LMI Systems

Load Moment Indicator Systems

Customer Value Proposition:

Load moment, or 'tipping' moment is the moment about the chassis of a piece of lifting equipment when the vehicle tends to tip over because the load is too heavy, given a certain boom angle or boom length.
In the past, operators relied on experience to tell them when a lift was too heavy, sensing the strain in the boom or waiting until they felt the back end start to 'float'.

Parker Electronic Controls has the products and system expertise to provide solutions that will keep the operator informed about the position of vehicle functions and keep the machine in a safe operating condition.

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Products and Features:

- Boom angle sensors
- Boom length sensors
- Pressure sensors
- Displays
- Mobile controllers
- Accounts for environmental effects on lifting capacity
- Redundant sensor signals or controller inputs for safety
- Real time calculations
- Ability to lock movement

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Load Moment Indication

Load Moment is a function of the weight of the load and supporting material times the moment arm. The moment arm is a function of the boom extension and boom angle.

Increasing the boom length, or lowering the boom, increases the moment arm. The weight of the load applied at the end of the moment arm distance can result in enough force to make the lifting vehicle or platform become unstable, or even tip over.

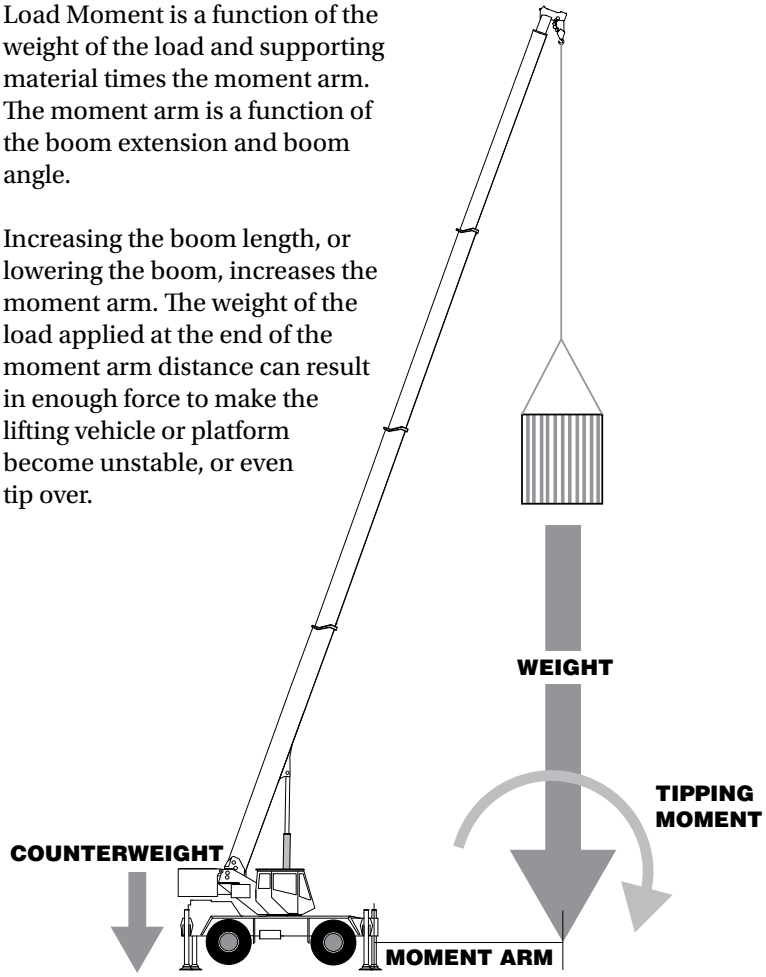


Illustration demonstrating the forces at work to create a tipping moment.

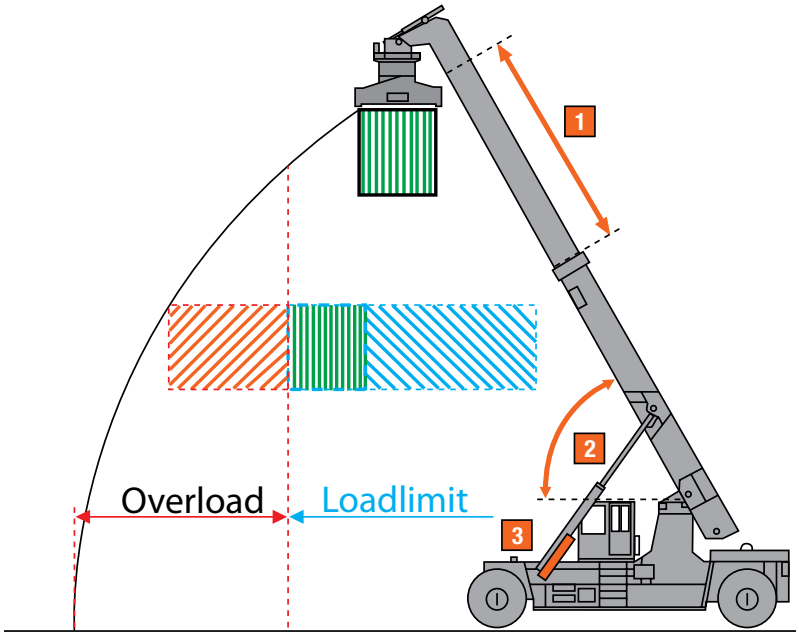
To determine the load moment, three values must be accurately and reliably measured.

1. Boom Length
2. Boom Angle
3. Load

Although Boom Angle and Boom Length are typically measured with sensors, the load can either be measured directly, or taken from the pressure of the Boom Cylinder.

When load is measured using pressure, usually the boom cylinder pressure is determined using differential Pressure (Δ P) between the rod and the bore cylinder end caps.

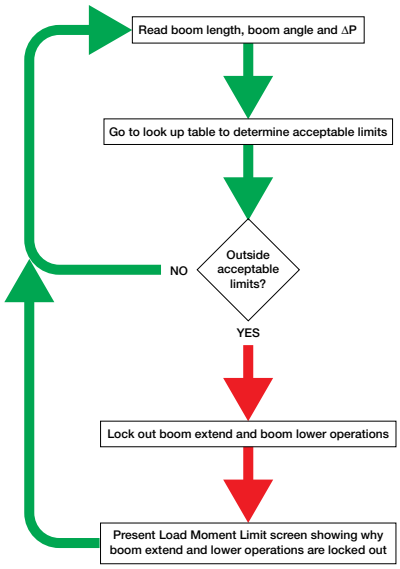
The position of the weight of the load and the cylinder pressure differential can be used to determine the load moment.



Load Moment Operation

During operation, the system constantly reads length, angle and pressure sensors and performs calculations that determine what percentage of the Load Moment Limit the vehicle is at.

Look up table with values
Although the load moment value can be calculated from sensor readings through the microprocessor, usually the load limits are determined by the vehicle manufacturer through experimentation. The values are loaded into a table in system memory, similar to a spreadsheet, called a "look up table"

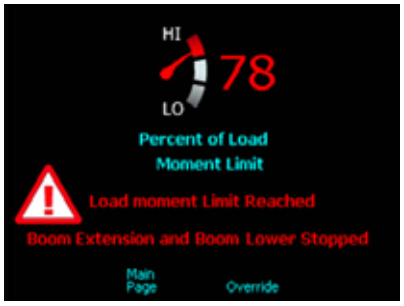


Load Moment operation process

Representative Load Moment

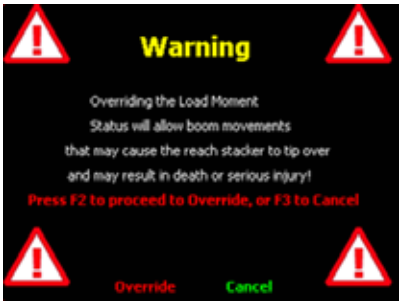
Examples of operator screens for load moment information

Override Load Moment Limits
In a typical Load Moment Indicator system, the Load Moment Limit screen will appear when the Load Moment Limit is reached. A process allows the operator to override the load moment limit in emergencies



Load Moment Limit screen.

- **The operator can select to override**
- **A Confirmation Screen appears**
- **Operator must confirm the selection to override the limit**



Override confirmation screen.

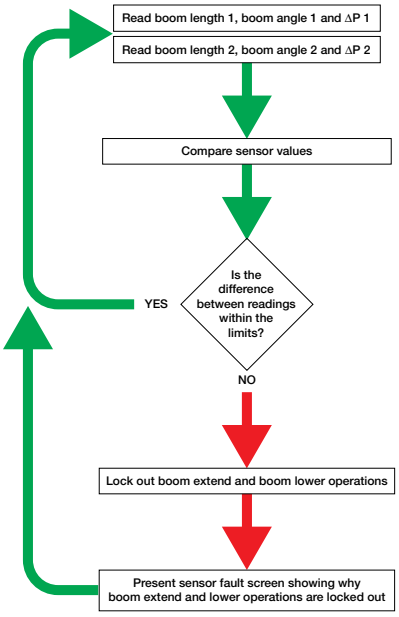
- **If confirmed, override is allowed, and Boom Extension and Boom Lower Functions are unlocked**
- **Override confirmation selection is entered into a non-volatile event log, indicating date and time that the operator overrode the limits**

Redundant systems provide an extra measure of safety

For a critical function such as monitoring the load moment of a vehicle, the added safety of a redundant capable system is a desirable feature.

Redundant sensors
Redundant sensors are often used to help ensure the sensors are performing correctly.

Redundancy can be built into a single sensor with redundant outputs and redundant power supplies. Redundant sensors allow dual readings to be compared to help ensure the readings are within acceptable limits.

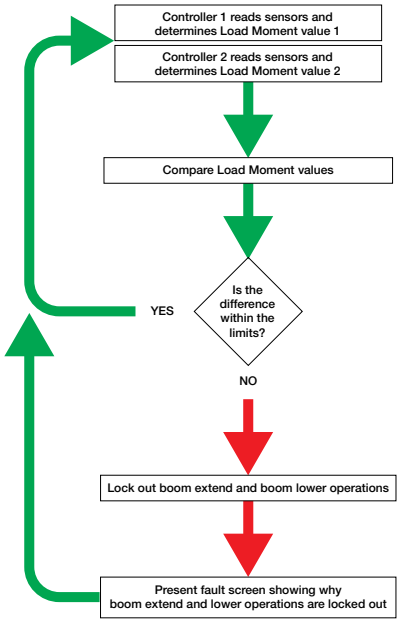


Redundant sensor process

Redundant controllers
In addition to redundant sensors, redundant controllers can be used.

Redundancy can be accomplished in two ways:

1. The master controller compares the load moment values that it determined from its sensor readings to the load moment values the slave controller determined from it's sensor readings.
2. The redundancy can be built into a single controller that is designed for safety applications.



Redundant controller process

Displays	Description
 IQAN-MD3  DPE70	IQAN-MD3 - 3.5" color master display unit DPE70 - 7" color display unit, portrait or landscape orientation
Controllers	
 IQAN-MC3 IQAN-MC2/XA2  CM0711	IQAN-MC3 - SIL2 safety controller IQAN-MC2 - master controller IQAN-XA2 - slave I/O module for MD3 CM0711 - master controller
Sensors	
 RS60  RS70	RS60 - dual output rotary sensor RS70 - redundant rotary sensor
 IQAN-SP500	IQAN-SP500 - 500 bar pressure sensor

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