

Same Weight, Three Times the Wind Load

A scale cannot tell you the wind load



A level balance answers a mass question. It cannot describe the area or shape facing the wind.

Imagine replacing a compact sensor assembly with a broad flat panel. Both complete payloads weigh 20 kilograms. The lifting requirement looks unchanged, but the wind may now push more than three times as hard. The missing information is the shape presented to the air.

Mass describes how much material the mast must carry and accelerate. Wind drag is a sideways force created by airflow around the exposed assembly. A broad, light enclosure can therefore be more demanding in wind than a compact, heavy one. Changing the enclosure without changing the mass is still a mechanical change worth reviewing. The distribution of that mass can also change [rotational inertia](#): how strongly the assembly resists angular acceleration.

Look at the silhouette

Projected area means the outline seen when looking straight along the wind direction. Think of a shadow cast onto a plane facing

the wind. Include the positioner, adapter, exposed cable loops and covers; then turn the assembly through its permitted positions. A narrow front view can conceal a much wider side view.

Area alone is not enough. The drag coefficient describes how shape and flow turn that area into force. Two bodies with the same frontal area can have different drag. A coefficient also belongs to a stated reference area: a value based on total surface area cannot simply be combined with a frontal-area measurement. [NASA's shape comparison](#) explains why shape and test conditions matter.

For a useful first comparison, record mass and exposed geometry separately. Keep the coefficient assumption visible. Otherwise a neat force calculation can hide the least certain input.

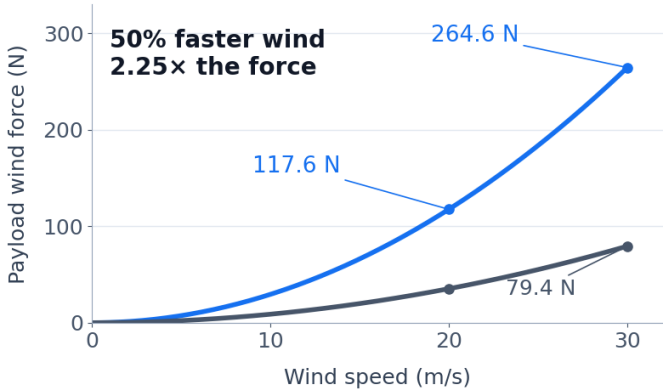
Equal mass does not mean equal wind demand.

50% faster wind, 125% more force

Shape, speed and height multiply

A calculated comparison — not a mast rating

More exposed area, more force

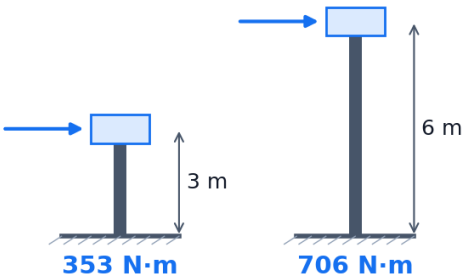


0.40 m² broad assembly
0.12 m² compact assembly

Inputs: air density 1.225 kg/m³; drag coefficient 1.2 for both shapes. Wind on the payload only.

Same force, different height

Payload wind force: 117.6 N



Base moment = force × height

Chosen inputs reveal two separate effects: wind speed changes force, while force height changes base moment.

Wind force = ½ × air density × drag coefficient × projected area × wind speed².

This is the [drag equation](#). Force is in newtons when density is in kilograms per cubic metre, area in square metres and speed in metres per second. Shape, orientation and the chosen coefficient must remain compatible.

For this planning example, assume air density of 1.225 kg/m³ and a drag coefficient of 1.2 for both payloads. These are chosen inputs, not measured coefficients for an Inventra S³ product. Let the compact assembly expose 0.12 m² and the broad assembly expose 0.40 m².

Wind speed	Compact assembly	Broad assembly
20 m/s, or 72 km/h	35.3 N	117.6 N
30 m/s, or 108 km/h	79.4 N	264.6 N

At either speed, the area ratio gives a 3.33-fold force difference. Raising speed from 20 to 30 m/s multiplies each force by 1.5², or 2.25. The increase is 125%, although speed rose only 50%. Doubling speed would multiply force by four under the same assumptions.

Ask what the wind number means

A reported average and a brief gust are different inputs. For example, [National Weather Service ASOS reporting](#) uses a two-minute average for wind speed and reports gust information separately. Record the averaging period and measurement height when comparing weather data with equipment requirements.

Force rises with speed squared when the other inputs stay fixed.

The sideways push becomes a turning load at the base



The load path continues below the payload: through the support, mounting plate, anchors and foundation.

Now raise the broad assembly. At 20 m/s, the calculated sideways force is 117.6 newtons. Apply it 3 metres above the base and its turning effect is about 353 newton-metres. Apply the same force at 6 metres and that becomes about 706 newton-metres.

The calculation is **base moment = sideways force × perpendicular height**. A moment is a force's turning effect about a point; its unit is the newton-metre. The [OpenStax explanation of torque](#) gives the underlying force-and-lever-arm relationship. Here, height is measured to the effective point where the payload's wind force acts, which need not be its centre of mass.

Weight follows a different lever arm

A centred vertical weight on an ideal straight, upright mast does not create a first-order bending moment merely because it is higher. An offset weight does: a 20 kg payload whose centre of mass sits 0.20 m sideways from the mast axis adds about

39 N·m from gravity. Real mast deflection can create additional effects, so this simple distinction does not replace structural analysis.

The support must resist the resulting loads, including the weight of the mast itself as well as its payload. On a fixed installation, follow the path through the mounting plate, anchors, foundation and ground. On a vehicle, include its mounting structure and deployed supports. The mast cannot define the whole system's capacity by itself.

Our numbers include only wind on the payload. Wind also acts along the mast and on cables. Those forces act at different heights, so their moments must be added with their directions considered. Gust response, vibration, pointing motion and structural capacity require a fuller assessment than this static comparison.

Height multiplies the moment from a sideways force; centred weight is a different load case.

Read the configuration, then verify the wind basis

The [Inventra S³ MEM10 product page](#) lists four configurations. Their main figures agree with the linked manufacturer datasheet:

Extended height	Retracted height	Rated payload	Mast weight
2.2 m	1.0 m	125 kg	72 kg
3.0 m	1.2 m	120 kg	106 kg
6.0 m	1.8 m	100 kg	144 kg
7.2 m	2.0 m	100 kg	219 kg

These rows describe different configurations. They are not a load curve showing how one mast's capacity changes as it rises. The 125 kg figure therefore cannot be carried across to the 7.2 m row, and the table does not supply intermediate-height ratings.

One published detail needs confirmation

The web specification block pairs 120 km/h with a 0.4 m² wind reference area. The [MEM10 datasheet, page 3](#), instead states 120 km/h at 1 m². Those are different published conditions. Neither area should be selected silently for a proposed installation; ask Inventra Inc. for the current wind basis tied to the exact configuration.

A useful request includes the required height, complete payload mass, centre-of-mass offset and maximum exposed geometry. Add the intended operating and recovery conditions, site wind definition and the supporting base. Ask which orientation, area basis, wind averaging period and support arrangement the confirmed limits assume.

The decision is then concrete: one mast configuration carrying one defined assembly on one defined support. If a cover, antenna or adapter changes later, revisit the geometry and load calculation as well as the weight.

A configuration row and its confirmed operating conditions belong together.

Sources and further reading

[MEM10: configurations and specifications](#)

Inventra Inc.

[MEM10 manufacturer datasheet, page 3](#)

Inventra Inc.

[Drag Equation](#)

NASA Glenn Research Center

[Shape Effects on Drag](#)

NASA Glenn Research Center

[University Physics Volume 1, section 10.6: Torque](#)

OpenStax, Rice University | 2016

[ASOS wind reporting](#)

NOAA National Weather Service

[University Physics Volume 1, section 10.5: Calculating Moments of Inertia](#)

OpenStax, Rice University | 2016

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