

Introduction

Weiss Klimatechnik are experts in the design of ultra clean ventilation (UCV), laminar flow ceilings for aseptic operating theatres.

Brandon Medical are experts in the design of surgical operating theatre luminaires and have particular expertise in the design of operating theatre lights for use with UCVs.

The purpose of this study is to prove the suitability of Brandon Medical's latest range of Galaxy Ultra operating theatre lights for use with UCVs and with Weiss Klimatechnik's UCVs in particular.

Executive Summary

The tests successfully demonstrated that Galaxy Ultra operating lights are suitable for use in UCVs. The shape of the light heads is effective in minimizing disruption to the air flow and there is no disruption from thermal buoyancy.

Initial tests were done with the lights turned off. The Galaxy Ultra lights created minimal disturbance of the laminar airflow in any of the 3 positional orientations used during the tests. The test demonstrate that the geometric shape of the Galaxy Ultra light heads is an aerodynamically efficient



shape in a working UCV. Furthermore, the test shows that the unique design of Galaxy Ultra light heads allow them to be placed at different incident angles to the airflow without any significant increase in disruption to the airflow.

A second set of tests were performed with the lights turned on and allowed to reach working temperature. The tests demonstrated that there was no significant increase in disruption of the airflow due to thermal buoyancy from the operating lights.

Method of Testing

Weiss ULA.4 32/32

The canopy used for the test was a return air canopy type ULA.4 32/32 with an outlet area of 3,185 x 3,185 m². The supply air velocity at 2 m from FFL was 0,38 m/sec average and 1 m from FFL not less than 0,2 m/sec. The side walls of the canopy came down to 2 m from FFL.

Galaxy Ultra 53

The operating light used for the tests was a Galaxy Ultra 53. This model uses 5 x 50W tungsten halogen light sources in the main light head and 3 x 50W tungsten halogen light sources in the satellite light head. Maximum light intensity is 140,000 Lux and 85,000 Lux from the main and satellite lights respectively.



The Galaxy Ultra light heads are a reticulated design developed specifically to minimize the disruption of the laminar airflow in UCV ceilings. The shape of the individual pods, the reticulation and the thermal management have all been optimized for this application.

Conclusions

It is clear that the positioning of any object within the controlled airflow of a UCV ceiling will cause some disruption of the airflow. It is well known that most operating lights will cause significant disruption to the airflow due to their large size, aerodynamic profile and thermal buoyancy (from waste heat). It is also clear that the orientation of the light heads relative to the laminar flow has a major impact on the level of air flow disruption.

The first tests with the Galaxy Ultra lights turned off show a very small level of disruption to airflow at the periphery of the UCV. The level of disruption was not significantly different in any of the 3 orientations measured.

The second tests with the light at working temperature did not show any significant increase in disruption to the air flow.

We consider this to be an excellent result and a clear demonstration that these lights are suitable for installation within UCVs.

Further recommendations for use

The 5 light source light head performed slightly better than the 3 light source unit which is due to its more "open" structure so a slightly better performance could be achieved by using a GU54 or GU55 model.

Positioning the light heads centrally above the operating table should be avoided. The light heads should be positioned either behind the surgeon's shoulders, on the opposite side of the table to the surgeon or at the ends of the operating table.



Air Velocity reading at 1 m without lights

Lindenstruth, den 17.10.07

17,2

fresh Air	FAN	Recirculation AIR = 21,3°C	FAN	fresh Air
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		0,29	0,57	0,43	0,36	0,40	0,58	0,30		
		0,32	0,59	0,45	0,35	0,51	0,42	0,35		
		0,32	0,52	0,44	0,38	0,35	0,47	0,39		
		0,33	0,48	0,35	0,33	0,40	0,44	0,33		
		0,39	0,58	0,39	0,25	0,40	0,53	0,25		
		0,33	0,68	0,48	0,38	0,46	0,55	0,26		
		0,30	0,43	0,36	0,35	0,34	0,29	0,21		

16,9

fresh Air	FAN	Recirculation AIR = 21,1°C	FAN	fresh Air
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Fresh Air ca. 6.000 m³/h ; Recirculation Air = 8.400 m³/h at all = ca. 14.400 m³/h; Velocity 10 sec.average ; Diff. fabric at 1,5 x 1,5 m ; measuring area at Floor = 2,1 m x 2,1 m, room temperature = 20,9 °C



Air Velocity reading at 1 m Pic 4; lights working

Lindenstruth, den 15.11.07

17,2

fresh Air	FAN	Recirculation AIR = 20,2°C	FAN	fresh Air
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		0,29	0,38	0,33	0,23	0,17	0,36	0,33		
		0,39	0,46	0,49	0,37	0,54	0,55	0,35		
		0,34	0,59	0,51	0,39	0,47	0,53	0,36		
		0,41	0,55	0,40	0,37	0,41	0,44	0,36		
		0,32	0,40	0,39	0,44	0,41	0,44	0,37		
		0,40	0,39	0,41	0,53	0,52	0,54	0,36		
		0,28	0,40	0,32	0,19	0,19	0,34	0,26		

16,9

fresh Air	FAN	Recirculation AIR = 20,3°C	FAN	fresh Air
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Fresh Air ca. 6.000 m³/h ; Recirculation Air = 8.400 m³/h at all = ca. 14.400 m³/h; Velocity 10 sec.average ; Diff. fabric at 1,5 x 1,5 m ; measuring area at Floor = 2,1 m x 2,1 m, room temperature = 19,8 °C



Air Velocity reading at 1 m Pic 4; lights off

Lindenstruth, den 08.11.07

17,2

fresh Air	FAN	Recirculation AIR = 20,6°C	FAN	fresh Air
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		0,30	0,40	0,47	0,38	0,45	0,50	0,25		
		0,35	0,58	0,48	0,40	0,55	0,65	0,29		
		0,32	0,52	0,39	0,25	0,42	0,54	0,27		
		0,31	0,45	0,40	0,27	0,40	0,44	0,32		
		0,33	0,57	0,47	0,36	0,43	0,41	0,34		
		0,37	0,60	0,43	0,44	0,39	0,50	0,24		
		0,36	0,43	0,17	0,33	0,36	0,47	0,22		

16,9

fresh Air	FAN	Recirculation AIR = 21,3°C	FAN	fresh Air
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Fresh Air ca. 6.000 m³/h ; Recirculation Air = 8.400 m³/h at all = ca. 14.400 m³/h; Velocity 10 sec.average ; Diff. fabric at 1,5 x 1,5 m ; measuring area at Floor = 2,1 m x 2,1 m, room temperature = 20,6 °C



Air Velocity reading at 1 m Pic 3; lights working

Lindenstruth, den 14.11.07

16.5

fresh Air	FAN	Recirculation AIR = 21,4°C	FAN	fresh Air
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		0,30	0,47	0,50	0,51	0,18	0,40	0,24		
		0,33	0,52	0,47	0,53	0,16	0,43	0,43		
		0,46	0,48	0,36	0,51	0,58	0,63	0,23		
		0,35	0,47	0,40	0,38	0,47	0,54	0,45		
		0,39	0,44	0,37	0,48	0,50	0,36	0,32		
		0,38	0,48	0,41	0,49	0,19	0,24	0,23		
		0,31	0,41	0,40	0,37	0,24	0,32	0,24		

16.9

fresh Air	FAN	Recirculation AIR = 21,7°C	FAN	fresh Air
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Fresh Air ca. 6.000 m³/h ; Recirculation Air = 8.400 m³/h at all = ca. 14.400 m³/h; Velocity 10 sec.average ; Diff. fabric at 1,5 x 1,5 m ; measuring area at Floor = 2,1 m x 2,1 m, room temperature = 21,2 °C



Air Velocity reading at 1 m Pic 3; lights off

Lindenstruth, den 07.11.07

16,5

fresh Air	FAN	Recirculation AIR = 19,8°C	FAN	fresh Air
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		0,21	0,53	0,47	0,15	0,22	0,52	0,32		
		0,30	0,57	0,31	0,24	0,16	0,47	0,51		
		0,28	0,47	0,38	0,43	0,42	0,53	0,39		
		0,33	0,46	0,42	0,34	0,51	0,46	0,45		
		0,39	0,56	0,35	0,26	0,38	0,52	0,32		
		0,43	0,56	0,35	0,21	0,25	0,47	0,31		
		0,38	0,56	0,23	0,17	0,20	0,52	0,22		

16,9

fresh Air	FAN	Recirculation AIR = 20,1°C	FAN	fresh Air
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Fresh Air ca. 6.000 m³/h ; Recirculation Air = 8.400 m³/h at all = ca. 14.400 m³/h; Velocity 10 sec.average ; Diff. fabric at 1,5 x 1,5 m ; measuring area at Floor = 2,1 m x 2,1 m, room temperature = 19,7 °C



Air Velocity reading at 1 m Pic 2; lights working

Lindenstruth, den 13.11.07

fresh Air	FAN	Recirculation AIR = 20,6°C	FAN
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		0,38	0,23	0,21	0,14	0,45	0,57	0,38		
		0,58	0,33	0,15	0,18	0,24	0,44	0,45		
		0,41	0,54	0,33	0,46	0,60	0,54	0,44		
		0,40	0,55	0,48	0,38	0,46	0,56	0,51		
		0,36	0,32	0,42	0,40	0,45	0,48	0,39		
		0,38	0,32	0,41	0,41	0,57	0,55	0,49		
		0,37	0,30	0,26	0,22	0,15	0,29	0,32		

16,9

fresh Air	FAN	Recirculation AIR = 21,1°C	FAN
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Fresh Air ca. 6.000 m³/h ; Recirculation Air = 8.400 m³/h at all = ca. 14.400 m³/h; Velocity 10 sec.average ;
Diff. fabric at 1,5 x 1,5 m ; measuring area at Floor = 2,1 m x 2,1 m, room temperature = 20,7 °C