Centrifugal Force

Centrifugal force occurs when mass is fleeing from the inside towards the outside; it is caused by inertia. Centrifugal force is applied to the mass sitting above the lift truck's centre gravity.

Centrifugal force occurs when a lift truck in motion turns a corner. The effects of speed, acceleration, sharp cornering, height, attachment, grade or ramps and load security all combine to affect the lateral stability of the lift truck.

Realize what happens to the pendulum if the lift truck turns too fast. Due to the principle of centrifugal force the pendulum would swing to the outside and could possible tip the lift truck on its side.

Centripetal Force

Centripetal force is the equal and opposite of centrifugal force. This is a force that moves towards the centre. Centripetal force is applied to the mass sitting below the lift truck's centre of gravity. Like centrifugal force, centripetal force occurs when lift trucks are turning a corner. Deceleration contributes to the effect of centripetal force.

Wind

Wind force is applied to both the lift truck and its load. It is important to take wind load into account when performing your hazard assessment. Sudden wind gusts applied against the machine and its load can be enough to cause tip-over. The effect of wind is compounded by having the load at height giving it the effect of a wind sail. It can be especially disastrous if workers are elevated in a work platform. Always refer to the operator's manual to determine safe operating conditions due to wind load.

Slopes and Inclines

The operating terrain should always be considered while operating your equipment. Should the operator need to climb or descend a slope or incline of any significance, they should know how combined forces affect the stability of the machine. Knowing where the centre of gravity sits within the lift truck's area of stability is the key to knowing how slopes and inclines affect the lift truck's stability.

We learned earlier that lift trucks sitting under static forces without a load carry approximately 70% of its load near the rear fulcrum of the machine, and approximately 70% of the weight is over the front fulcrum when loaded.

Let's see what happens when we operate the lift truck on inclines and slopes.

Inclines

A lift truck operator faced with travelling up or down an incline without load should know that based on the principles of the stability shape, the force of leverage caused by the counterweight will drive the centre of gravity towards the rear fulcrum reducing the stability of the lift truck.

Remember, due to the narrow aspect of the rear fulcrum of the lift truck whose stability shape is that of the tetrahedron, that in addition to rear longitudinal stability being compromised, lateral stability is also compromised. However, with load the centre of gravity will sit closer to the front of the machine allowing for greater lateral stability.

The operator should also keep in mind that due to the limited amount of weight on the front axle, traction will also be reduced.

Inclines without load:

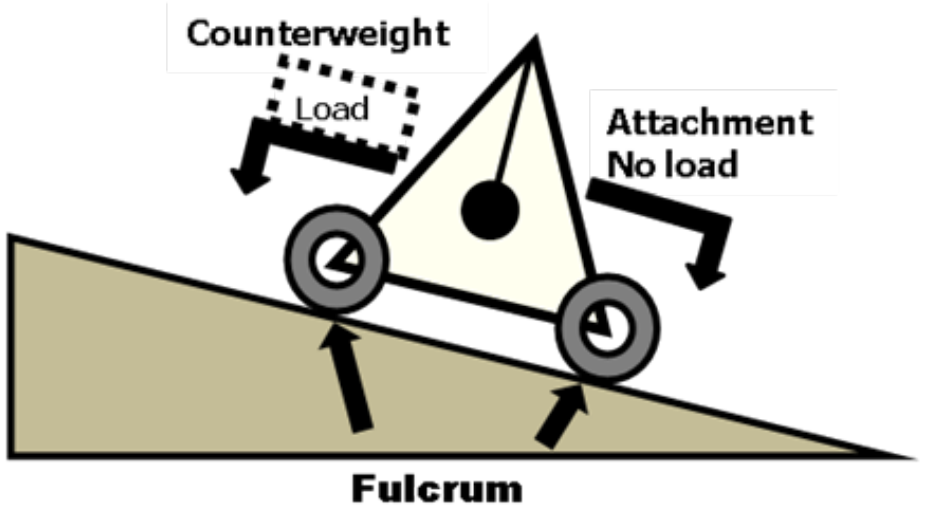
When an operator has no load, the operator should approach the incline with the empty attachment facing downhill, with the counterweight facing the up-hill side. This will drive the centre of gravity towards the centre of the machine increasing both stability and traction to climb and descend the hill.

For example, if lift truck without load is at the bottom of an incline and wants to travel uphill, he should do this in reverse. If, however, the lift truck operator is at the top of the hill, the operator should drive with the empty attachment facing downhill.

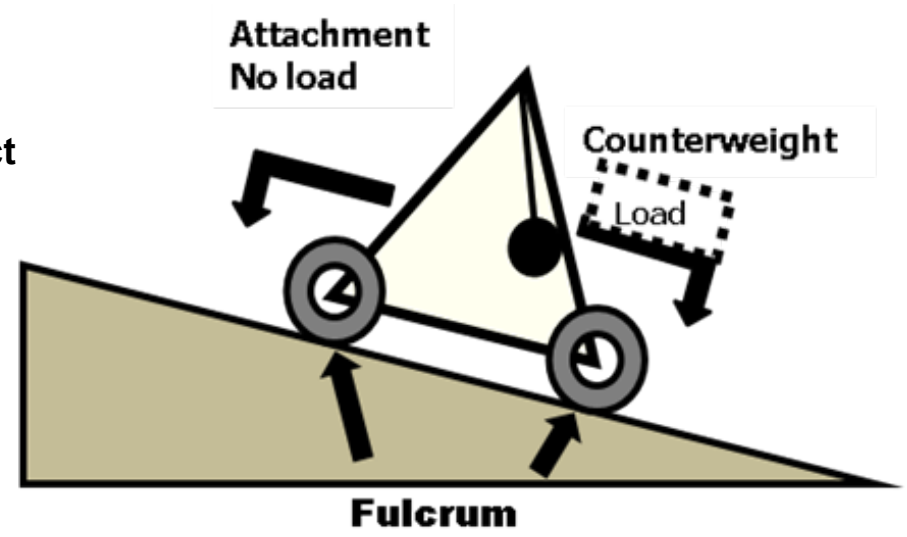
Having the empty attachment facing downhill could also prove beneficial should the equipment loses some control or traction. The attachment can be lowered to assist in braking and prevent sliding in an uncontrolled situation.

The following images illustrate both the correct and incorrect method of travelling on an incline.

Correct



Incorrect



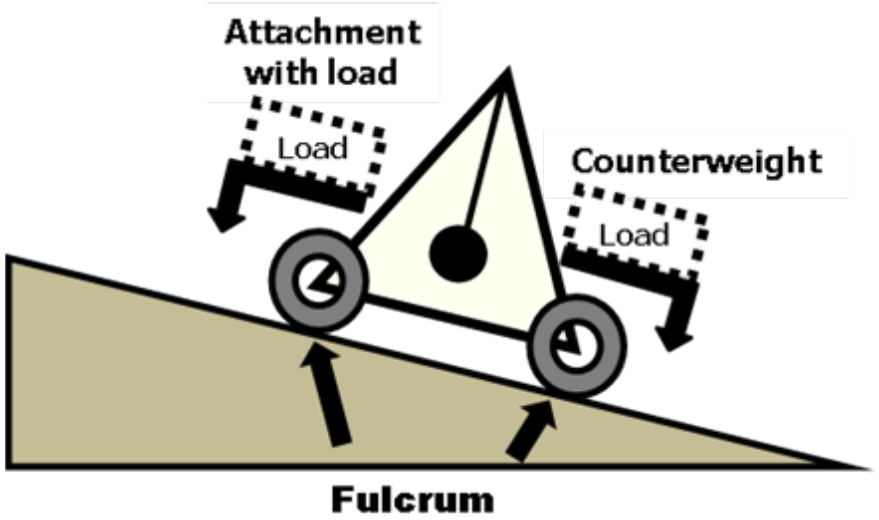
Inclines with load:

The opposite is true if the operator is facing an incline with a load. Again, because the centre of gravity shifts towards the front fulcrum of the lift truck with load, and using the knowledge of the stability shape, the lift truck operator should approach the incline with the loaded attachment facing uphill.

For example, if the operator needed to climb a hill, he should approach the incline with the loaded attachment facing uphill. But, if the operator needed to travel down the incline, he should do this in reverse with the loaded attachment still facing uphill.

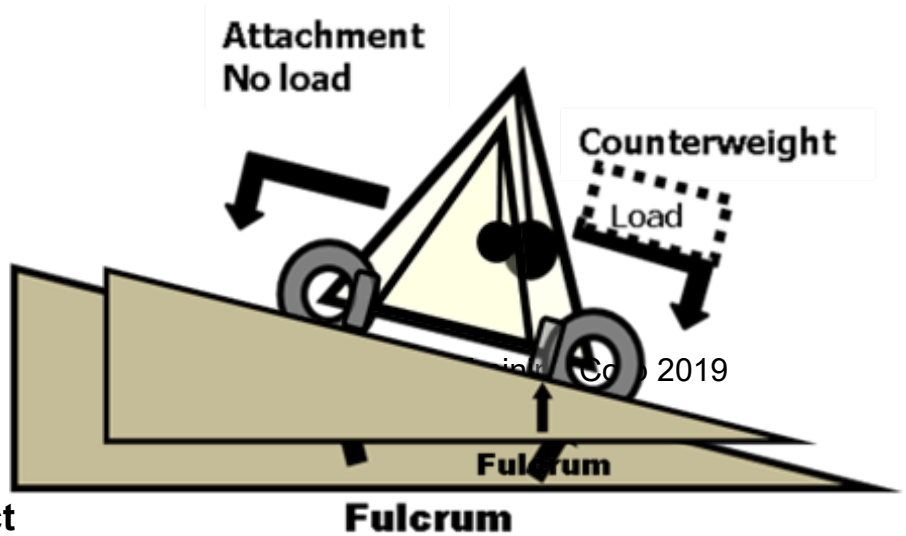
This is also important to keep the load secured. Facing downhill with a load not only increases the likelihood of the lift truck losing stability and traction, but the load is also likely to be lost while facing downhill, especially if braking.

Correct



Side Slopes

Slopes have a serious effect on the lateral stability of the lift truck. Due to the relatively narrow shape of the stability tetrahedron, degree of slope and height of load combined



Incorrect

will cause the lift truck to become unstable quickly. If you must travel on a side slope it is very important to keep the load as close to the ground as possible.

Further, due to the cross angle of the slope, the treads on the equipment tires may not provide as much traction as expected. If the equipment starts to slip sideways, turn the equipment down slope and lower the attachment.

Tips for operating on Inclines and Slopes

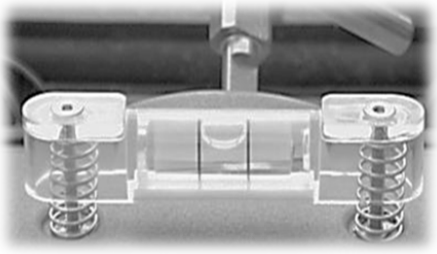
Unique consideration and precautions need to be taken when working on inclines and slopes Always refer to the operator's manual for maximum slide slope operation Try to avoid working on inclines and side slopes.

If this cannot be avoided:

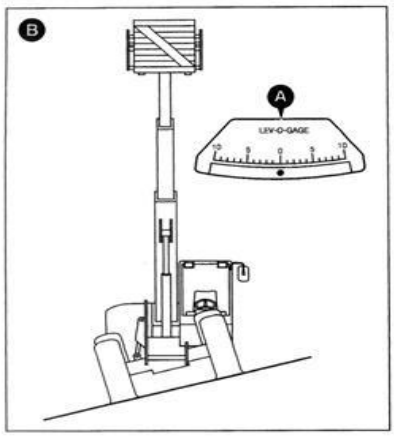
- Check out all slopes and inclines before beginning travel.
- Look for water, ice, snow, or other debris that makes travel hazardous.
- Always travel in the center portion of the slope or incline.
- Always keep the load low and level when traveling on any type of slope.
- Travel straight up or down and incline. Avoid crossing a slope.
- Never turn or raise loads on an Incline.
- When the load is raised, less movement will be necessary to turn the machine on its side. Never attempt to turn or travel with the attachment at height.
- Never raise a load if the lift truck is facing downhill. This will cause the back of the equipment to leave the ground easier and less weight is needed to create an out-of-balance condition.
- Avoid sudden or jerky moves when the load is raised on a slope or incline.
- Be ready to turn machine downhill and lower the attachment if machine begins to slide.

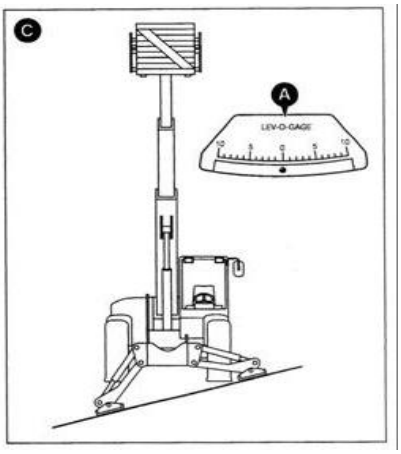
Inclinometer

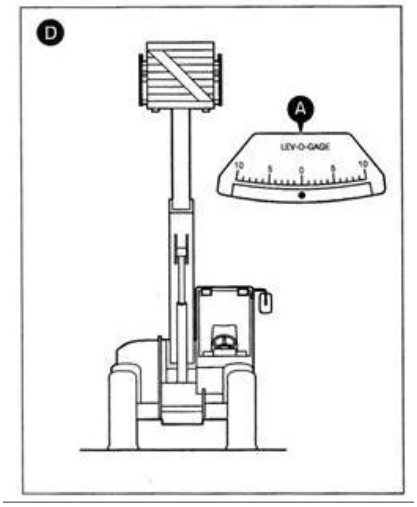
For Variable Reach Lift Trucks, there should be a gauge in the cab called an inclinometer. The inclinometer is used to show whether the lift truck is level on a slope.

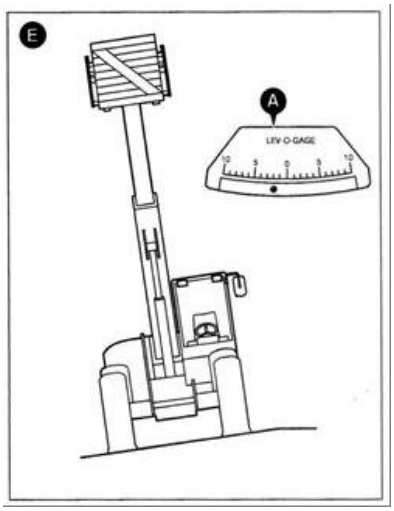


Diagrams B, C, D indicate the desirable positions that operators should place their machines in when lifting loads. The most hazardous position is shown in diagram E because the boom and the load are not level and there is a higher chance of losing lateral stability.







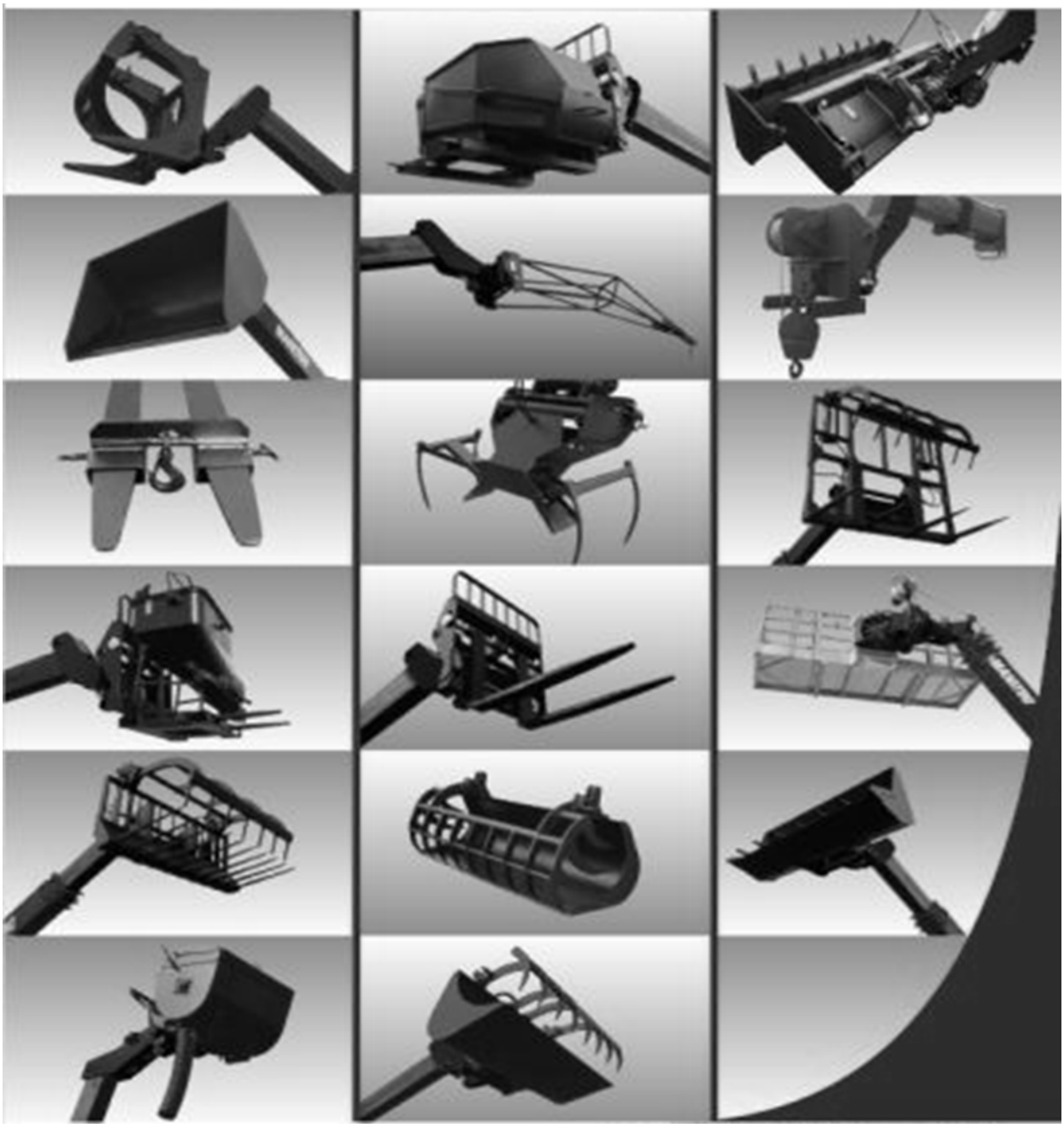


Material Handling

Equipment operators are responsible for themselves, their machine and the people around them. When handling various loads, it's easy to develop a narrow focus on the immediate job at hand. Think, then work! Think ahead so that you don't have to move loads twice or more. Work as a team, the equipment operator is very important to help others get their job done.

The Attachment

A lift truck usually comes with a standard set of four-foot forks. That's not to say that some lift trucks won't come with additional or non-standard attachments. For example, a VRLT may replace its standard forks for a different number of attachments including a bucket, jib crane, winch, and a man-lift.



It’s very important for operators to remember that a machines capacity is calculated using the centre of the standard attachment intended for the machine. When the machine uses a different attachment other than the one intended for the machine, the capacity of the machine will change too. Rarely is the capacity increased as the attachment changes, the capacity will either stay the same or be reduced.

Using the attachment for the wrong material can also change the machine’s capacity. For example, using a light materials bucket for heavy material.

There are other restrictors to the machine’s capacity other than the attachment; the lifting arms or mast may not support the weight of the attachment; the attachment could be significantly heavier than the original attachment. For example: using a barrel grapple, jib crane, carpet fork or fork extensions will cause the machine to have reduced capacity and when used, risk roll-over.

Other restrictors to a machine’s increased capacity may be due to the overhead protection structure, the machines carriage and frame, its tire, and motor strength. The protection structure is usually designed to withstand the machines maximum capacity falling from a specified height, the carriage assembly and frame may not be designed to support the extra load, or the motor may be underpowered to operate under increased capacity.

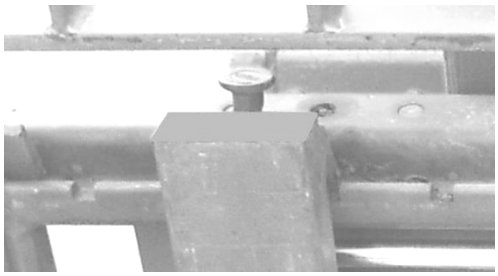
The operator should also be careful not to overload the attachment either. Increased attachment load will ultimately overload the machine carrying the attachment. As mentioned earlier, if the machine is used beyond the manufacturer’s rated capacity, the manufacturer may void any warranty leaving the operator and employer liable for anything that goes wrong while using the machine beyond the machines scope.

Finally, to keep the machine stable, it’s important to keep the attachment or load close to the ground while ensuring there is still enough clearance for the operating terrain. For smooth terrain, 4-6 inches from the lowest part of the attachment or load, 12-16 inches for rougher terrain.

Forks

Forks are the horizontal bars that suspend from the carriage that engage and support loads. Generally, forks are used in pairs, and are therefore required to have a rated capacity of at least ½ the manufactures rated capacity of the truck. This means that each fork is expected to be able to carry half of the expected weight of the load. This also takes into account the rated load centre distance shown on the lift truck's capacity plate.

Fork Locking Latch



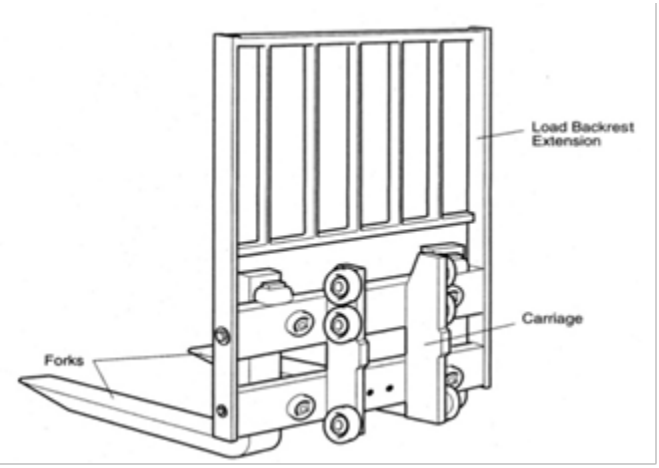
Locking latches are designed as a component of the forks to prevent movement from the set positions on the carriage. The locking latches can be of several different designs, often they are spring-loaded and require the operator to lift the latch or pin and slide the fork to the new locking position.

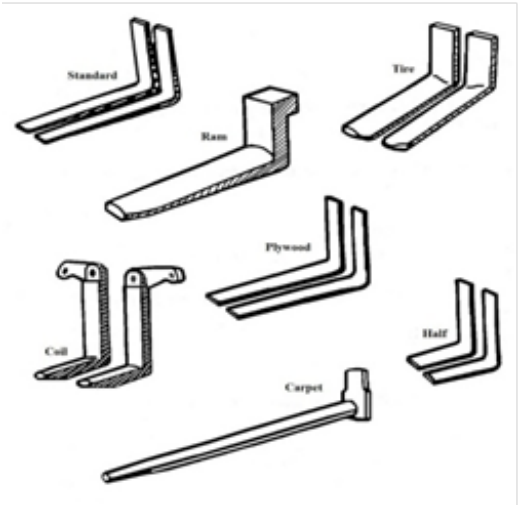
Carriage

Carriages are the support structure for the forks and other attachments. The rated capacity of the carriage depends on the loads and types of attachments used. The carriage provides the connection between the load carrying devices (Forks) and the lifting device (Mast or boom). The carriage is often mounted to the mast by chains, rollers, and stops that allow it to move vertically in the designed channels.

Backrest (Load)

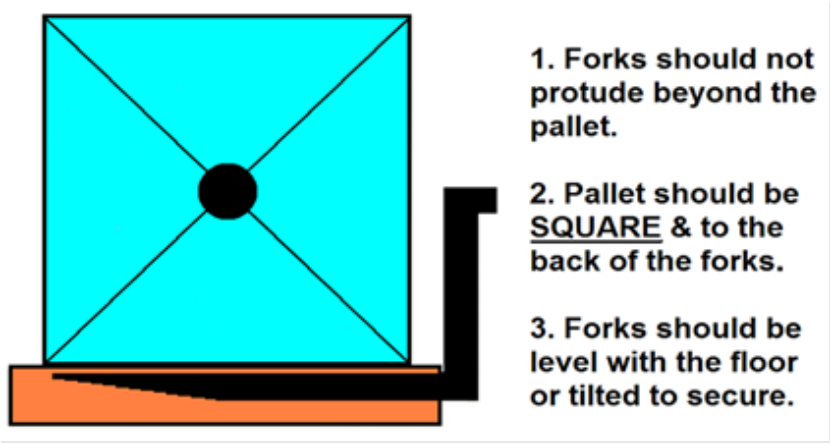
The backrest is an extension piece that is attached to the carriage to provide support for the loads being carried. Essentially the backrest stabilizes the load above the carriage.



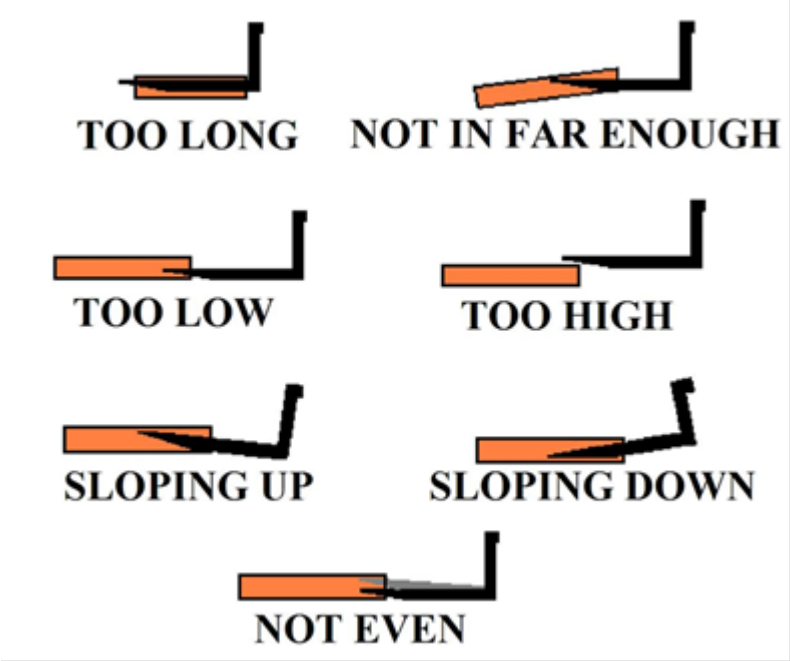


Fork Position

Ideally forks should be positioned so they are not protruding beyond the pallet, the pallet is square with the back of the forks, and the load is level with the floor or secured to the forklift. It is realized however, it is difficult to get the ideal fork position on all loads due to different sizes, weights, and lengths of loads.



In order to maintain the capacities of the forks it is important to position them properly. There are, however, some fork concerns that operators should be aware of. The diagram below demonstrates the different issues that can occur with fork placement.

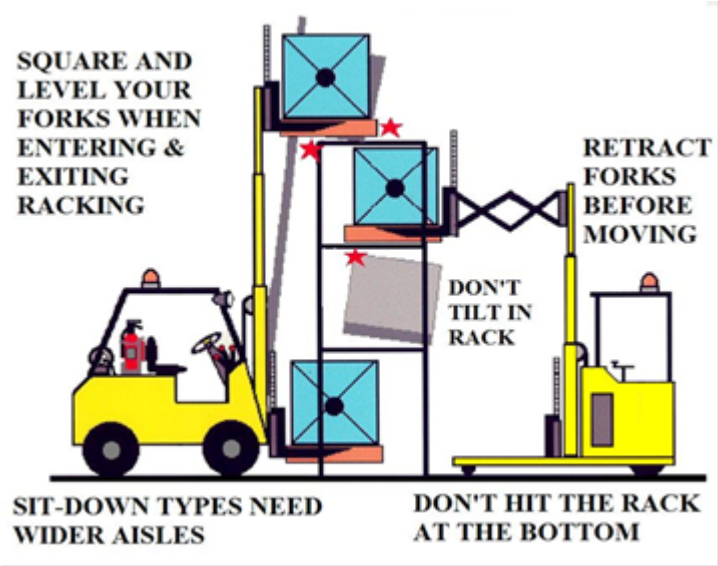


Loading Racks

Racks can pose a hazard to the forklift operator; it is important to take great care in moving loads in and out of racks. The clearances are small and in the event of damaging a rack the results could be catastrophic. The following is a list of how to load and unload from racks.

1. Your load should be square with your forks.
2. Reduce your speed, as you get closer to the empty rack.
3. Turn your forklift so that it is square with the rack. Make sure that your mast is in the vertical position. Keep in mind the rear swing of the forklift, watch for racks or obstacles behind you.
4. Raise the load a little higher than the empty rack. Watch the top clearance! Ensure the load will fit in the rack.
5. On the sit-down type of forklift, drive forward slowly making sure that you still have your clearance space. With the reach type of forklift, extend the load into the rack, again making sure that you still have clearance.
6. Lower the load until the pallet rests on the rack completely. Caution, watch for short pallets that don't reach both beams of the rack, you may need to re-pallet the load to a larger pallet.
7. Remove the forks by backing away or retracting the reach type.
8. Lower the forks and maneuver out of position.

For unloading do the reverse of the above. Keep in mind that racks should be designed and built for the intended capacities. Many racks need to be bolted to the floor and the locking pins should be in every rail to prevent unnecessary detachment.



Stacking

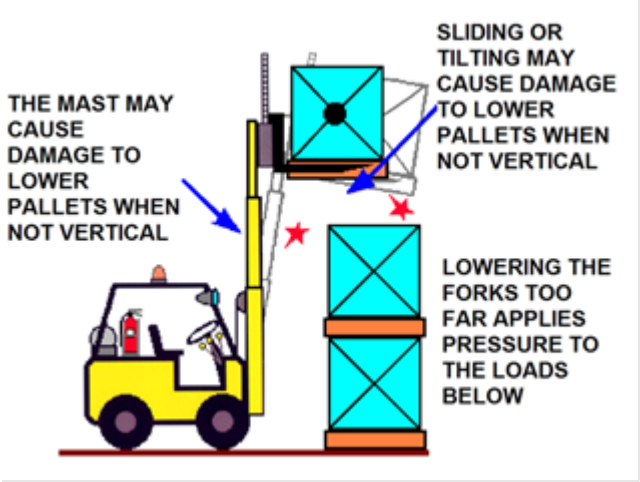
As an operator there are many hazards to be aware of when stacking loads. If you are stacking loads on top of one another the operator needs to be sure that the loads underneath can support the added load. The following is a list of steps on how to maneuver and stack a load safely.

1. Ensure that the bottom loads can support your new load.
2. Maneuver the forklift square and level with the other loads.
3. Raise the load up, about 10 – 15 cm (4-6 inches) above the stack. Watch for overhead obstacles such as ducts, pipes, wiring, and lights.
4. Move the load over the stack by driving forward or extending the reach.
5. Lower the load on the stack until the stack is supporting the weight of the load.
6. Retract or move the forks from beneath the load.
7. Lower the forks.
8. Maneuver away from the stack.

To remove a load from a stack, do the reverse of the above.

Most stacking errors are a result of the operator not being attentive. Some things to watch for include:

- Mast is not vertical, catching the top of the stack.
- Sliding or tilting causing damage to the lower loads.
- Lowering the forks too far causing pressure and damaging the loads below.
- The load is raised too high and hits overhead obstacles.
- Unintentionally hitting the bottom of the stack causing damage or causing the loads above to collapse.



Landing Zone

When choosing a landing zone to place your load, ensure that it is level, secure, and able to support the weight of the load being placed on it. It may be necessary to have a spotter at the landing zone to help place the load. Place the load square and centred on the landing zone otherwise you could apply forces to the landing zone that it is not intended to be subjected to.

The Load

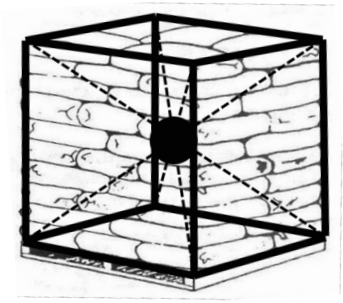
Ensure only stable loads are moved, otherwise a shifting load can fall damaging the product or injuring the operator. If the operator is expected to move hazardous materials, the employer should develop specific company procedures to ensure the safe handling of these loads and the operator should use extra caution.

Load Centre

Similar to what we learned regarding the centre of the lift truck and the centre of gravity of the lift truck. The load that the lift truck is intended to lift and carry also has a load centre and that loads centre of gravity. The load centre is the measured center of the load; it may not be the same as the load center of gravity.

A competent operator is one who knows the weight and dimensions of his load, but also where the centre of gravity lies for the load being carried. Without this knowledge, the operator faces carrying an unstable load or making the equipment unstable.

To calculate the centre of a load, simply draw intersecting lines from the furthest outside diameter of the load. The point at which the lines intersect is the centre of the load.



Load centre of gravity

The center of gravity of the load is the point at which the load mass is concentrated. It is usually located ½ ways between the horizontal and vertical lines of the load. However, some loads may have a centre of gravity that is off set from the centre of the load. The operator needs to distinguish the centre of the load from the centre of gravity of the load. The centre of gravity of the load should be centred in the machines lifting attachment.

Tipping Capacity of PME

The tipping capacity of a machine is the amount of load required to upset the machine. Tipping capacities are found in the operators manual specific to each machine.

Maximum Operating Capacity of lift trucks

As stated earlier, lift trucks have a maximum rated operating capacity of approximately 70% of the lift truck's tipping capacity. Capacity ratings are calculated using the attachment that came with the machine from the manufacturer. For lift trucks, standard forks are used. As mentioned earlier, if the machine changes attachments, the machine's capacity changes too. Tipping and operating capacities are listed in the operator's manual and should also be in a conspicuous location somewhere on the machine.

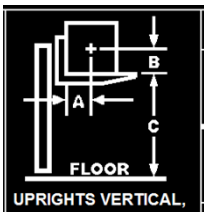
To achieve maximum capacity on lift trucks, the:

1. Vehicle must be **stopped with outriggers deployed**.
2. Vehicle and its load must be **level**.
3. Load must be **lowered** and **retracted.**

Capacity Plates

Laws require that every piece of equipment intended to lift load have a capacity plate permanently fixed to the machine. They typically show the following information.

A. Type / designation
B. Truck mass (weight)
C. Capacity rating at a given load centre
D. Maximum lifting height of attachments
E. The attachment type
F. Minimum / maximum battery mass (weight)



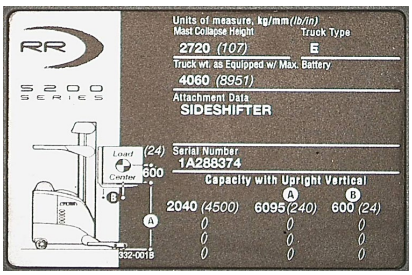
UPRIGHTS VERTICAL, LOAD CENTERED

Capacity	A	B	C	Attachments
2775 LBS	24 IN	24 IN	159 IN	W Hang-on SS
1525 LBS	24 IN	24 IN	189 IN	and Forks Only
1280 KG	600 MM	600 MM	4069 MM	55F-SSS-A015
700 KG	600 MM	600 MM	4810 MM	X X X X
Model #	H 99R - 04	Serial #	999-999-999-999	

The maximum weight capacity of this sit-down counterbalanced lift truck is 2775 LBS (1280 KG) with the load centre 24 inches (600 MM) from the “heel” of the forks.

Most pallets are four feet by four feet; therefore 24 inches should be considered the centre of the load. Notice that as you increase the height of the load the capacity decreases from 2775 LBS (1280 KG) to 1525 LBS (700 KG). This change in the capacity takes into account the stability of the lift truck.

Some lift trucks may or may not have a capacity that decreases with the height of the load. This lift truck can safely lift its maximum rated capacity at maximum height and reach. The sample plate below shows that the capacity of this lift truck is 4500 LBS (2040 KG) at a total height of 240 inches (6095 MM) with the load center being 24 inches (600 MM) from the heel of the forks.



Load Charts

Load charts are one of the most important pieces of information that operators need to understand when operating variable reach lift trucks.

Load charts are calculated by certified professional engineers based on the following factors:

- Weight of the load.
- Boom extension.
- Boom angle.
- Attachment type (Forks, bucket, jib crane, etc.).
- Stabilizer positions up or down.

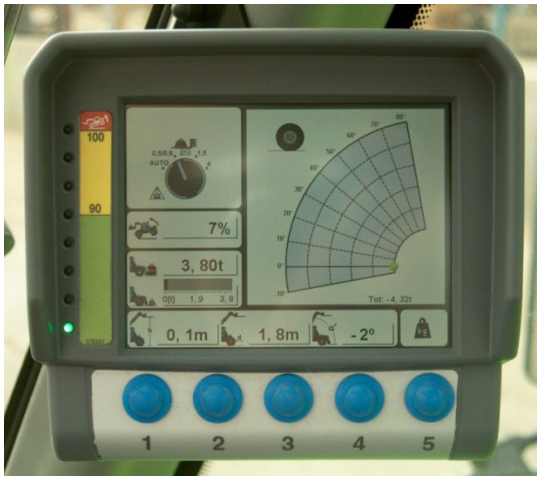
Boom Indicators

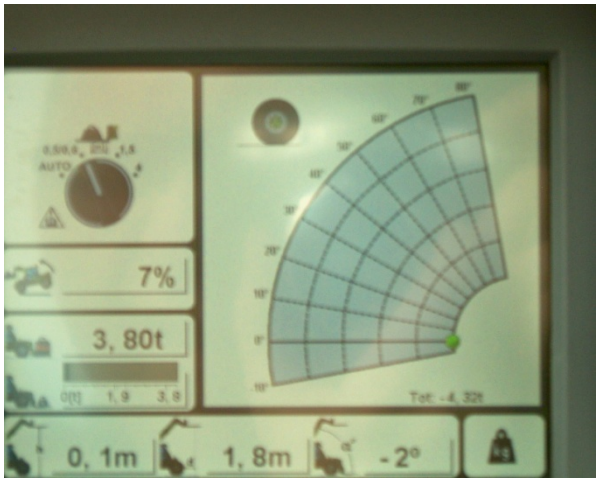
There are two boom indicators on a VRLT, the Boom Angle Indicator and Boom Extension Indicator. These indicators are designed to help show the position of the forks to determine load capacities on the load chart. Boom angle indicator shows the angle of the boom, the boom extension indicator is used to show how far the boom is extended and both are used in correlation with the load charts.

Boom Extension Indicator

Boom Angle Indicator

The following images are from a VRLT that provides the information found on load charts on an electronic “heads-up display” module. This will remove a lot of confusion operators may have reading their load charts. This particular machine is also eletrtonically weight governed, ensuring the operator canot bring the machine beyond its capacity.





Reading Load Charts:

When reading load charts, it is important to know that the limits on the charts are based on a stationary and level machine. Do not raise or extend the boom when the machine is moving. Load charts are typically based on 24” load centers from the surface and heel of the forks. Before lifting the load, the operator needs to know the weight of the load; the height of the landing zone and the distance from the machine’s wheels to the landing zone.

Caution: If your machine feels unstable when the boom is raised and extended, always retract the boom before lowering it!

To read the load chart you always select the coloured segment of the next highest weight. For example, if you have an 1800 lb. weight you move to the 2000 lb. segment. This would be the maximum load segment for your load.

You then look at the left-hand edge of the segment to show the stability limits for your load. Operators need to keep weights, angles, and extensions to the right of the maximum stability limits for that lift. Before you pick up any load it is important to check the load charts to see if they intersect inside your maximum load segment as shown on next page.

Chart A

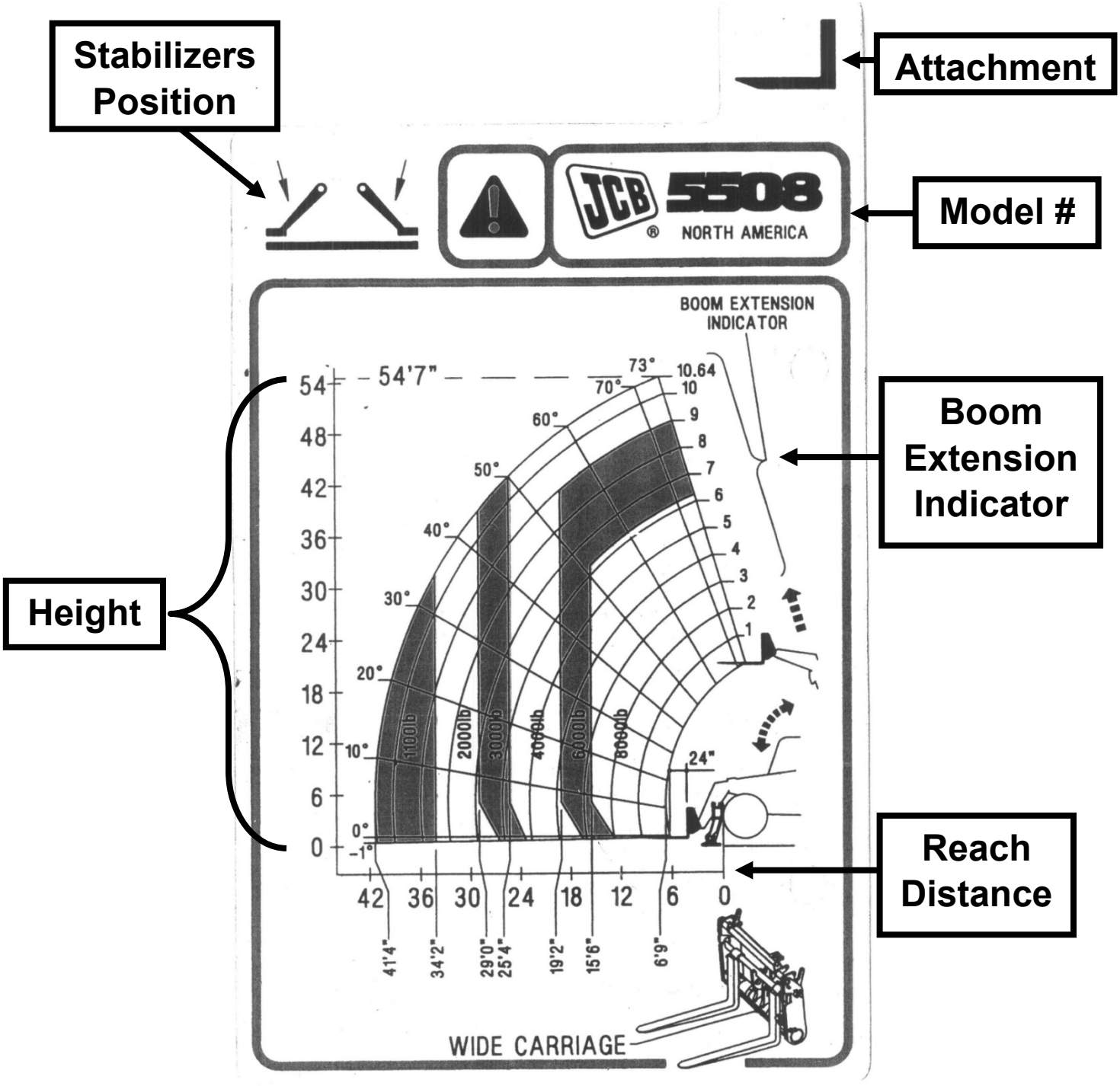
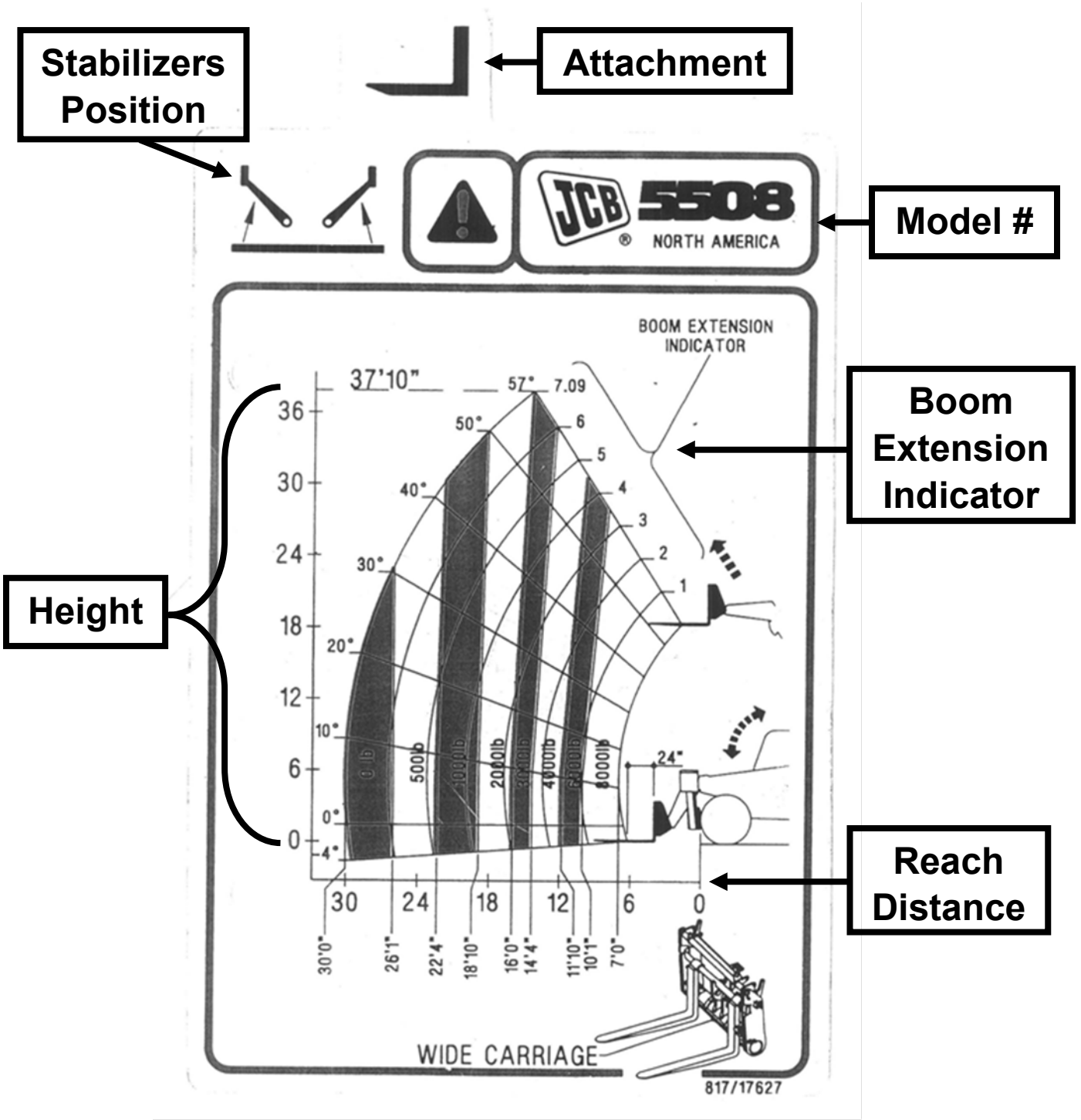


Chart B



Examples

Using the charts on the following pages, answer these sample questions.

You have been asked to lift a load weighing 5,500 lb. to the top of a roof that is 3 stories high (32 feet high). The closest you can get to the structure is 18 feet because they haven't filled in the foundation. Can you lift the load safely given these conditions? Do we need to use our stabilizers?

Answer: First we need to establish which load segment on the chart to look at. We are intending to lift a 5,500-lb. load; our load chart rules say we must look at the next highest segment (6,000 lb.). Next look at the bottom of the chart to see if we position our machine 18 feet away would we still be within the 6000-lb. segment. Then look at the height of our structure (32 feet); does the height and length lines intersect within our 6000 lb. or greater segment? The lines do intersect on the right side of the segment; therefore, we can lift our load safely. The angle of our boom would be approximately 50 degrees. To answer our second question, we would need to have our stabilizers down because we can't get close enough to the structure to lift the 5,500-lb. furnace according to chart B.

You have been asked to lift a pallet of "easy melts" weighing 2,500 lbs. to the top of a 3-story commercial complex (32 feet high). The closest you can get to the structure is 30 feet due to construction materials being in the way. Can you lift the load given those conditions? Do we need to use our stabilizers?

Answer: Because we have a 2,500-lb. load, we need to look at the 3000 lb. segment. According to our chart the 3,000-lb. segment ends at 29 feet. Our question states that we can only get within 30 feet of the structure. Regardless of how high our lift is going to be, the distance away from the structure limits our ability to lift the load safely. Our options are to split the load into two loads or get closer to our structure.

You are responsible for lifting an air conditioning unit to the top of a 2-storey structure that is 24 feet high. The unit weights approximately 1,200 lb. The closest you can get to the structure is 33 feet because of construction debris. Can we lift the load safely to the roof? Do we need to use our stabilizers?

Answer: We are dealing with a 1,200-lb. load so we need to look at the 2,000-lb. segment. By placing our lift truck 33 away from the structure and given the lift height we are within the safe loading limits of our chart. Therefore, we can lift the load safely. Stabilizers would have to be used because we would have to get within 18 feet to lift our load without them.

Operators Manual

As mentioned previously, lift truck operators must be familiar with the operator's manual for the specific lift truck they operate. The information is vital for safe operation of the lift truck and outlines the lift truck's safety issues, safe operation and the lift truck's maintenance requirements.

Read and follow the operators' manual. Each lift truck must have a manual available for it, if it doesn't then report this to your supervisor and order a new one. Observe all warning plates and decals on the lift truck and in the operators' manual.

The operator's manuals will explain any potential safety hazards whenever necessary in special messages that are identified with the word DANGER, WARNING, or CAUTION, and the safety alert symbol.

Memorize the meaning of the following boldface terms appearing in warnings in both the lift truck manuals and on the lift truck itself. Thorough understanding of these terms is essential to your safety.

 **Danger!** Indicates a high probability of death or serious injury and/or serious equipment damage if the hazard is not avoided.

 **Warning!** Indicates a potentially dangerous situation that could cause injury or death and/or serious equipment damage if the hazard is not avoided.

 **Caution!** Indicates hazards that could result in minor or moderate injury or damage to the equipment.

Refer to the operator's manual for the Safety, Operation and Maintenance of the specific lift truck to be operated.