THORN

Invincible II

Advanced lighting systems
for cleanroom applications

Cleanrooms at a glance

In our ever changing natural world and the advances in technology, we are now seeing more than ever before, an increase in demand for cleaner sterile environments

The need to manage the way in which the environment comes into contact with human activity has become increasingly important over the decades.

The process probably began with the early recognition of the importance of 'cleanliness' in medicine. After addressing issues such as personal hygiene and the sterilisation of instruments, clinicians began to consider other factors such as airborne contaminants.

It soon became clear that a truly sterile operating theatre required clean air as well as sterile surfaces to allow operational practices to be undertaken safely. The modern cleanroom was born.

The concept soon moved from medicine to manufacturing and engineering. High-precision industries now demand pure environments that allow processes and product production to be executed effectively. The outcome of the smallest degree of contamination would lead to defective products or incorrect process results.

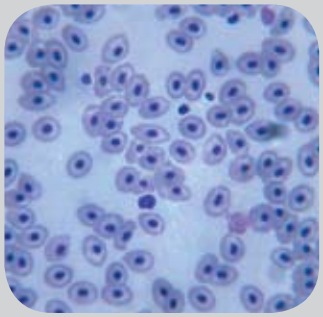
From high volume production lines to individual task areas, cleanrooms call for lighting solutions that maintain the integrity of the environment while providing good visual effectiveness so tasks can be performed accurately.

Invincible II, from Thorn, addresses all these requirements.

What is a cleanroom?

Although different applications have different thresholds governing 'cleanliness', all cleanrooms have a number of common features:

- Controlled environments
- Specially designed for a purpose/task
- Air particle content is monitored, filtered and regulated to avoid contamination
- Airflow, pressurisation and temperature are all key aspects
- Strict rules and regulations govern user personal hygiene, equipment and maintenance
- Appropriate equipment must be used and cleaned regularly



Tasks within a cleanroom?

In principle, there are three basic tasks undertaken in a cleanroom environment:

1. Patient Protection
2. Product Production
3. Medical/Scientific Analysis

The major sectors with cleanroom applications include:

Healthcare – Operating theatres, intensive care units, accident and emergency departments, examination and treatment rooms

Industry and Engineering – Food manufacturing, pharmaceutical and chemical engineering, micromechanics, biogenetics

What is contamination?

Contamination occurs when one particle joins another particle of a different origin, making it impure. There are three primary sources:

Facilities: Walls, ceilings, paint spillages and leaks can all contribute to additional particles to those normally present in the air

People: Hair, skin flakes, cosmetics and clothing fibres can all create particles

Equipment: Friction and vibration can cause equipment to shed particles

Managing contamination

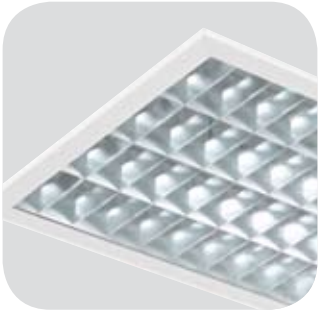
Contamination is managed in a cleanroom in the following ways:

- Room construction
- Special room layout to minimise movement
- Strict internal procedures and guidelines are to be followed at all times whilst undertaking any task
- Garments such as jump suits, gloves and face masks are a standard to prevent human contamination
- Specially designed equipment
- Air filtration and ventilation systems

Impact of contamination

The result of contamination can have drastic consequences depending on the tasks being undertaken in a cleanroom.

- Bacterial contamination could result in further infection or illness for the patient
- Dust contamination could result in the rejection of defective products and additional business expense for wasted production time
- In medical/scientific analysis such as genetics any contamination could result in incorrect findings and outcome



Healthcare

Hygiene is part of everyday life for healthcare professionals. Areas close to operating theatres or laboratories are at higher risk of contamination.

Cleanrooms combine outstanding environmental performance while satisfying the demanding requirements of surgeons and other practitioners. The lighting systems must enable them to maintain exceptionally high levels of concentration while completing difficult visual tasks in hygienic conditions.

Cleanroom luminaires have all the contamination control features needed to integrate naturally into the physical, operational and maintenance structure of healthcare buildings. Invincible II luminaires are specially designed and provide:

- High Ingress Protection ratings from both below and above. This prevents additional dust or water particles contaminating the controlled environment.
- A smooth surface finish reduces the possible area for particles accumulating that could be missed during cleaning
- Suitable for use with the majority of disinfectants and cleaning agents
- The ability to perform under positive and negative pressure
- Glare-free output to eliminate distracting reflections on equipment such as monitors

Adaptable to any clinical area

Each lighting scheme must be designed to suit the specific healthcare application area. Depending on the task requirements different luminance levels ranging from 200 lux to 2000 lux can be achieved with cleanroom luminaires.

A typical healthcare application includes:

- Operating theatres
- Intensive care units
- Laboratories
- Examination rooms

Industry and engineering

With the advance of material technology over recent years, and the expectation of greater quality products, cleanrooms are now a common feature in both Industry and Engineering facilities

Cleanroom applications demand lighting schemes that promote comfort and performance while maintaining the requirements of a clean environment.

The construction of a cleanroom may often vary depending on the tasks involved but most will have similar aspects such as strict procedures, dress codes, operation under positive pressures and air filtration systems.

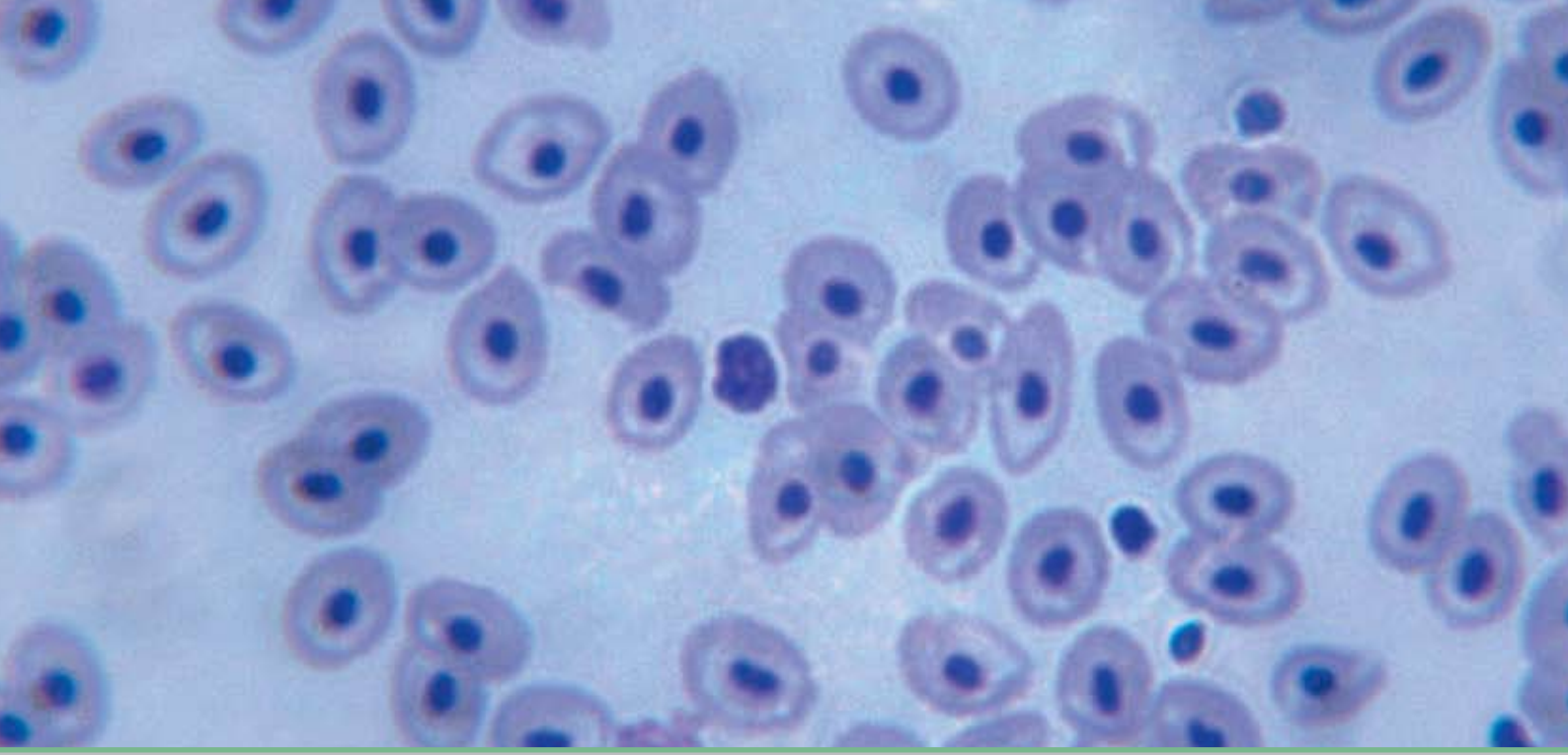
There are different standards and codes of practice depending on the cleanroom application task including:

- (GMP) Good Manufacturing Practice Guidelines
- (FDA) Food and Drug Administration
- EU Pharmaceutical Regulation
- (HACCP) Hazard Analysis Critical Control Point Regulations

The ultimate aim is to minimise air contaminations so increased production is achieved with higher quality products and less rejects.

From purer food products to more reliable hard disks, better pharmaceuticals and accurate medical research, cleanroom environments have an impact on the way things are produced or studied.

Cleanroom luminaires are designed for easy maintenance, installation into high ceilings and are not affected by vapour, heat dust or corrosive atmospheres.



Regulations and standards

Cleanrooms protect people, products and processes against contamination from dust, pollen, bacteria, viruses and aerosols

Generally, cleanrooms are classified by cleanliness of air. Air cleanliness classification is determined by the maximum permissible particle count per cubic metres (m^3).

A variety of different particle sizes and quantities can be contaminated into the air. This can be from a selection of sources depending on the particular task being executed.

Particle size is measured in $\mu m/m^3$. Figure 1 and 2 shows a size comparison between different particle types commonly found in a typical cleanroom environment.

It is therefore critical that different particle sizes and quantities are covered by the cleanroom classifications to ensure tasks are executed in the best environmental conditions.

The table on page 7 outlines a summary of different cleanliness classifications.

Cleanrooms are normally maintained at a positive pressure, relative to the surrounding unclassified areas. This positive pressure acts as a force to keep out additional particles from entering the cleanroom. Specially designed room layouts, air filtration systems, equipment and strict procedures are normally key elements.

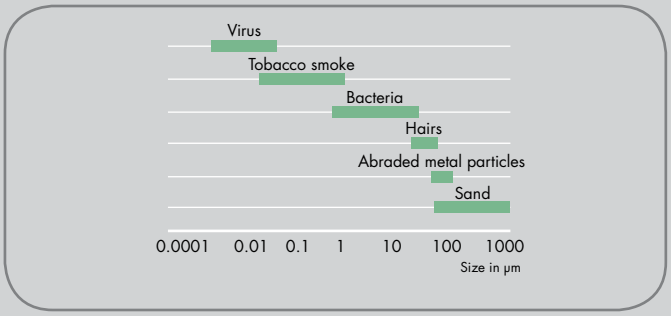


Figure 1

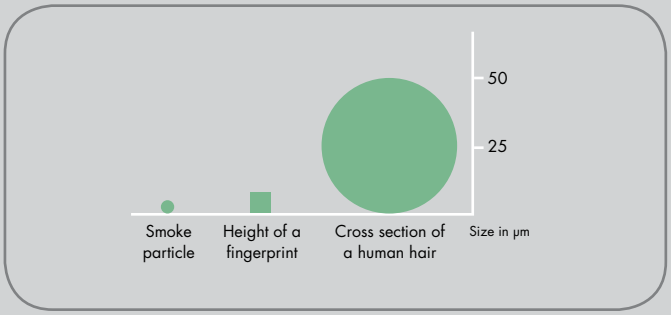


Figure 2

Correct luminaires for the job

It is essential that luminaires do not contribute to the total number of air particles within the cleanroom. Any particles that enter the luminaire from unclassified areas such as ceiling voids, are present in the luminaire at the time of installation or are generated during its operation should be contained and not permitted to enter the cleanroom through the luminaire. This is why high ingress protection ratings are a must in these environments:

- (GMP) Good Manufacturing Practice Guidelines
- (FDA) Food and Drug Administration
- EU Pharmaceutical Regulation
- (HACCP) Hazard Analysis Critical Control Point Regulations
- (EAGDG) European Hygienic Engineering and Design Group

Reassurance with Invincible II

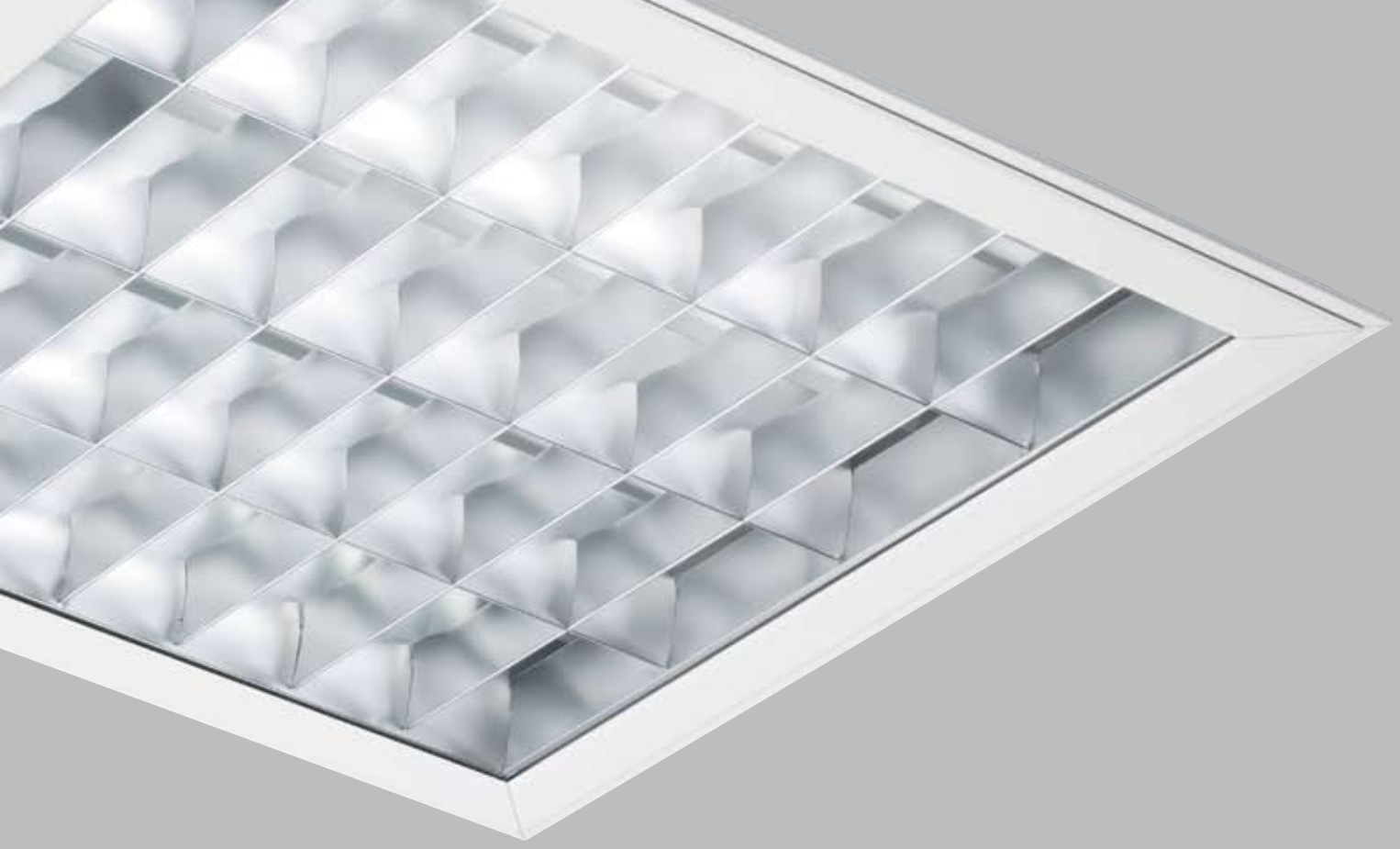
On all equipment used in cleanroom applications, basic principles including resistance to chemicals, air flow behaviour, electrostatic charge and surface quality characteristics are all requirements that can effect cleanliness compatibility.

In order to confirm actual product performance against these principal characteristics, Invincible II has been externally tested by Fraunhofer Institute IPA Germany, an expert in this field. The outcome of these tests and evaluations was to determine Invincible II's suitability for use in cleanroom classifications according to EN ISO 14644-1.

The results based on the extensive assessment and measurements taken by Fraunhofer Institute IPA concluded, Invincible II is suitable for cleanrooms in EN ISO 14644-1 classes 3 to 9.

EN ISO 14644-1	US Fed. Std.209E*	EU GMP Guidelines	Maximum permissible particulate count per cubic metre according to EN ISO 14644-1 0.5µm/m³
ISO class 1			
ISO class 2			4
ISO class 3			35
	1		35.2
ISO class 4			352
	10		353
ISO class 5			3,520
	100		3,530
		A/B	3,500
ISO class 6			35,200
	1,000		35,300
ISO class 7			352,000
	10,000		353,000
		C	350,000
ISO class 8			3,520,000
	100,000		3,530,000
		D	3,500,000
ISO class 9			35,200,000

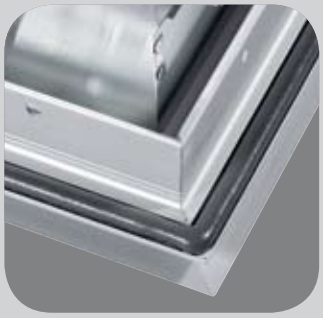
*since withdrawn and replaced by EN ISO 14644-1



Introduction to the range

A range of recessed fluorescent luminaires sealed to IP65/54 for maximum protection when used in healthcare or industrial cleanroom applications

- Available in a range of wattages for both T16 and TC-L lamps
- Choice of louvre or prismatic optics
- Smooth white painted anodised aluminium extruded frame with internal locking mechanism
- Low profile frame design with toughened safety glass cover
- Easy to wipe clean
- IP65 (below)/54 (above) protection ensures safety and performance
- Resistance to most oil vapours, chemical substances, heat, corrosive atmospheres, disinfectants and cleaning agents
- Self regulating breather ensures IP65 high protection through air pressure equalisation
- Dimmable and emergency versions available
- Simple to open/close frame (Please refer to page 14 for further details)
- Suitable for cleaning with the majority of disinfectants and cleaning agents



High Protection

- IP65 (below)/54 (above) ensures high protection
- Polyurethane foam gaskets on both housing and frame
- Additional plastic housing corners offer extra seal

Smooth surface frame design

- Easy to clean low profile frame
- Smooth aluminium extruded white painted frame
- No external locking fasteners which could promote increased particle contamination

Toughened safety glass

- As standard for all louvre and prismatic optic versions
- Promotes quick and easy luminaire cleaning
- 4mm thick toughened safety glass

Simple frame opening method

- Internal locking mechanism
- Push/pull action enables the fitting to be opened with ease offering reduced maintenance times
- Front frame must be opened with a suction cup (Suction cup must be ordered separately)

Self Regulating breather

- Allows air pressure to equalise within the housing
- Ensures high IP performance by preventing any ingress of air and moisture in and around the seals

Easy to install

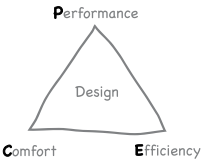
- Quick screw push technique automatically moves the levelling arms over the ceiling grid in to the clamping position
- Simple to adjust levelling brackets
- Pre-fitted 4 point levelling kit (Please refer to page 15 for further details)

Improving quality of life by lighting people and places

As in any other work area, cleanroom lighting must address the needs of different users

Thorn Lighting's aim is to improve quality of life by lighting people and places. Supporting this mission is our PEC programme. This provides a framework to deliver efficient and reliable lighting, contributing to a healthy and comfortable environment, and is based on the principle that three main factors influence quality in a lighting installation.

Performance, efficiency and comfort



These three factors have the potential to positively or negatively affect quality of life and our natural environment:

Performance: Providing the best visual effectiveness

Efficiency: Minimising the use of energy

Comfort: Giving people satisfaction and stimulation

These PEC principles are embodied in both our product design and lighting scheme design and we need to address all three factors to really improve quality of life.

Performance

Providing the best visual effectiveness

Light quality is an essential part of any cleanroom application. Excellent light for high visual effectiveness will enable us to perform tasks accurately without any distraction. Most tasks that are performed are very complicated and detailed so light distribution, good horizontal luminance and colour rendering are all important elements.

Good luminance levels are required as most tasks are performed on a horizontal working plane. Whether the application is in a hospital where a patient lies on a bed, or in industry where a variety of tasks are executed at different workstations, Invincible II has been designed to provide an even light distribution.

The use of T16 lamps produce excellent colour rendering ability for detailed tasks such as patient examinations by a doctor or a bio chemist reviewing important research results.

Efficiency

Minimising the use of energy

In the past more and more CO_2 emissions have been released into the environmental atmosphere. Quality of life will be greatly impacted upon in the future if this pollution continues.

It is therefore vital that today's manufactured products take into account this aspect and this is why Invincible II offers high frequency gear, T16 lamps and dimmable versions.

Comfort

Giving people satisfaction and stimulation

In cleanroom applications glare control is a key aspect that needs to be considered. Whether it is glare from computer screens in an engineering laboratory or a patients monitor in a hospital, clear vision needs to be maintained at all times to prevent any errors occurring during the task in hand. Invincible II offers a choice of louvre or diffused optics to allow constant glare control to suit the required application.

Cleanliness is another element in a cleanroom. All cleanroom environments are controlled and regulated to allow a number of air particles per cubic metre. Any environments that exceed this limit will result in potentially contaminating the specific task in hand. For example in healthcare applications excess bacterial particles could increase infection to a patient. It is therefore vital that the environments can be cleaned using disinfectants and other cleaning agents.

Invincible II has a smooth low profile frame design with no external fasteners and a clear glass cover for easy cleaning which helps to minimise particle accumulation contribution.

A basic summary of the critical requirements for a luminaire is its ability to maintain the integrity of the environment and offer:

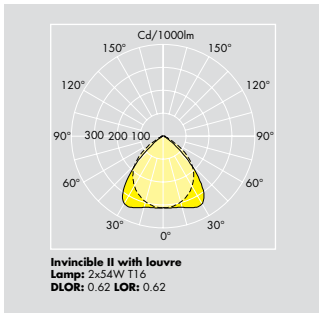
- High ingress protection from both above and below the luminaire, ensuring not to shed particles into the atmosphere
- Smooth frame surfaces for easy cleaning
- Designed so particles cannot accumulate on surfaces
- Integration into ceiling structures for the perfect seal

Invincible II has therefore been designed to fulfil all criteria for achieving PEC in demanding cleanroom environments.

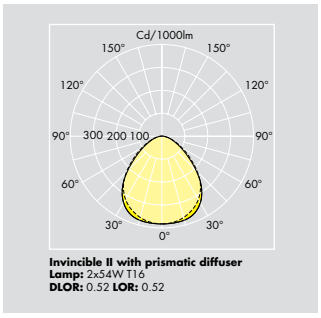
Ordering Guide
Photometrics
Dimensions

Louvre version

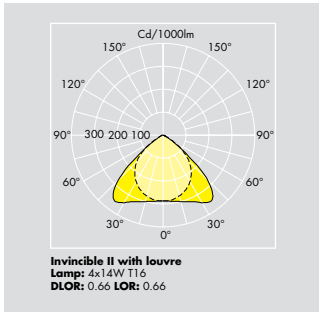
Prismatic diffuser version



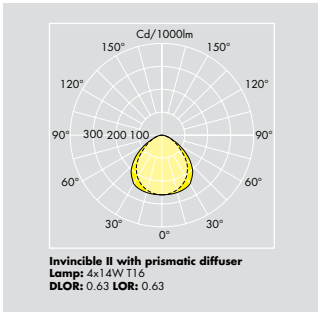
Invincible II with louvre
Lamp: 2x54W T16
DLOR: 0.62 **LOR:** 0.62



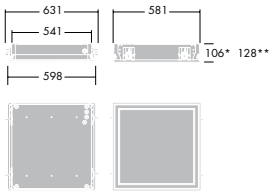
Invincible II with prismatic diffuser
Lamp: 2x54W T16
DLOR: 0.52 **LOR:** 0.52



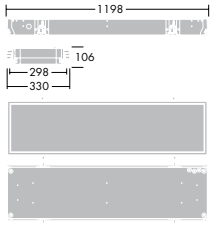
Invincible II with louvre
Lamp: 4x14W T16
DLOR: 0.66 **LOR:** 0.66



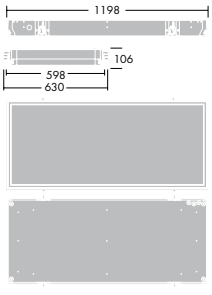
Invincible II with prismatic diffuser
Lamp: 4x14W T16
DLOR: 0.63 **LOR:** 0.63



600 x 600 (*T16 lamp, **TC-L lamps)



300 x 1200



600 x 1200

Lamps

14-54W, T16 (FDH) linear fluorescent. Cap: G5
40-55W, TC-L (FSD) compact fluorescent. Cap: 2G11

Materials/Finish

Housing:
welded sheet steel with a white coating resistant to oil vapours, chemical substances, disinfectants and cleaning agents.
Polycarbonate corner pieces.
Polyurethane foam gasket around housing edge.
Optics:
double parabolic Satinbrite Bivergenz® louvre optic with glare limitation for DSE L<1000 cd/m^2 at 65°, K12 clear prismatic PMMA diffuser.
Frame:
white painted low profile anodised aluminium frame with 4mm toughened safety glass cover and polyurethane foam gasket.
Reflectors:
pre-painted steel, white finish (louvre optic versions only)

Installation/Mounting

Designed for installation into most ceiling type systems including exposed and concealed tees (luminaires are not compatible when ceiling tiles join the concealed tee on a side 'off centre' position), spring tees (luminaire lamps must run parallel to the spring tees) and solid ceilings. In general the tee size and ceiling structure will determine luminaire compatibility. The tee must have maximum dimensions of up to 24mm in width and a height range between 20mm to 60mm. Further ceiling details can be found on page 15. Please consult the ceiling manufacturers technical specification for compatibility.

Invincible II has 4 x 20mm diameter suspension holes. Please note on this installation method the gear tray needs to be removed before the housing is installed. This must only be completed by a qualified professional.
Suction cups must be ordered separately and are required to open the luminaire.
An internal locking mechanism secures the front frame to the housing. All luminaires have a 4-point pre-fitted adjustable levelling mounting kit.

Standards

Designed and manufactured to comply with EN 60598
Emergency version with EN 605982.22
Suitable for cleanrooms in EN ISO 14644-1, classes 3 to 9
Class I electrical
IK07 impact resistance
IP65 (below)
IP54 (above)

Specification

To specify state:
Recessed luminaire IP65/54 sealed with clear prismatic diffuser or louvre optics.
Smooth white low profile anodised aluminium extruded frame with a 4mm toughened safety glass cover. For 14/24/28/54W T16 linear fluorescent lamps or 40/55W TC-L compact fluorescent lamps with high frequency control gear.
Self regulating breather.
As Thorn Invincible II

Ordering Guide

Lamps and suction cup to be ordered separately. The installer must decide the appropriate quantity of suction cups required for each project.

Description	Ilcos Code	Socket	Weight (Kg)	SAP Code
Louvre Versions				
600x600				
INVINC2 4X14W T16 HF DSB IP65	FDH	G5	13.4	96502859
INVINC2 4X24W T16 HF DSB IP65	FDH	G5	13.4	96502861
INVINC2 3X40W TC-L HF DSB IP65	FSD	2G11	10.4	96502866
INVINC2 3X55W TC-L HF DSB IP65	FSD	2G11	10.4	96502867
INVINC2 4X14W T16 HFD DSB IP65	FDH	G5	13.4	96502871
INVINC2 4X24W T16 HFD DSB IP65	FDH	G5	13.4	96502873
INVINC2 3X40W TC-L HFD DSB IP65	FSD	2G11	10.4	96502878
INVINC2 3X55W TC-L HFD DSB IP65	FSD	2G11	10.4	96502879
INVINC2 4X14W T16 HF E3 DSB IP65	FDH	G5	14.4	96502883
INVINC2 4X14W T16 HFD E3 DSB IP65	FDH	G5	14.4	96502895
300x1200				
INVINC2 2X28W T16 HF DSB IP65	FDH	G5	9.9	96502856
INVINC2 2X54W T16 HF DSB IP65	FDH	G5	9.9	96502857
INVINC2 2X28W T16 HFD DSB IP65	FDH	G5	9.9	96502868
INVINC2 2X54W T16 HFD DSB IP65	FDH	G5	9.9	96502869
INVINC2 2X28W T16 HF E3 DSB IP65	FDH	G5	10.9	96502880
INVINC2 2X54W T16 HF E3 DSB IP65	FDH	G5	10.9	96502881
INVINC2 2X28W T16 HFD E3 DSB IP65	FDH	G5	10.9	96502892
INVINC2 2X54W T16 HFD E3 DSB IP65	FDH	G5	10.9	96502893
600x1200				
INVINC2 4X28W T16 HF DSB IP65	FDH	G5	18.5	96502863
INVINC2 4X54W T16 HF DSB IP65	FDH	G5	18.5	96502865
INVINC2 4X28W T16 HFD DSB IP65	FDH	G5	18.5	96502875
INVINC2 4X54W T16 HFD DSB IP65	FDH	G5	18.5	96502877
INVINC2 4X28W T16 HF E3 DSB IP65	FDH	G5	19.5	96502887
INVINC2 4X54W T16 HF E3 DSB IP65	FDH	G5	19.5	96502889
INVINC2 4X28W T16 HFD E3 DSB IP65	FDH	G5	19.5	96502899
INVINC2 4X54W T16 HFD E3 DSB IP65	FDH	G5	19.5	96502901

HF- High Frequency
HFD- High Frequency Dimmable
E3 - Emergency
DSB - Double Parabolic Satinbrite Louvre

Description	Ilcos Code	Socket	Weight (Kg)	SAP Code
Prismatic Diffuser Versions				
600x600				
INVINC2 4X14W T16 HF PR IP65	FDH	G5	13.4	96502907
INVINC2 4X24W T16 HF PR IP65	FDH	G5	13.4	96502909
INVINC2 3X40W TC-L HF PR IP65	FSD	2G11	10.4	96502914
INVINC2 3X55W TC-L HF PR IP65	FSD	2G11	10.4	96502915
INVINC2 4X14W T16 HFD PR IP65	FDH	G5	13.4	96502919
INVINC2 4X24W T16 HFD PR IP65	FDH	G5	13.4	96502921
INVINC2 3X40W TC-L HFD PR IP65	FSD	2G11	10.4	96502926
INVINC2 3X55W TC-L HFD PR IP65	FSD	2G11	10.4	96502927
INVINC2 4X14W T16 HF E3 PR IP65	FDH	G5	14.4	96502931
INVINC2 4X14W T16 HFD E3 PR IP65	FDH	G5	14.4	96502943
300x1200				
INVINC2 2X28W T16 HF PR IP65	FDH	G5	9.9	96502904
INVINC2 2X54W T16 HF PR IP65	FDH	G5	9.9	96502905
INVINC2 2X28W T16 HFD PR IP65	FDH	G5	9.9	96502916
INVINC2 2X54W T16 HFD PR IP65	FDH	G5	9.9	96502917
INVINC2 2X28W T16 HF E3 PR IP65	FDH	G5	10.9	96502928
INVINC2 2X54W T16 HF E3 PR IP65	FDH	G5	10.9	96502929
INVINC2 2X28W T16 HFD E3 PR IP65	FDH	G5	10.9	96502940
INVINC2 2X54W T16 HFD E3 PR IP65	FDH	G5	10.9	96502941
600x1200				
INVINC2 4X28W T16 HF PR IP65	FDH	G5	18.5	96502911
INVINC2 4X54W T16 HF PR IP65	FDH	G5	18.5	96502913
INVINC2 4X28W T16 HFD PR IP65	FDH	G5	18.5	96502923
INVINC2 4X54W T16 HFD PR IP65	FDH	G5	18.5	96502925
INVINC2 4X28W T16 HF E3 PR IP65	FDH	G5	19.5	96502935
INVINC2 4X54W T16 HF E3 PR IP65	FDH	G5	19.5	96502937
INVINC2 4X28W T16 HFD E3 PR IP65	FDH	G5	19.5	96502947
INVINC2 4X54W T16 HFD E3 PR IP65	FDH	G5	19.5	96502949

Accessories	
SUCTION CUP	20935455

Installation/Mounting

1. Individual suction cup

2. Correct suction cup position

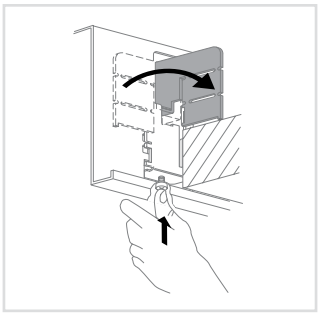
3. Incorrect suction cup position

To open the luminaire

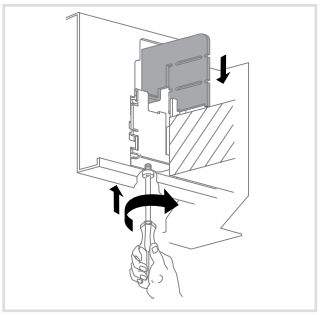
The luminaire is simple to open using a suction cup. NB: suction cups must be ordered independently to luminaires.

1. Push the suction cup onto the frame front glass cover close to the corner (See diagrams 1, 2 & 3)
   NB: If the position of the suction cup is not correctly placed then you may experience difficulties in opening the luminaire
2. Pull the suction cup away from the luminaire
3. The internal locking mechanism will now release the front frame from the housing
4. The frame can now easily be removed from the housing

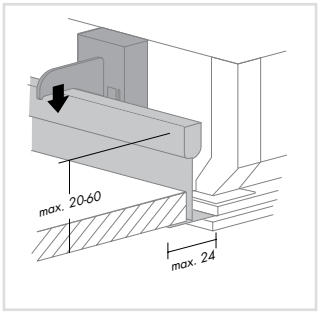
Once the luminaire is removed from the packaging, strips of red paper located inside the luminaire between the frame and housing allows the frame to be removed easily.



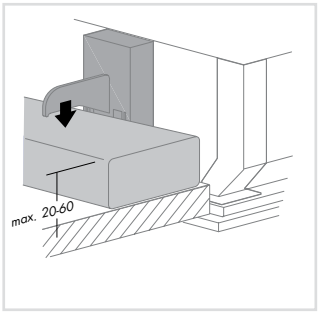
1.



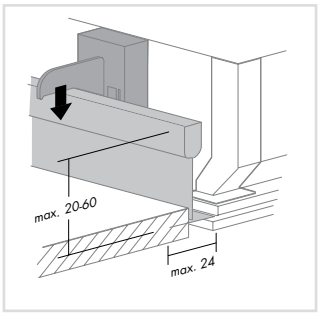
2.



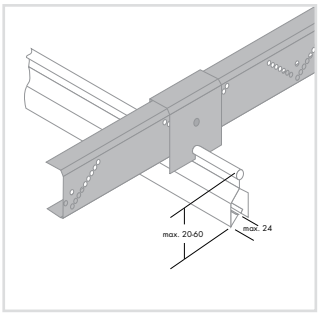
Exposed Tee Ceiling Systems



Solid Ceiling Systems



Concealed Tee Ceiling Systems



Spring Tee Ceiling Systems

Levelling the Luminaire
Luminaires come as standard with 4 pre-installed adjustable levelling kits. The levelling kits are located on the housing sides parallel to the lamps.

Once the luminaire has been placed into the ceiling the levelling kits can be adjusted using a star screw headed tool via a small hole in the housing.

1. Push screw head upwards to automatically flip out the mounting pad
2. Adjust mounting bracket by rotating the screw until the luminaire is level and fixed

Ceiling Type Compatibility
Luminaires are compatible with most exposed tee, concealed tee, spring tee and solid ceiling systems. It is critical that both the ceiling system grid and ceiling tiles are considered when specifing this product range. Please consult the intended ceiling manufacturers technical specification for compatibility.

Exposed Tee Ceiling Systems
- Tee height range – min 20mm to max 60mm
- Tee width range – up to 24mm

Solid Ceiling Systems
- Maximum height from ceiling front edge to the top edge of the aperture is 60mm
- Minimum height from ceiling front edge to the top edge of the aperture is 20mm
- Suitable apertures are recommended to support the weight of the luminaire
- Recommended cut out dimensions are listed in the table below

Concealed Tee Ceiling Systems
- Tee height range – min 20mm to max 60mm
- Tee width range – up to 24mm
- Luminaires are not compatible when ceiling tiles join the tee on a side 'off centre' position

Spring Tee Ceiling Systems
- Tee height range – min 20mm to max 60mm
- Tee width range – up to 24m
- Luminaire lamps must run parallel to the spring tees

Invincible II	Cut Out Length (mm)	Cut Out Width (mm)
2x28/54W	1182	282
4x14/24W	582	582
4x28/54W	1182	582
3x40/55W	582	582

THORN

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