CLIP IN YOUR LINE

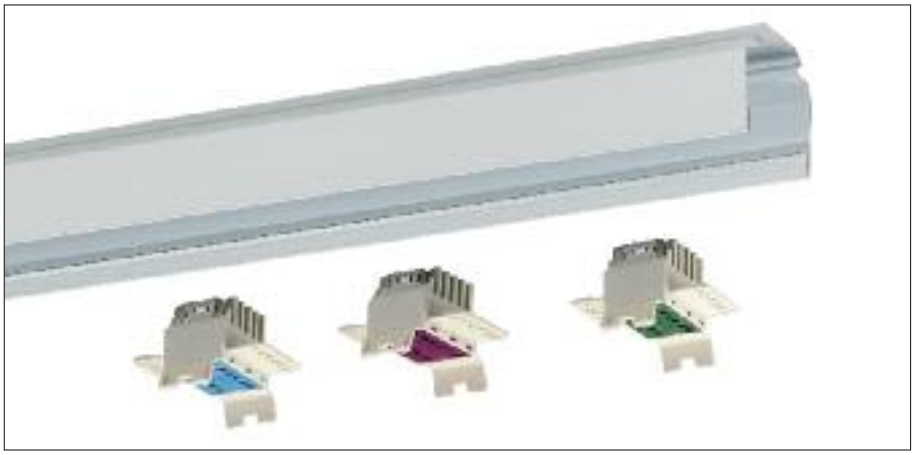
LED CONTINUOUS LIGHTING SYSTEM

RIDI LINIA® LED

RIDI-LED – efficiency plus quality

RIDI LINIA goes LED

RIDI LINIA trunking VLT ...
Stable basic continuous lighting system with through wiring profile



RIDI LINIA LED is taking the familiar RIDI LINIA continuous lighting system to a new level with a solution that is fast, simple, reliable and totally variable – all without the need for tools!
On the basis of the tried and tested continuous lighting system, the new LED gear trays have now been added to the flexible modular concept to create a range of high-efficiency lighting elements.
As well as new installations, existing RIDI LINIA continuous lighting systems can be converted for LED without the need to exchange the trunking.

The luminous flux levels have been designed in keeping with T16HE and HO wattages.
The standard models are available in the colour temperatures 3,000, 4,000 or 6,500 Kelvin with colour rendering Ra > 80.
Special solutions can also be configured using any required luminous flux, colour temperature and colour rendering index.

The linear circuit boards with mid-power LEDs guarantee maximum efficiency.
The circuit boards operated in conformity with SELV have full-surface contact with the aluminium profile for optimum heat dissipation.

The gear trays are available with the following components: standard EVG, dimmable DALI, dimmable 1-10V.
The gear trays are offered in three versions:

- 5-pole with blue colour coding for mounting in VLT-5, VLT-7 or VLT-11
- 7-pole with purple colour coding for mounting in VLT-7 or VLT-11
- 11-pole with green colour coding for mounting in VLT-11

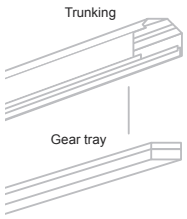
The toolless mounting process used to insert the gear tray in the trunking serves the double function of electrical contacting and mechanical fixture using the tried and tested RIDI quick-release catch (LINIA-TURN, LINIA-R) or stable clamps (LINIA-FLAT). Both solutions provide a secure hold in case of fire.

The gear tray can be mounted in any optional position in the trunking with variable spacing, and can also be combined with VLM modules within the continuous lighting system (the interim spaces created must be fully closed using a dummy cover).

Mechanical trunking connection:
Toolless plug-in connection by simply pushing the trunking elements together

Electrical trunking connection:
Clear coding of the through wiring profiles with continuous colour strips along the sides

Contacting the power take-off at the through wiring profile (for the sake of clarity, only the power take-off is shown here, not the complete gear tray)
The power pick-up also has a contact at the side for automatic earthing.



RIDI LINIA-FLAT

VLG-F with flush integrated linear optics

The gear trays made of extruded profile aluminium accommodate the RIDI LED linear modules and the optics made of clear PMMA with their longitudinal prismatic structure.
The linear modules are held in the aluminium profile by interlocking catches which ensure optimum dissipation of heat over the entire length.
No additional reflectors are required for optical control, making for a low-profile, slimline luminaire design.

Installation

The gear tray is clipped into the trunking using a clamp which provides both electrical and mechanical coupling without the need for tools.
The flexible end cap with seal guarantees compliance with protection rating IP54.

Variants

- One or two linear output variants
- For different applications, six different light distribution modes are available to choose from. For large-scale projects, the optics can also be combined in the two-lamp variant.

Technical data

Subject to technical changes

	Designation	Luminaire output [W]	Luminous flux max. [lm]	Light colour	Luminaire efficiency max. [lm/W]	Available optics
Variants equivalent to T26	VLG-F 136	27	3190	830/840/865	118	T/B/E/D/A/O
	VLG-F 158	40	4820	830/840/865	120	T/B/E/D/A/O
	VLG-F 236	54	6380	830/840/865	118	T/B/E/D/A/O
	VLG-F 258	80	9640	830/840/865	120	T/B/E/D/A/O
equivalent to HO	VLG-F 149	34	4400	830/840/865	129	T/B/E/D/A/O
	VLG-F 180	52	6300	830/840/865	121	T/B/E/D/A/O
	VLG-F 154	35	4000	830/840/865	114	T/B/E/D/A/O
	VLG-F 249	67	8800	830/840/865	131	T/B/E/D/A/O
	VLG-F 280	83	10500	830/840/865	126	T/B/E/D/A/O
	VLG-F 254	70	8000	830/840/865	114	T/B/E/D/A/O
equivalent to HE	VLG-F 128	23	2700	830/840/865	117	T/B/E/D/A/O
	VLG-F 135	28	3400	830/840/865	121	T/B/E/D/A/O
	VLG-F 228	46	5300	830/840/865	115	T/B/E/D/A/O
	VLG-F 235	56	6800	830/840/865	121	T/B/E/D/A/O

IP54

Lengths

	Comparable to gear trays for:
1186 mm	*T16 28 W / 54 W*
1237 mm	*T26 36 W*
1486 mm	*T16 35 W / 49 W / 80 W*
1537 mm	*T26 58 W*

Additional designs

DALI, ED1, ED3, Z, UR

DALI: Dimmable DALI ballast

ED1: Gear tray with emergency lighting element and maintenance-free NiCd battery for 1 hour maintained switching. With a 2-lamp gear tray, in emergency operation 1 lamp is functional. Output in emergency operation 3 W with appr. 380 lm. (Installation over the trunking joint is not possible)

ED3: Gear tray with emergency lighting element and maintenance-free NiMH battery for 3 hours maintained switching. With a 2-lamp gear tray, in emergency operation 1 lamp is functional. Output in emergency operation 3 W with appr. 380 lm. (Installation over the trunking joint is not possible)

Z: Emergency lighting gear tray for central replacement power supply. 1-lamp: 1 lamp for replacement power supply and 1 lamp for standard power supply.

Z-UR: Emergency lighting gear tray with switchover relay for central replacement power supply. 1-lamp: 1 lamp for standard and replacement power supply (maintained mode). 2-lamp: 1 lamp for standard and replacement power supply (maintained mode) and 1 lamp for standard power supply.

Light distribution

Narrow beam (T) | Extreme narrow beam (E) | Wide beam (B) | Diffuse (O) | Asymmetrical (A) | Double asymmetrical (D)

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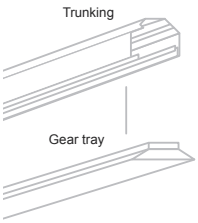

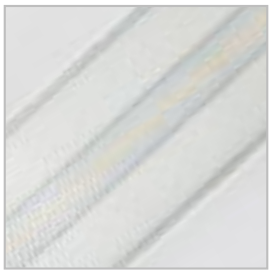

RIDI LINIA-FLAT

VLG-FS with linear optics and/or panel to reduce longitudinal glare

The gear tray made of extruded profile aluminium accommodates the RIDI LED linear modules and the optics made of clear PMMA. In addition, a clear panel can be inserted to allow easy removal of accumulated dirt on the underneath.

The linear modules are held in the aluminium profile by interlocking catches which ensure optimum dissipation of heat over the entire length.

Installation

The gear tray is clipped into the trunking using a clamp which provides both electrical and mechanical coupling without the need for tools.

The flexible end cap with seal guarantees compliance with protection rating IP40. Further development for protection rating IP54 is in progress.

Variants

- One or two linear output variants
- MP: With microprism UV stabilized PMMA panel
- BQP: With wide-beam linear optics and cross-prism UV-stabilised PMMA panel

Technical data

Subject to technical changes

	Designation	Luminaire output [W]	Luminous flux [lm]	Light colour	Luminaire efficiency [lm/W]	Designation	Luminaire output [W]	Luminous flux [lm]	Light colour	Luminaire efficiency [lm/W]
Varianten äquivalent zu T16 HO	VLG-FS 149 MP *	34	3497	840/865	102	VLG-FS 149 BQP	34	3974	840/865	116
	VLG-FS 180 MP	52	5023	840/865	96	VLG-FS 180 BQP	52	5713	840/865	109
	VLG-FS 154 MP	35	3133	840/865	89	VLG-FS 154 BQP	35	3560	840/865	101
	VLG-FS 249 MP	67	6995	840/865	104	VLG-FS 249 BQP	67	7949	840/865	118
	VLG-FS 280 MP	83	8306	840/865	100	VLG-FS 280 BQP	83	9439	840/865	113
	VLG-FS 254 MP	70	6266	840/865	89	VLG-FS 254 BQP	70	7121	840/865	101
äquiv. zu T16 HE	VLG-FS 135 MP *	28	2696	840/865	96	VLG-FS 135 BQP	28	3064	840/865	109

CE · IP40 · LED · LED SELV

* Suitable for illumination of VDU workstations in compliance with DIN-EN 12464-1

Lengths

1186 mm — *Comparable to gear trays for: T16 28 W / 54 W*

1486 mm — *T16 35 W / 49 W / 80 W*

Additional designs

DALI, ED1, ED3, Z, UR
(see explanation on page 6)

Light distribution

All round glare reduction (MP)

Longitudinal glare reduction (BQP)

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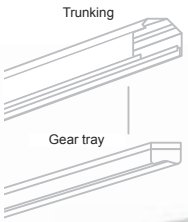


RIDI LINIA-FLAT

VLG-F ... W with diffusor for diffuse light distribution with indirect component

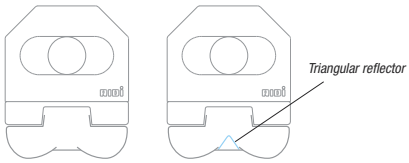
The sectional extruded aluminium gear tray accommodates the RIDI LED linear modules and the diffuser made of satinised, UV-stabilised PMMA.
The linear modules are held in the aluminium profile by interlocking catches which ensure optimum dissipation of heat over the entire length.
For an extremely low-profile, slimline design, the diffuser closes flush with the gear tray and the trunking.

Installation

The gear tray is clipped into the trunking using a clamp which provides both electrical and mechanical coupling without the need for tools.
The diffuser end caps in satinised PMMA act as an insect guard.
Protection rating IP20.

Variants

- Alternatively with central triangular reflector for wider beam and greater indirect component.



Technical data

Subject to technical changes

	Designation	Luminaire output [W]	Luminous flux [lm]	Light colour	Luminaire efficiency [lm/W]
Variants equiv. to T16 HO	VLG-F 149 W	36	3795	840/865	105
	VLG-F 154 W	29	3036	840/865	104
	VLG-F 180 W	51	5161	840/865	101
equivalent to HE	VLG-F 128 W	21	2201	840/865	105
	VLG-F 135 W	25	2808	840/865	112

CE | IP20 | LED | LED SELV

Lengths

1186 mm

1486 mm

Comparable to gear trays for:

T16 28 W / 54 W

T16 35 W / 49 W / 80 W

Additional designs

DALI, ED1, ED3, Z, UR
(see explanation on page 6)

Light distribution

diffuse beam with indirect component

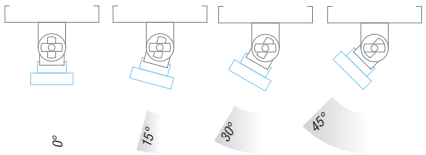
LED technology is in a continuous process of further development. The specified efficiency values are provided as an illustrative example and reflect the state of the art at the time of going to print. The latest updated values can be accessed at www.ridi.de.

RIDI LINIA-TURN-FLAT

VLG-TF with LED lamp L-TUBE-F* with linear optics, swivel-mounted lamp

* For details see page 12

The adjustable L-TUBE-F lamps with rotating bearings can be swivelled in 15° steps without using tools from 0° to 45°.



The light distribution changes depending on the position of the L-TUBE-F and can be adjusted variably as required. L-TUBE-F lamps are included in the delivery.

Installation

The toolless mounting process used to insert the gear tray in the trunking serves the double function of electrical contacting and mechanical fixture using the tried and tested RIDI quick-release catch.
The L-TUBE-F with fixture is clipped into the gear tray, and removed by pressing in the catches using a screwdriver.

Technical data

Subject to technical changes

	Designation	Luminaire output [W]	Luminous flux max. [lm]	Light colour	Luminaire efficiency max. [lm/W]	Available optics
Variants equivalent to T26	VLG-TF 136	27	3190	830/840/865	118	T/B/E/D/A/O
	VLG-TF 158	40	4820	830/840/865	120	T/B/E/D/A/O
	VLG-TF 236	54	6380	830/840/865	118	T/B/E/D/A/O
	VLG-TF 258	80	9640	830/840/865	120	T/B/E/D/A/O
equivalent to T16 HO	VLG-TF 149	34	4400	830/840/865	129	T/B/E/D/A/O
	VLG-TF 180	52	6300	830/840/865	121	T/B/E/D/A/O
	VLG-TF 154	35	4000	830/840/865	114	T/B/E/D/A/O
	VLG-TF 249	67	8800	830/840/865	131	T/B/E/D/A/O
	VLG-TF 280	83	10500	830/840/865	126	T/B/E/D/A/O
	VLG-TF 254	70	8000	830/840/865	114	T/B/E/D/A/O
equivalent to T16 HE	VLG-TF 128	23	2700	830/840/865	117	T/B/E/D/A/O
	VLG-TF 135	28	3400	830/840/865	121	T/B/E/D/A/O
	VLG-TF 228	46	5300	830/840/865	115	T/B/E/D/A/O
	VLG-TF 235	56	6800	830/840/865	121	T/B/E/D/A/O

IP20 LED SELV

Lengths

	Comparable to gear trays for:
1186 mm	*T16 28 W / 54 W*
1237 mm	*T26 36 W*
1486 mm	*T16 35 W / 49 W / 80 W*
1537 mm	*T26 58 W*

Variants

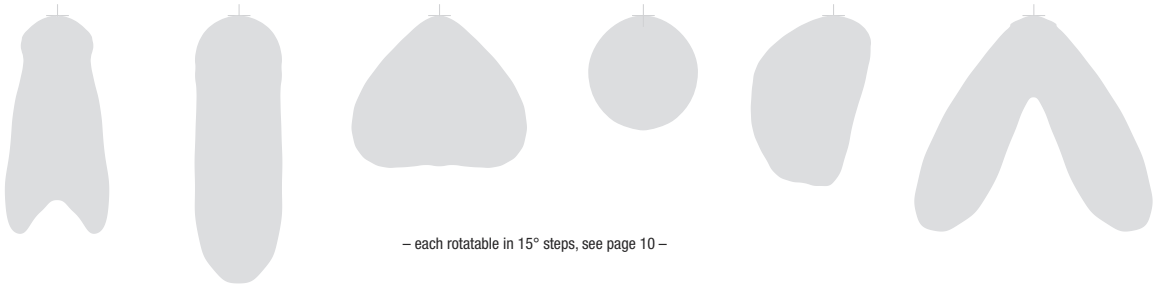
- One or two tube variants
- For different applications, users can choose between six different light distribution options. For large-scale projects, the optics of the two-lamp variant can also be combined.
- Optional cover using a reflector to mask the lamp adapter.

Additional designs

DALI, ED1, ED3, Z, UR
(see explanation on page 6)

Light distribution

Narrow beam (T) | Extreme narrow beam (E) | Wide beam (B) | Diffuse (O) | Asymmetrical (A) | Double asymmetrical (D)



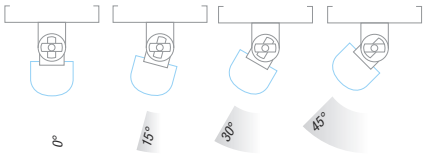
– each rotatable in 15° steps, see page 10 –

LED technology is in a continuous process of further development. The specified efficiency values are provided as an illustrative example and reflect the state of the art at the time of going to print. The latest updated values can be accessed at www.ridi.de.

RIDI LINIA-TURN

VLG-T with LED lamp L-TUBE*,
swivel-mounted lamp * For details see page 12

The adjustable L-TUBE lamps with rotating bearings can be swivelled in 15° steps without using tools from 0° to 45.



For different applications, users can choose between different covers for the L-TUBE (clear, matt or opal).
The light distribution changes depending on the position of the L-TUBE and can be adjusted variably as required. L-TUBE lamps are included in the delivery.

Installation

The toolless mounting process used to insert the gear tray in the trunking serves the double function of electrical contacting and mechanical fixture using the tried and tested RIDI quick-release catch. The L-TUBE with fixture is clipped into the gear tray, and removed by pressing in the catches using a screwdriver.

Technical data *Subject to technical changes*

	Designation	Luminaire output [W]	Luminous flux max. [lm]	Light colour	Luminaire efficiency [lm/W]	Covers
Variants equivalent to T26	VLG-T 136	28	3600	840*	128	clear / matt / opal
	VLG-T 158	39	5400	840*	138	clear / matt / opal
	VLG-T 236	56	7200	840*	128	clear / matt / opal
	VLG-T 258	78	10800	840*	138	clear / matt / opal
equivalent to HO	VLG-T 149	34	4600	840*	135	clear / matt / opal
	VLG-T 180	52	6700	840*	128	clear / matt / opal
	VLG-T 154	35	4400	840*	125	clear / matt / opal
	VLG-T 249	68	9200	840*	135	clear / matt / opal
	VLG-T 280	104	13400	840*	128	clear / matt / opal
	VLG-T 254	70	8800	840*	125	clear / matt / opal
equivalent to HE	VLG-T 128	23	3000	840*	130	clear / matt / opal
	VLG-T 135	28	3700	840*	132	clear / matt / opal
	VLG-T 228	46	6000	840*	130	clear / matt / opal
	VLG-T 235	56	7400	840*	132	clear / matt / opal

** Light colour 830 and 865 on request*

CE · IP20 · LED · LED SELV

Lengths

	Comparable to gear trays for:
1186 mm	*T16 28 W / 54 W*
1237 mm	*T26 36 W*
1486 mm	*T16 35 W / 49 W / 80 W*
1537 mm	*T26 58 W*

Variants

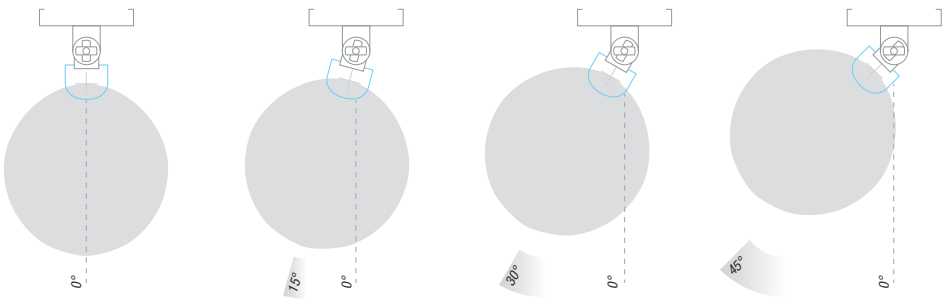
- One or two tube variants
- Exposed with clear, matt or opal cover
- Optional cover using a reflector to mask the lamp adapter

Additional designs

DALI, ED1, ED3, Z, UR
(see explanation on page 6)

Light distribution

Exposed
e.g. one-lamp



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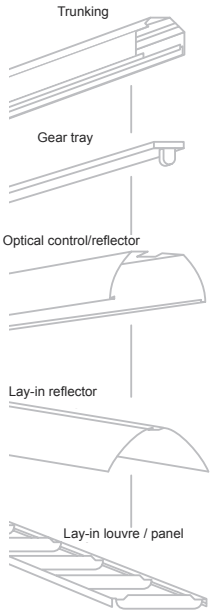
RIDI LINIA-R

RIDI LINIA-R VLG-R with LED lamp R-TUBE * For details see page 12



The design is similar to the existing T16 gear tray and so permits an extensive range of optical controls, reflectors and louvres. The R-TUBEs can be selected with a clear, satinised or opal cover and are also suitable for exposed operation. Using its innovative lamp base system, the R-TUBE can be exchanged just as simply as conventional T16 lamps. R-TUBE lamps are not included in the delivery.

Installation

The toolless mounting process used to insert the gear tray in the trunking serves the double function of electrical contacting and mechanical fixture using the tried and tested RIDI quick-release catch, which is also able to accommodate the optical control.

Technical data

Subject to technical changes

	Designation	Länge [mm]	Luminaire output* [W]	Luminous flux max.* [lm]	Light colour	Luminaire efficiency* [lm/W]
Variants equivalent to T26	VLG-R1X120/25-5ND	1237	28	3600	830/840/865	128
	VLG-R1X150/40-5ND	1537	39	5400	830/840/865	138
	VLG-R2X120/25-5ND	1237	56	7200	830/840/865	128
	VLG-R2X150/40-5ND	1537	78	10800	830/840/865	138
equivalent to HO	VLG-R1X115/30-5ND	1186	35	4400	830/840/865	125
	VLG-R1X145/35-5ND	1486	34	4600	830/840/865	135
	VLG-R1X145/50-5ND	1486	52	6700	830/840/865	128
	VLG-R2X115/30-5ND	1186	70	8800	830/840/865	125
	VLG-R2X145/35-5ND	1486	68	9200	830/840/865	135
	VLG-R2X145/40-5ND	1486	83	11000	830/840/865	132
equivalent to HE	VLG-R1X115/25-5ND	1186	23	3000	830/840/865	130
	VLG-R1X145/30-5ND	1486	28	3700	830/840/865	132
	VLG-R2X115/25-5ND	1186	46	6000	830/840/865	130
	VLG-R2X145/30-5ND	1486	56	7400	830/840/865	132

** Values based on R-TUBE with clear cover*

IP20 | LED | LED SELV

Variants

- One or two tube variants
- Extensive range of optical controls (similar to LINIA T16), e.g. painted reflectors, cross-blade louvres, parabolic louvres, panels.
- The R-TUBE lamp must be ordered separately. The light colour, output and cover of the R-TUBE (matt, opal or clear) can be selected as required.

Additional designs

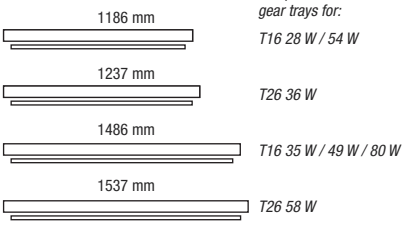
DALI, ED1, ED3, Z, UR
(see explanation on page 6)

Light distribution

exposed

Lengths

Comparable to gear trays for:



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R-TUBE *in RIDI LINIA-R* L-TUBE *in RIDI LINIA-TURN* L-TUBE-F *in RIDI LINIA-TURN-FLAT*

- *High-efficiency LED-TUBE, made by RIDI*
- *Light flux complying with T16 HE and HO wattages*
- *Mid-power LEDs on a stable aluminium base profile*
- *PMMA covers in clear, matt or opal*
- *System efficiency 141 lm/W**
- *Exchangeable without the use of tools*
- *Service life 50,000 hours*
- *5 year warranty*

** L-TUBE with clear cover, length 550 mm*

R-TUBE, L-TUBE and L-TUBE-F are highly efficient LED lamps developed and produced by RIDI. Their dimensions are designed to correspond to conventional fluorescent lamps, and the luminous flux packages also comply with the T15-HE wattages with up to 3,600 lm. HO luminous fluxes of up to 6,700 lm are also available.

Maximum efficiency is guaranteed by the linear circuit boards fitted with mid-power LEDs.
While the efficiency of T16 lamps is limited to 85 - 95 lm/W, the the RIDI LED TUBEs achieve up to 163 lm/W (length 550 mm with clear cover). The SELV-conforming circuit boards are pressed over their whole surface against the stable aluminium base profile using a separate LED converter for optimum thermal management.
Depending on the lighting requirements, RIDI LED TUBEs come with a clear, matt or opal plastic cover, and are available in light colours 3.000, 4.000 or 6.500 Kelvin. They achieve a colour rendering index of Ra > 80.

When used in RIDI LINIA continuous lighting systems, the RIDI LED TUBEs achieve a service life of 50,000 hours.

R-TUBE: lamp base system

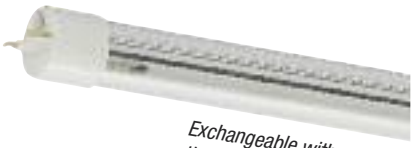
Electrical side

Mechanical side

R-TUBE in RIDI LINIA-R

The innovative lamp base system allows R-TUBEs to be as easily exchanged as conventional T16 or T26 lamps.

Covers clear, matt or opal



Exchangeable without the use of tools

L-TUBE with cover Clear

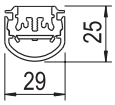
Matt

Opal

L-TUBE in RIDI LINIA-TURN

Fixture using an adapter attached to the L-TUBE. Exchange takes place inclusive of the adapter.

Clear, matt or opal cover.

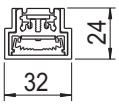


L-TUBE-F with integrated linear optics

L-TUBE-F in RIDI LINIA-TURN-FLAT

Fixture using an adapter attached to the L-TUBE-F. Exchange takes place inclusive of the adapter.

Available optics: Narrow beam, wide beam, extreme narrow beam, double asymmetrical, diffuse beam



LED technology is in a continuous process of further development. The specified efficiency values are provided as an illustrative example and reflect the state of the art at the time of going to print. The latest updated values can be accessed at www.ridi.de.

Modernisation of a lighting system

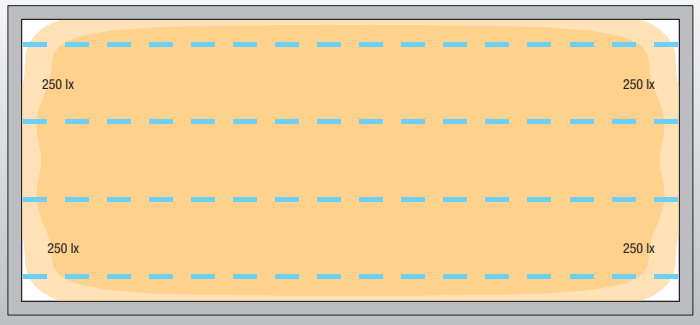
DATA

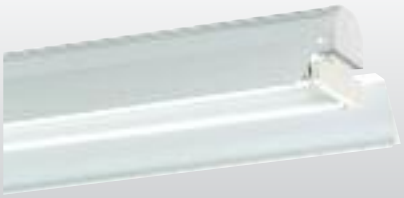
Production hall
Hall dimensions 50 m x 22.5 m
Room height 6 m
Mounting: Pendant
Luminaire type:
Continuous lighting system

Maintenance factor 0.67

Recommended illuminance as per
DIN EN 12464-1:300 lx

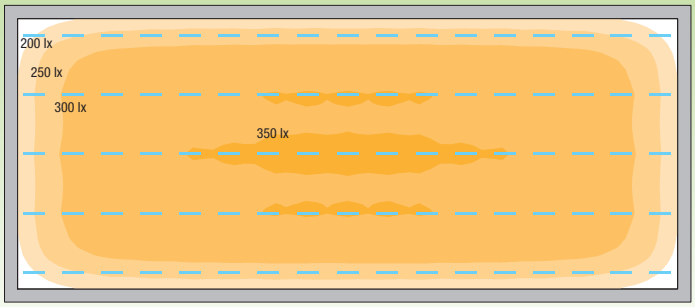
BEFORE





64 continuous lighting system units
VLG 258 + optical control VLRF
VVG, 134 Wsys
Each fitted with 2 T26 fluorescent tubes (58 Watts)

AFTER



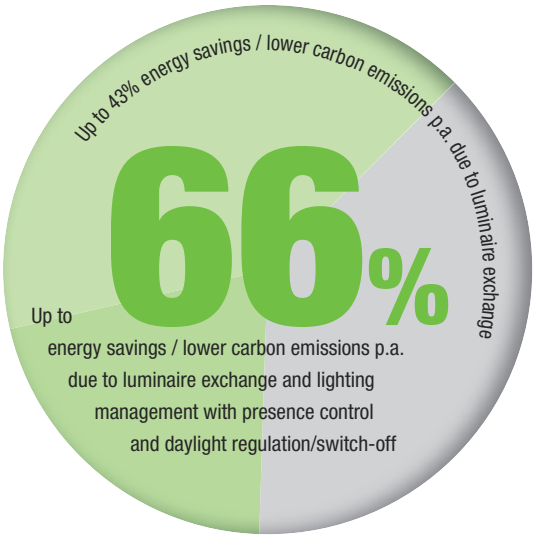
85 continuous **LED** lighting system units
RIDI VLG-F235-5NDWS-736B840
56 Wsys,
fitted with: LED linear profile 2 x 3.680 lm (24 Watt)

SAVING

BEFORE Mean illuminance on the working plane 299 lx with a connected load of **8,600 WATT**

AFTER Mean illuminance on the working plane 312 lx with a connected load of **4,760 WATT**

Energy saving: 43 %



LED technology is in a continuous process of further development. The specified efficiency values are provided as an illustrative example and reflect the state of the art at the time of going to print. The latest updated values can be accessed at www.ridi.de.

LED – The benefits at a glance:

- Long service life of up to 50,000 hours reduces maintenance costs, so producing less waste
- High energy efficiency, specifically in conjunction with light management systems
- No UV radiation
- No infrared radiation, low thermal load in the light cone
- Good colour rendering
- 100% light immediately on activation – no flickering
- LEDs are dimmable
- High switching resistance
- LEDs are highly durable, impact and vibration resistant
- Free of mercury

Low energy consumption

Users may look forward to reduced energy bills. These luminaires supply a higher light yield coupled with lower power consumption than comparable luminaires using conventional lamps – without compromising on performance and reliability. Produced and developed in our plant in Jungingen/Germany, we use exclusively LEDs from leading manufacturers which have been tested to ensure optimum operation in our luminaires. This level of efficiency ensures that the required level of illuminance is achieved at the workplace and in other applications while using significantly less energy.

Reliability and a long service life

LED luminaires achieve a maintenance-free service life of up to 50,000 hours. Light yield and reliability are maintained to a large degree over the entire service life of the luminaire. The LED modules are designed so that they can be simply exchanged at the end of their life. RIDI R-TUBES can be simply exchanged without the need for tools in a similar way to conventional fluorescent lamps.

RIDI LED
Efficiency and quality

Warranty

RIDI grants a 5 or 3-year warranty on its LED modules, LED gear and other LED components (5 years for products with a rated service life of ≥ 50,000 operating hours, 3 years for products with a rated service live of < 50,000 operating hours). The warranty is applicable across Europe, but can also be extended on request to other countries. It covers exclusively product failures due to material, design or production faults.
For more information, go to www.ridi.de/en/service/warranty

Replacement

Because RIDI produces its own LED modules and R-TUBEs in-house at its Jungingen production plant, RIDI is able to guarantee equivalent replacement deliveries for a period of 10 years.

Quality made by RIDI – lamps produced in-house

By investing in an LED mounting line, RIDI is now able to produce its own specially adapted LED modules in its Jungingen plant. This allows RIDI to respond independently, flexibly and rapidly to changing demands on lighting technology and design. This offers scope for the flexible mounting of LEDs and subsequent soldering of individual modules in different configurations, dimensions, luminous intensities and light colours. The surface area and linear modules can be adjusted for different types of luminaires to achieve optimum illumination. Another quality benefit of our own mounting line is that ESD damage to the circuit boards can be excluded by implementing the necessary protective measures.

Quality testing

To ensure that only the very best quality products leave our production line, RIDI imposes stringent requirements on itself and on the materials it uses.
A high quality standard is ensured by continuous testing.
Solder points are X-rayed for cavities and microsections are produced.
The mechanical strength of the LED modules is placed under close scrutiny by means of vibration and torsion testing. The thermal loading capacity is tested using climatic and temperature chambers, and photometric characteristics are determined and verified by measurements using spectroradiometers, Ulbricht spheres and photogoniometers.
Compatibility with materials and substances which could impact on the LED quality is tested at elevated ambient temperatures.

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