



**BIG ASS
FANS®**

STAYING COOL:

THE COST OF HEAT STRESS IN THE WORKPLACE AND HOW BIG FANS MAKE A BIG DIFFERENCE





WHEN THINGS HEAT UP... WORK SLOWS DOWN

The warehouse, manufacturing and distribution sectors operate in high labour and often heat intensive environments. This can lead to heat stress, which is proven to result in lost productivity through lowered cognitive functions, absenteeism and lowered physical capabilities.

With climate scientists predicting an increase in heat waves of greater intensity, government bodies and global health authorities are recommending companies adopt adaptation measures as a matter of urgency to avoid severe economic impacts from labour productivity loss.

Heat stress can negatively affect businesses and its people at all levels.

Big Ass Fans, the world leader in innovative ceiling fans, has a commitment to safety and comfort and has researched and developed methods to overcome these issues. This research has been carried out at both their research and development facility in the US, the largest facility of its kind, as well as working extensively with NASA to better understand thermal comfort.

This whitepaper explains what causes heat stress and its impacts and offers a scientifically proven solution: big fans. In particular, HVLS (high volume, low speed) fans.

WHAT IS HEAT STRESS?

Before delving into how to overcome heat stress, it's important to understand what it is and how it can affect individuals and a business. The human body is constantly working to maintain an ideal temperature of around 36–37°Celsius. Heat stress occurs when the body is unable to cool itself enough to maintain a healthy body temperature. It relates to the total heat load on the body from all sources, including ambient air temperature, radiant heat, air movement, relative humidity, clothing and physical exertion.

Heat strain, on the other hand, is how the body responds to heat stress. It is dependent on physical fitness, acclimatisation, medical conditions, age, general health, weight, hydration levels and medications.

Heat-related illnesses can range from mild conditions like dehydration or a heat rash, to potentially lethal conditions such as heat stroke. Heat-related illness can be caused by:

- High temperature and humidity
- Limited air movement
- Direct sun exposure or extreme heat
- Low fluid consumption
- Physical exertion
- Use of bulky protective clothing and equipment

3 PRIMARY FORMS OF HEAT STRESS

- **Heat cramps** – caused by performing hard physical labour in a hot environment. Symptoms include: muscle cramps; pain or spasms in the abdomen, arms or legs.

- **Heat exhaustion** – a result of excessive loss of water and salt through sweating. It is extremely dangerous if the affected person is operating machinery. Symptoms include: rapid heartbeat and profuse sweating; extreme weakness or fatigue; dizziness or fainting; nausea or vomiting; elevated body temperature; headache; thirst.

- **Heat stroke** – a medical emergency, heat stroke occurs when the body's temperature regulating system fails and the body temperature rises to critical levels (greater than 40°Celsius). This can cause death or permanent disability. Symptoms include: high body temperature; confusion or loss of coordination; hot, dry skin or profuse sweating; throbbing headache; seizures; coma. Workers experiencing heat stroke may also stop sweating.



THE IMPORTANCE OF MITIGATING HEAT STRESS IN THE WORKPLACE

Exposure to heat has killed more people in Australia than the sum of all other natural hazards, according to a 2014 report published by the journal, *Environmental Science & Policy*ⁱⁱ. Worryingly, studies show workers routinely overestimate their heat tolerance, believing they are capable of continued work in high heat.ⁱⁱⁱ This is of concern for managers responsible for worker safety.

A *New York Times* article (July 15, 2021) reported new research that shows heat stress has led to an additional 20,000 workplace injuries each year in California alone. This is alarming when you consider how much harsher Australia's climate can be in comparison. The data suggests heat increases the incidence of workplace injuries — such as falling, being struck by machinery or mishandling machinery — by making it harder to concentrate.^{iv}

Heat stress also reduces productivity. Most workers will naturally reduce work intensity and/or limit working hours in response to heat stress in a bid to minimise body heat production^{vii}.

But it's not just the financial impacts that sting – heat stress related absenteeism and workplace injury also negatively affects employee morale and overall productivity.

In 2016, the United Nations released a report, *Climate Change and Labour: Impacts of Heat in the Workplace*, which highlighted the rapid increase in daylight working hours lost due to overheating, and the impact on livelihood and health.^{ix}

A report published in the journal, *Nature Climate Change*^{viii}, estimated the cost of work absenteeism and reductions in work performance caused by heat in Australia during 2013/14 was approximately \$885 per person across a representative sample of 1726 employees. This amounts to an annual economic burden of approximately \$8.3 billion for the Australian workforce.

ESSENTIAL RESPONSIBILITIES FOR MANAGERS

Australian Workplace Health and Safety (WHS) laws do not specify a 'stop work' temperature. However, WHS laws require any person conducting a business or undertaking (PCBU) to monitor temperatures in the workplace and eliminate or minimise the risks of working in heat. "The model *Code of Practice: Managing the work environment and facilities* recommends that work be carried out in an environment where the temperature range is comfortable for workers and suits the work they carry out."^x

HOW FANS MAKE WORKERS FEEL MUCH COOLER

Fans cool people, not rooms. They create airflow that quickly evaporates perspiration from the skin, carrying away heat. They also reduce the thickness

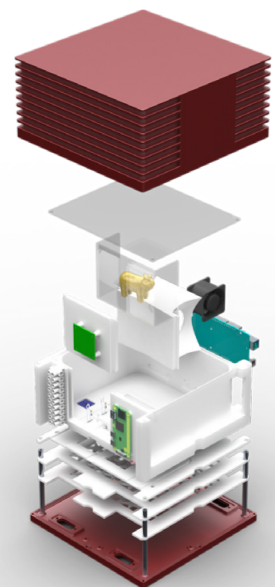


BIG ASS FANS GOES TO SPACE

A 2004 research paper by NASA examined the effects of thermal stress (heat and cold) on performance^v. It reported reductions in vigilance, visual tracking, and auditory discrimination tasks when participants were subjected to heat. At temperatures over 29.4°C, problem-solving skills diminished and "the gradual accumulation of heat in the body during longer and more intense exposures gradually builds up fatigue and a corresponding decrease in endurance".

To look further into this, Big Ass Fans partnered with Space Tango in 2019, a local third-party payload sealer, and went into space on a Northrop Grumman Cygnus Antares rocket before coming back on a SpaceX rocket. All of the project's engineering and design was handled by Big Ass Fans' team and the project managed internally. The experiment was a CFD (computational fluid dynamics) simulation to see how airflow affects thermodynamics in microgravity environments. Big Ass Fans' experiment also included micro-versions of its mascot, Fanny, to be an obstruction, allowing to more realistically simulate environments.

The experiment taking place on the International Space Station is a micro version of the services Big Ass Fans provides for its customers through the Facility Layout Tool[®]. It will be able to draw correlation from what Big Ass Fans does in space to a service provided on earth.



Cross-section of the experiment.

of hot, humid air that builds up around workers. This improves heat dissipation and helps people's natural cooling mechanisms to function more efficiently.

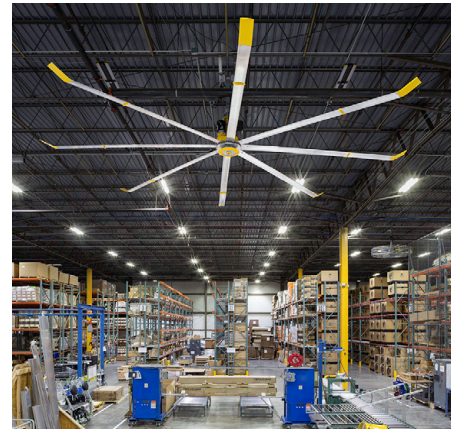
A common misconception is that fans don't provide a cooling benefit when the air is above 36°C. As long as the person is sweating and the air isn't 100% saturated with humidity, airflow from fans can still provide evaporative cooling.

WHY HVLS FANS ARE SO EFFECTIVE

Elevated air speed and increased air circulation directly improve occupants' thermal comfort, delivering businesses a wide range of personal and financial benefits. High Volume, Low Speed (HVLS) fans are perfect for large workspaces, gently moving large quantities of air. The air from a HVLS fan moves toward the floor in a column that radiates in all

directions, flowing horizontally until it reaches a wall — or airflow from another fan — at which point it turns upward and flows back toward the fan. This creates convection-like air currents that build as the fan continues to spin. The increased air circulation accelerates the rate in which sweat can be evaporated from the skin. The result is a silent, non-disruptive and even distribution of 4.8- to 8-kph breezes over large spaces, with a perceived cooling effect on occupants of up to approximately 6°C. During winter, HVLS fans effectively redistribute warm air trapped at the ceiling down to the floor level.

In addition, fans improve the efficiency and effectiveness of air-conditioning. By generating a few degrees of cooling from an energy-efficient fan, you can raise your A/C thermostat set point by a few degrees, which can save 3 to 6% on cooling costs.



PRODUCTIVITY AND THERMAL COMFORT

Thermal discomfort at work can be a major distraction as well as a safety concern, impairing a person's ability to produce efficient, high-quality work.

In a US study published in *ASHRAE Journal*[®], it was found that the impact of hot and humid conditions on occupants of **heated-and-ventilated-only warehouses** is significant and costly, with some workers spending more than 40% of their day outside of the comfort zone specified by ASHRAE Standard 55, an industry certification that specifies conditions for acceptable thermal environments.

Temperature vs productivity loss, based on research from the Helsinki University of Technology, Finland.

TEMPERATURE	PRODUCTIVITY LOSS
25.5°C	0.0%
26.6°C	-3.2%
29.4°C	-8.8%
32.2°C	-14.3%
35.0°C	-19.9%
37.7°C	-25.4%
40.5°C	-31.0%

Source: Seppanen, O., Fisk, W.J. and Lei, Q.H. (2006)

7 BENEFITS OF HVLS FANS



- Keep workers safe from extreme temperatures



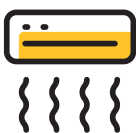
- Provide airflow that makes people feel cooler



- A single HVLS can replace 10–20 high-velocity floor fans



- Increase air exchange rate across wide areas



- Reduce need for A/C, reducing power bills



- Improve efficiency and effectiveness of A/C



- HVLS fans are durable and long-lasting because they run at a low speed

WHY BIG ASS FANS?

Big Ass Fans is the world leader in transforming warehouse and logistic spaces with innovative ceiling fans. Having engineered and manufactured premium fans since its inception in 1999 in the United States, it now sells fans in 175 countries. The company has had an Australian presence since 2008, with an office and warehouse in Brisbane.

In naturally ventilated spaces, fresh air is passively distributed throughout the space, so localised areas may have stagnant pockets that result in poor air quality and the build-up of pollutants. Big Ass Fans' HVLS fans dilute these pockets and increase the circulation of fresh air, evenly distributing it throughout the space and improving warehouse air quality.



LEADING THE WAY IN INNOVATION AND RESEARCH

Big Ass Fans leads the way in innovation and research as well as its commitment to safety and comfort.

It has developed its own research and development (R&D) facility in the US, where it conducts extensive research and

testing. This laboratory is a LEED® Gold certified facility dedicated to developing energy-efficient fans. No other facility exists to meet the unique requirements and challenges of testing large-diameter ceiling fans.

Big Ass Fans' products are purpose-built for optimum cooling power, improved air circulation, energy efficiency and unrivalled durability in any setting.

Benefits include:

- Perceived cooling by up to 6°C
- Reduce productivity loss by 59%
- Saving on cooling costs by up to 3-6% for every setpoint raised on a thermostat.

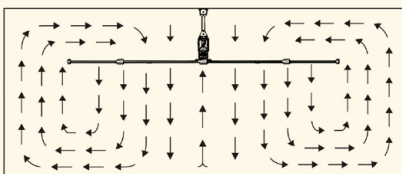
When working outside and a breeze rolls in, an instant cooling effect is created. Air movement doesn't lower the actual temperature, but it does create a wind-chill effect as the breeze brushes over the skin. This augments the body's natural cooling mechanisms, which can make workers feel up to 6°C cooler.

To help measure the cost of lowered productivity due to heat stress, Big Ass Fans developed a productivity calculator^{xii} based on NASA research. Using this calculator, it is estimated a warehouse in Brisbane with 30 employees earning \$26 per hour and working 38 hours per week could lose \$27,127 per year in lowered productivity. The installation of Big Ass Fans products could save \$15,831 per year. Based on these figures, Big Ass Fans could reduce productivity loss by 59%.

Air-conditioning is a massive cost and fans reduce that cost by making air-conditioning more effective and efficient. Generating a few degrees of cooling from an energy-efficient fan allows the thermostat set point on an air-conditioner to be raised by a few degrees. For every set point raised on a thermostat, 3 to 6% is saved in cooling costs.

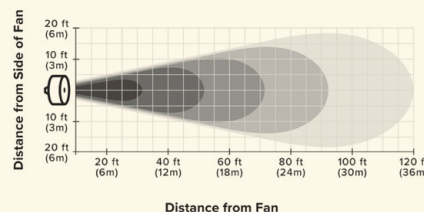
HOW DOES AN OVERHEAD BIG ASS FAN AFFECT AIRFLOW?

Using a ceiling mounted fan, Big Ass Fans provides bi-directional airflow and elevated air speed as a powerful way to keep workers and guests comfortable in a space. Immediately underneath a Big Ass Fan, airflow is pushed downward. Outside its diameter, the airflow transitions to horizontal air movement, providing comfortable airflow over a large area as per ASHRAE Standard 55's thermal comfort calculations.



HOW DOES A DIRECTIONAL BIG ASS FAN AFFECT AIRFLOW?

Big Ass Fans' directional fans create a one-way airflow pattern that moves air to the area in front of the fan. Directional fans are most often used to cool workers in congested areas where overhead fans cannot be safely mounted. Additionally, most Big Ass Fans' directional fans feature variable speed control, allowing users to adjust airflow to provide the optimal desired cooling effect.



CASE STUDY:

WHEN NASA GIVES YOU THE THUMBS UP, YOU KNOW YOU'RE DOING SOMETHING RIGHT

NASA's Langley Research Centre in Hampton, Virginia, US, uses Big Ass Fans to solve its year-round air movement problems. At building 1244, a 90,000-square-foot aircraft hangar with 100-foot (30.48-metre) ceilings, four 24-foot (7.32-metre) diameter Big Ass Fans were installed to create a cool summertime space, and a more evenly heated area in the winter.

The facility used Big Ass Fans' bestselling product – the Powerfoil X3.0 – to keep employees feeling cool. Increased air temperature and humidity in the summer months combined with increased security

restrictions that mandate hangar doors should stay closed as much as possible, meant air-conditioning would have been impractical for the size of the facility.

Four Big Ass Fans' HVLS fans did the trick, creating more airflow and helping to dehumidify the air. Facility coordinator John Hefner said at first, employees were sceptical: "They didn't believe they'd work, but now they wouldn't be without them. There is much more air movement now."

5 FACTS ABOUT BIG ASS FANS



BIG ASS FANS®



THE LARGEST

MANUFACTURER OF
HIGH VOLUME, LOW
SPEED (HVLS) FANS



MORE THAN
700,000
BIG ASS FANS HAVE
BEEN SOLD GLOBALLY

PRESENT IN
175 
COUNTRIES



MORE THAN
225
COMPANY AWARDS



MORE THAN
70%
OF FORTUNE 500 COMPANIES

USE BIG ASS COMPANIES



UNCOMPROMISING SAFETY + ADVANCED CONTROL OPTIONS

No other company comes close to matching Big Ass Fans' extensive safety and control features.

- Secure, balanced mount
- Fully-reinforced, interlocking airfoils
- Large, flexible hub to prevent fatigue points
- Integration into fire suppression systems
- Automated controls and environmental sensors
- Patented Airfoil Retention System available on industrial overhead models
- Hi-tech control options enable users to control all Big Ass Fans' products, lights and building ventilation from a single device
- the BAFCon control system uses temperature-sensing technology to create a consistent temperature level



THE BIG ASS FANS' PROMISE

Big Ass Fans are created using industry-leading designs and premium materials. Airflow experts work with each customer every step of the way, from initial quote to installation to customer aftercare.

When buying Big Ass Fans' products, there is guaranteed durability and style with each product that will last the distance. The lifespan of Big Ass Fans is exceptionally high, offering great financial benefits in the long run with minimal maintenance.

With its state-of-the-art products, exceptional customer service and unmatched warranty coverage, Big Ass Fans is the world leader in the airflow game, leading the industry in the name of comfort.

To find out how Big Ass Fans can improve the safety and efficiency of a workspace, call 1300 244 277 or head over to www.bigassfans.com/au/



BIG ASS FANS®

References

¹ <https://www.mayoclinic.org/diseases-conditions/heat-stroke/symptoms-causes/syc-20353581>

² Coates, L., Haynes, K., O'Brien, J., McAneney, J., Dimer de Oliveira, F. (2014) 'Exploring 167 years of vulnerability: An examination of extreme heat events in Australia 1844–2010, *Environmental Science & Policy*, Volume 42, 33–44.

³ Hanna, L. (2017) 'Coping with the Heat. Mismatch: Perceptions v Reality', presented at the 15th World Congress on Public Health at Melbourne Convention Centre.

⁴ Flavelle, C. 'Work Injuries Tied to Heat are Vastly Undercounted, Study Finds', *New York Times* (July 17, 2021)

⁵ Staal, M.A. (2004) *Stress, Cognition, and Human Performance: A Literature Review and Conceptual Framework*, Ames Research Center, Moffett Field, California, 86–88.

⁶ <https://www.bigassfans.com/jp/6774/attachment/ft-1500px/>

⁷ Parsons, K. (2002) *Human Thermal Environments: The Effects of Hot, Moderate, and Cold Environments on Human Health, Comfort and Permanence*, CRC Press, London.

⁸ Zander, K., Botzen, W., Oppermann, E., Kjellstrom, T., Garnett, S. (2015) 'Heat stress causes substantial labour productivity loss in

Australia', *Nature Climate Change*, 5, 647–651.

⁹ UNDP (2016) *Climate change and labour: Impacts of heat in the workplace*, with UNI-Global, ILO, ITUC, ACT Alliance, IOM, and WHO, New York: UNDP.

¹⁰ Safe Work Australia (2018) *Model Code of Practice: Managing the work environment and facilities*: <https://www.safeworkaustralia.gov.au/doc/model-code-practice-managing-work-environment-and-facilities>

¹¹ Taber, C., Colliver, D. (2018) *Thermal Comfort in Heated-and-Ventilated-Only Warehouses*, *ASHRAE Journal*.

¹² <https://www.bigassfans.com/au/productivity-calculator/>