ACAR HAKAN BAYRAMOGLU

Operation Theatres

“Construction”

TYPICAL OPERATION THEATRE

Construction Standards and Materials

All information described in this booklet, is aiming to give brief explanations about construction design and materials about Operation Theatres. Acar Hakan Bayramoglu keeps the rights of changing the information according to the variations of the international standards.

Tel + 90 212 672 5804 (after 19:00) • Mobile + 90 532 546 9890

Contents

Foreword

The studies concerning Hygienic Air-Conditioning Systems in the operating theaters have been started by me in 1989 and until 1995 interior construction details were separately handled.

Feasibility Studies

Architectural Planning and Designing

Interior Construction

Installations (medical gas systems, hygienic air systems, water treatment, waste treatment)

Medical Equipment

Section

1

Standards

Country	**Standard**	Year
Austria	Ö-Norm H 6020 - 1 and 2	1999
Germany	DIN 1946 - 4	1999
Great Britain	Health Technical Memorandum 2025	1999
New Zealand	NZ Code of Practice for Ventilation Requirements for Operating Theatres. Draft for Comment	1995
Switzerland	SKI Richtlinie 35	1987
USA	ASHRAE Handbook "HVAC Applications", Chapter 7 "Health Care Facilities"	1999

Different requirements for highly aseptic operating rooms

Standard	Requirements for highly aseptic operating rooms									
	Type of Airflow	Size of outlet	Air Flow Rate	Fresh Air Portion	Air Filters	Air CleanlinessClass	Airborne CFU	Tempe-rature	Humidity	Sound Level
Austria Ö-Norm H 6020-1	LF	-	< 0,45 m/s	20 m³/hm²	F7+F8 +H13	100 Fed.Std.209	-	22-24°C	40% 60 %	45 dB(A)
Germany DIN 1946 part 4	Vertical LF	> 2,9 m²	µ*3600m³/h	1.200 m³/h	F5+F7 +H13	-	-	22-26°C	DIN 1946/2 (20-65%)	40 dB(A)
Great Britain Health Technical Memorandum 2025	unidirectio-nal non-LF	> 7,8 m²	> 0,2 m/s	2.700 m³/h	EU3+EU9	-	<10BCP/m³ < 1 BCP/m³	16-25°C	55%+-5%	50 dB(A)
New Zealand Code of Practice for Vent. Requ. for OTs	downflow	not specified	>20 1/h	> 10 %	terminal HEPA	10.000 Fed.Std.209	-	18-25°C	50-65%	-
Switzerland SKI 35/1987	Vertical LF	6-11 m²	0,25-0,45 m/s	80 m³/h person	EU5+EU8 +EU11	-	<10 CFU/m³	18-24°C	30%	50 dB(A)
USA, ASHRAE Handbook "HVAC Appl.", "Health Care Facilities"	Vertical LF	not specified	15 1/h	3 1/h	EU4+EU7/8	100 Fed.Std.209	-	21-24°C	50-60 %	-

CFU – colony forming units

BCP – bacteria carrying particles

dT – temperature difference for winter heating or summer cooling

Requirements for OTs according to

DIN EN1946 part 4

min supply air	"normal" Ots "highly" aseptic Ots	µ*2.400 m³/h µ*3.600m³/h
min. fresh air		1.200 m³/h
min. supply air rate outside normal hours of use		hygienic overflow or > 2m/s
air filters	"normal" Ots "highly" aseptic Ots	F5+F7+H13
max. noise level		40 dB(A)
design temperature (winter)	indoor outdoor	26°C ta, DIN 4701
design temperature (summer)	indoor outdoor	22°C ta, VDI 2078 – 4K
min. relative humidity (winter)		DIN 1946/2 30% (20%)
max relative humidity (summer)		DIN 1946/2 65% or 11,5 g/kg
return air inlets	lower upper	>1.200 m³/h rest

Section

2

Stages of Constructing an Operation Theatre

Architectural Planning and Designing

An operation theatre should have 6 meters by 6 meters floor area and 3 meters height as finished or 3,5 meters height as building construction from floor to ceiling concrete. These dimensions are equal to 20 air–changes per hour for an operation theatre which equals about 2.400 m^3 air volume per hour minimum.

All surfaces inside of operation theatre, must be flat and can not build or left any surface which can not easily cleanable and germ or microorganisms can live potentially.

Projects should draw by an engineer group consists of hospital, electrical, electronic, mechanical, and building engineers. Mechanical engineers should have enough education and experience about heating, cooling, HVAC, medical gas and plumbing systems.

Determination of necessary materials and equipments

All necessary materials and equipments should be determined according to the drawn projects and offers should have been requested from the authorized sales companies.

The sales conditions of the companies should inspect very carefully by purchasing department and different offers should compare to each others according sales and delivery conditions.

Timing

According to delivery terms of the offers, general time schedule of project should arrange by the engineers.

Of course, it is very important point that the workers should be well trained about application of sterile areas, prevention rules of the materials and storing the products before mounting them.

Logistic services are one of the most valuable events of these projects. Coordination of the deliveries, working teams, storage management, engineering infrastructure and inspecting the finishes are the other important points.

Validating the air handling units, hygienic equipments and complete operation theatres, is another issue of these projects.

Section

3

Construction Materials and Equipments

Necessary materials and equipments should evaluate in six different sections as below;

1. Building Materials
2. Electrical and Electronic Equipments
3. Medical Gas Equipments
4. Hygienic Ventilation & Air-Conditioning Equipments
5. Automation
6. Multi-function Equipments

Section
3.1

3.1 Building Materials

The building materials are ;

3.1.1 Wall Coverings

3.1.2 Floor Coverings

3.1.3 Ceiling Coverings

3.1.4 Doors

3.1.5 Scrub Units

3.1.6 Technical Walls

3.1.1 Wall Coverings

3.1.1.1 Compact Laminated Panels Wall Covering

Panels should be made of high pressure compact laminate sheet consisting of layers of cellulosic fibrous material impregnated with thermosetting resins and bonded together by a high pressure process.

- Panels should made from thermo-setting resins that are very stable ,
- Panels should be extremely impact and abrasive resistant,
- Panels should be highly water resistant ,
- Panels should be hygienic and do not support bacteria or mould growth,

- Panels should be easily cleanable or resistant to disinfectants.
- Graffiti is easily removed without damage to the finish
- Panels don't lose integrity – even after willful damage
- Compact Laminates should fully comply with the demands of the International Standards for high pressure laminates: American NEMALD-3 and European EN 438. The Fire Retardant Laminates also comply with the American Standard ASTM E-84 and the British Standard B.S. 476

Operation theatres will be framed by 50 x 50 x 3 mms galvanized steel profiles with 55 cms intervals.

Profile tops will be closed with isobuthylen covers. Profiles will be fixed with galvanized fixation plates mechanically. Longitudinal profiles will be framed with 6 rows of horizontal 15 x 25 cms galvanized steel profiles. The bottom 10 cms part of the construction will be covered with MDF band for PVC coverings. 10 mms thick Compact laminated panels are hung on the construction with special galvanized hinges, between the axis 10 cms- 295 cms.

PICTURE 1
An application of compact laminated wall covering in operation theatre

3.1.1.2 Vinyl Wall Covering

It must be flexible vinyl sheet constructed from plasticised PVC with colored grains encrusted into the homogeneous wearlayer. Minimum thickness should be 1.5 mm. It must be reinforced with a non-woven glass fibres grids.

The joins should be welded as hot-welding system to ensure perfect waterproof specification. It must be treated with an anti-bacterial and anti-fungicidal treatment material.

It must be complied with EN 649, as fully resistant to impact. It must act as a buffer against damage from trolleys, indoor motorized vehicles and other transportation materials.

It must be recyclable and environment friendly.

PICTURE 2
An application of vinyl wall covering in operation theatre

3.1.2 Floor Coverings

3.1.2.1 PVC Floor Covering

It should be static-conductive, flexible homogeneous vinyl floor covering with an electrical resistance of 5 x 10^4 to 10^6 EN 1081, available in tiles. The conductive carbon coated PVC pellets should

create the permanent static-conductive properties. It should comply with EN 649.

Below technical specifications should be asked to the producer;

- 2 mm thickness according to EN 428,
- 3.150 gr/m² weight according to EN 430,
- 600 x 600 mm tile dimension EN 427,
- Comply with European classifications EN 685 and EN 649 34-43
- Comply K5 Classification
- Fire Rating according to EN 13501-1 Bfls1 and DIN 4102 B1
- Electrical resistance < 2 kV according to EN 1815
- Electrical resistance $5 \times 10^4 \leq Ret \leq 10^6$ Ω according to EN 1081
- Abrasion resistance 0,15 mm according to EN 660.1
- Dimensional stability ≤ 0,25 % according EN 434
- Chemical resistance = Good according to EN 423
- Fungustatic & bacteriostatic = Yes

PICTURE 3
An application of PVC floor covering in operation theatre

3.1.3 Ceiling Coverings

3.1.3.1 Acrylic and Anti-Microbial Ceiling Covering

In facilities such as hospitals, pharmaceutical cleanrooms, and laboratories, it is extremely important to both achieve and maintain the highest possible standards of cleanliness and sterility, as airborne bacteria can pose a serious threat to production processes and daily routines. To meet these high standards, it is essential that walls, ceilings and floors are kept free from bacterial contamination.

Water based hygiene coatings for application to the internal ceilings of sterile environments. It should be specially developed to provide complete long-term protection against the growth of mould, bacteria and yeasts, the coatings should incorporate an advanced anti-microbial system which combats micro-organisms.

The coatings should apply in a cold fluid form by brush, roller or airless spray, provide a truly seamless finish irrespective of the configuration of the substrate. As they should be free from joints, seams and other fixings which might harbour dirt and bacteria, it should provide a tough, easy clean surface.

PICTURE 4
An application of ceiling covering in operation theatre

3.1.4 Doors

3.1.4.1 Non-hermetic Automatic Sliding Doors

They have been using for positive pressure controls of sterile areas such as Intensive Care Units, Medical Operation Rooms, Laboratories and Operation Theatres.

PICTURE 5

An application of operation theatre door

The doors should have aluminum profile case 2.8 mm, stainless steel (AISI 304) covered body, EPDM gasket and polypropylen brushes. Double sided wieving glass, flat and 4 mm thickness, dimension is 30x50 cm, aluminum profiles between glasses, aluminum frames thickness 1 mm.

Specifications should be as below;

MECHANISM :

Mechanism	: Microprocessor controlled
Opening Speed	: 10-60 cms / sec, adjustable
Closing Speed	: 10-60 cms / sec, adjustable
Open Position Period	: 0,5 – 30 sec, adjustable
Opening Length	: Adjustable
Brake Torque	: Adjustable
Motor	: Brushless DC
Permanent Pressure	: 5 – 15 kg when closed position

Necessary set-up adjusting should be viewed and adjust from LED display.

Electrostatic powder covered aluminum profile mechanism cover should be installed.

CASE :

It should be Stainless Steel (AISI 304) and security photocell should be on it.

HANGER PULLEYS :

Door position should be adjustable via hanger pulleys. Both vertical position and horizontal position should be fixed.

CONTROL :

Doors should open via IP 65 class buttons which are mounted inside and outside of the area.

DOOR :

Aluminum profile case 2.8 mm, stainless steel (AISI 304) covered body, EPDM gasket and polypropylen brushes. Double sided viewing glass, flat and 4 mm thickness, dimension is 30x50 cm, aluminum profiles between glasses, aluminum frames thickness 1 mm.

3.1.4.2 Hermetically Sealing Automatic Sliding Doors

The door blade should be suspended from an overhead track and as the door closes it should drop through an angle of 45 degrees inwards and downwards. The rubber gasket should seal the door positively against the frame and the floor.

It should be specifically designed for the use in the Medical and Pharmaceutical Industries, including Clean Rooms, Laboratories, Operating Theatres, X Ray Rooms (with lead lining within the door blade) and any other area requiring a clean, hygienic well sealing door.

PICTURE 6
An application of hermetic doors in operation theatre

It should be supplied a sealing frame manufactured from satin anodized aluminum profiles which is designed to fit the sub-frame. The sealing frame should be fixed by means of screws, which are concealed by a self-adhesive cover strip. The door track is manufactured from a satin anodized extruded aluminum section. The track should be completely covered by an aluminum or stainless steel canopy with a sloping top to prevent the build up of dust. The door blade should be a single leaf construction comprising of a 41mm thick solid core faced with plastic laminate on both sides. It should be encapsulated in a satin anodized extruded aluminum framework giving the overall thickness of 56 mm.

PICTURE 7
Another application of hermetic doors in operation theatre

3.1.5 Scrubs

3.1.5.1 Aseptic Scrub Units

The scrub unit, should have 1, 2 or 3 stations options for use in the operating theatre, incorporate a bacteriological water treatment system (anti-bacterial filter).

The system should operate pneumatically, using knee-controls or by means of a proximity detector.

PICTURE 8
Aseptic Scrub Unit (5 stations)

Water sterilization by means of micro filtration requires a filter element with a pore-size less 0.3 micron. The 0.2 micron scrub filter cartridge should be constructed of polypropylene and should contain nylon 6 filter medium whose reliability and efficiency have been verified under laboratory conditions.

The filtration surface should be minimum 2000 cm^2. The scrub filter cartridge should be adapted to a swan neck by means of a quick-connector. Water proof specification should be guaranteed by silicone seals, eliminating all risk of contaminating the treated water.

It should be possible to autoclave the cartridge and adapter kit up 50 items. A 2 micron pre-filtration system should be available as an option. The thermostatic mixer option should be available.

3.1.5.2 Stainless Steel Scrub Units

It should produce by stainless steel AISI 304 which has 1.5 mm thickness.

Faucets and soap/disinfectant dispensers should be photocell controlled.

Hot and cold water should be adjusted via mixer.

PICTURE 9
Stainless Steel Scrub Unit (2 stations)

Water volume should be adjustable.

3.1.6 Technical Walls

It should be made by stainless steel AISI 304 which has 1.5 mm thickness.

It should mount into the wall.

It has to have enough drawers determined by the hospital management.

As an option, clock and chronometer and x-ray display can be mounted on it.

PICTURE 10
An application of a technical wall

Section 3.2

3.2 Electrical and Electronic Equipments

Equipments are;

- 3.2.1 OT Electrical Supply Panel
- 3.2.2 Isolating Transformer
- 3.2.3 OT Control Panel
- 3.2.4 Lighting Armature
- 3.2.5 Clock and Chronometer
- 3.2.6 Mushroom Type Buttons
- 3.2.7 Temperature Sensor
- 3.2.8 Pressure Sensor
- 3.2.9 Humidity Sensor

3.2.1 OT Electrical Supply Panel

After calculations of necessary total electrical power for the Operation Theatres, individual electrical supply panel should prepare for each operation theatres.

It should be produced with glass for easy viewing and all fuses should be labeled individually.

PICTURE 11
A sample of a supply panel

3.2.2 Isolating Transformer

The transformer should have reinforced insulation and comply with the requirements of DIN EN61558-1 (VDE 570 Part 1):1998-07 and DIN EN 61558-2-15 (VDE 0570 Part 2-15):2001-11. In addition, the transformers should comply with the requirements of DIN VDE 0107(VDE 0107):1994-10, DIN VDE 0100-710 (VDE 0100 Teil 710):2002-11 for IT systems in rooms used for medical purposes.

The windings should have galvanic isolation. In order to minimize electrical interferences, an electrostatic screen should be installed between the primary and secondary winding providing an isolated terminal suitable for connection to the equipotential bonding.

PICTURE 12
A sample of a isolating transformer

The fixing angles should be isolated from the transformer core in order to guarantee an isolated installation to comply with the requirements of DIN VDE 0107 (VDE0107):1994-10,clause 3.3.3.8, DIN VDE0100-710 (VDE 0100 Part 710):2002-11,section 710.512.1,6,2).

The transformer should be available for vertical installation. Protection against corrosion should be guaranteed by a complete resin impregnation. The transformer should be designed for use in dry locations. Transformer should completely encapsulated and fulfill the requirements of protection class II.

The transformer should be designed for rated frequencies of 50 ...60 Hz. Maximum ambient temperature of 40 °C and a rated frequency of 50 Hz should be guaranteed.

Free air circulation must be ensured. If the ambient temperature exceeds 40 °C, the rated power decreases. For temperature monitoring, a PTC thermistor should be placed on each transformer leg and the leads are connected to the terminals.

3.2.3 OT Control Panel

The control panel should be flush mount, stove enameled finish, 2 mm steel case with front and rear access. Front panels should be made as laser cut and from brushed stainless steel. The panel frame system should have a modular format and provide a stylish and effective means of direct mounting of the hardware equipment.

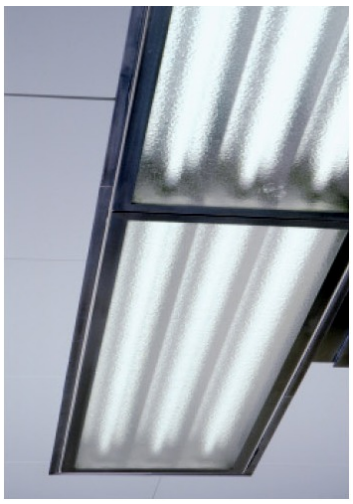
PICTURE 13
A sample of a OT Control Panel

The robust construction should ensure suitability for a wide range of applications with extremely easy assembly.

It must be high range, sophisticated and very easy to use process control unit with two 10 bit RISC microprocessor, LCD display with backlighting, polyester layer keypad, high accuracy temperature, humidity , room and filter pressure measurements, high and low limit alarms and monitors, illumination light dimming and switching, operation lamp primary control, air condition process controls, bidirectional analog data

communication with other process control units, music channel and volume controls, chronometer controls, x- ray viewer dimming and switching.

3.2.4 Lighting Armature



BODY : 0,80 mm Stainless Steel, AISI 304 quality, mat polished.

HANGERS : 2,00 mm Stainless Steel, AISI 304 quality, mono-block

REFLECTOR : 0,40 mm Aluminum, anodized, Alanod 350 G

GLASS : 6,00 mm thickness, 250 °C tempered glass

PICTURE 14
A sample of a Lighting Armature

CABLE : Isolated and fire protected cable

BALLAST : Tridonic, 3 x 36 W, 198 V – 254 V,

SOCKET : Mellert or BJB, polycarbon, water and dust proof

GASKET : EPDM material

3.2.5 Clock and Chronometer

It should be made of 1 mm AISI 304 quality stainless steel body. It should mount into the wall.

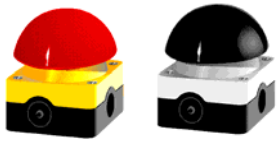
PICTURE 15
A sample of a Lighting Armature

It must have an analog clock supplied by battery, a digital Chronometer which has 5 digits, Liquid Crystal Display, On-Off, Stop and Reset Signals controlled by OT Control Panel.

3.2.6 Mushroom Buttons

It must be IP 65 standard.

It should mount inner or outer side of the sliding doors.



PICTURE 16
Mushroom Buttons

3.2.7 Temperature Sensor

It should mount into the operation room on ceiling for having indoor temperature information and giving data signals to the automation system. These data will be seen on the display of OT Control panel at same time.

3.2.8 Pressure Sensor

It should mount into the operation room on ceiling for having positive and negative pressure information about operation theatre and side areas, and giving data signals to the automation system.

3.2.9 Humidity Sensor

It should mount into the operation room on ceiling for having indoor relative humidity information and giving data signals to the automation system. These data will be seen on the display of OT Control panel at same time.

Section 3.3

3.3 Medical Gas Equipments

3.3.1 Oxygen Central Station

3.3.2 Nitrous Oxide Central Station

3.3.3 Vacuum Central Station

3.3.4 Compressed Air Central Station

3.3.5 Equipments and Devices

3.3.1 Oxygen Central Station

Decompression central station for compressed gas in cylinders connected by means of ramps, a certain number of cylinders in which the gas is stored under pressure according with its characteristics, at the gaseous (oxygen) state.

Oxygen pressure is reduced, adjusted and maintained at the needed distribution level by means of pressure control and reduction panel boards.

The supplying sources are installed in a place easily accessible to the transport vehicles; this place is within a safe distance from the surrounding buildings and plants.

Central station is designed according to the principle of simultaneous operation.

System is in accordance with ISO 7396 norm. EN-737

An oxygen central station consists below units;

3.3.1.1 Automatic Control and Reducing Panel Board

3.3.1.2 Cylinder Ramp with Valve

3.3.1.3 Profile with Separator

3.3.1.4 Pigtail Connecting Ramps to Cylinders and Panel Board

3.3.1.5 Over Pressure Safety Valve and Emergency Outlet Unit

3.3.1.6 High Pressure Evacuation Valve

3.3.1.7 Audiovisual Alarm

3.1.1.1 Automatic Control and Reducing Panel Board

In this system, when the pressure of the operating ramp is decreased to 5 bars, the other ramp automatically starts operation. In this way, it balances the 24–75 m^3/h loading quantity in the primary circuit so that it will not reflect the differences in pressure and load to the secondary circuit.

There is no discontinuity during the changing of the empty cylinders of ramp and after this change the other ramp starts operating at the moment that the ramp in operation will not be able to supply the needed capacity.

PICTURE 17
Panel Board

If the empty cylinders of ramps are not changed, the audible and visible alarm placed on it will command the audible and visible alarm systems at the floors so that the alarm network is always in operation. In other words, the alarm signals continue until the reasons of the signal of alarm disappear.

In order to supply 24–75 m^3/h load capacity and 8 bars output pressure, there are:

- 2 ea 24–75 m^3/h primary network double pressure reducers which adjust 200 bars input system pressure to 5 bar system pressure,
- 2 ea high pressure relief valves,
- 1 ea 0 – 16 bars low pressure manometer,
- 2 ea 315 bars high pressure manometers,
- 1 ea interchanging ramp inverter system,

- A stainless steel box that combines all the items mentioned above.

3.1.1.2 Cylinder Ramp with Valve

It provides the connection of cylinders with automatic control and primary pressure reducer panel board. The connections are made with copper pipes which are welded with silver alloy and have wall mounting fixation parts.

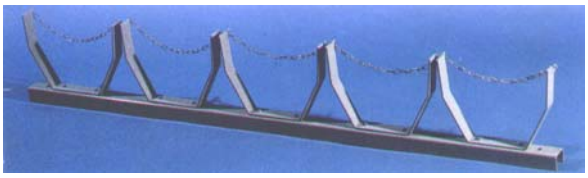
A secondary ramp or evacuation valve to the atmosphere can be connected to the end of the cylinder connection ramp with non-return valve.

PICTURE 18
Cylinder Ramp with Valve

3.1.1.3 Profile with Separator

It provides the fixation of cylinders in groups. There are enameled steel wall mounting parts which hold the separators with safety chain.

Separators are composed of enameled steel socket and safety chains for holding the cylinders safely on the wall mounted fixation profiles.



PICTURE 19
Profile with Separator

3.1.1.4 Pigtail Connecting Ramps to Cylinders and Panel Board

It is produced from tempered extruded copper pipe which is resistant to 300 bars pressure.

It is chrome plated and there are couplings at both ends for cylinder and ramp connection.

Its length is 100 cm in spiral form and its diameter is 10–8 mm.

PICTURE 20
Pigtail

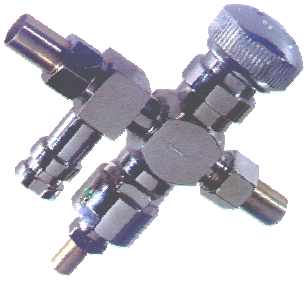
3.1.1.5 Over Pressure Safety Valve and Emergency Outlet Unit

It is installed at the beginning of the network. It is a combined group consisting of :

Over pressure safety valve (it provides gas evacuation automatically when it is needed) that operates when there is an overload of pressure due to a problem in the primary pressure reducer.

Emergency outlet that connects the cylinders directly to the system in case of emergency situations whenever both ramps are empty and are not renewed.

Stop valve that operates as evacuation valve.



PICTURE 21
Safety Valve

3.1.1.6 High Pressure Evacuation Valve

There are 2 ea high pressure relief valves for evacuation of the pressure at ramps to be operated manually in case of danger.

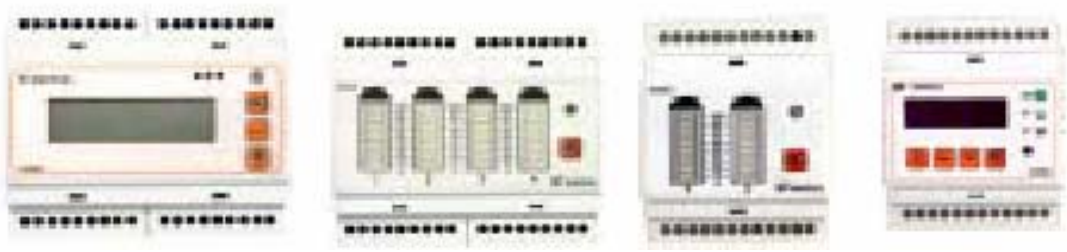
These valves are appropriate for 200 bar operating pressure.

PICTURE 22
Evacuation Valve

3.1.1.7 Audiovisual Alarm

Alarms are used for giving audible and visible signals during an emergency situation at central station.

Alarm systems consist of two circuits. One of them is alarm circuit and the other one is the circuit that informs about the system's normal operation.
The color indications of the visual alarm are as follows:
Green warning light, indicates that 24V electrical supply is present,
Flashing red warning light indicates that left ramp is empty,
Flashing red warning light indicates that right ramp is empty,
Flashing red warning light indicates the high pressure condition at primary network,
Flashing red warning light indicates the low pressure condition at primary network,
Warning light indicates the position of normal or spare operation.
The audible alarm circuit operates in connection with the flashing of the warning light.
The audible alarm is equipped with an interception switch to cancel the alarm, but the warning light continues to flash in this case.
The interception switch has a timer circuit that puts the alarm back into operation every 20 minutes until the malfunctioning in the system is repaired.
The alarm is completely automatic and it operates on 24V electrical supply. The warning lights are LED.
The alarm is equipped with an electronic self-test system and test button.



PICTURE 23
Different Alarm Panels

3.3.2 Nitrous Oxide Central Station

Decompression central station for compressed gas in cylinders connected by means of ramps, a certain number of cylinders in which the gas is stored under pressure according to its characteristics, at the liquefied (nitrous oxide) state.

Nitrous oxide pressure is reduced, adjusted and maintained at the needed distribution level by means of pressure control and reduction panel boards.

The supplying sources are installed in a place easily accessible to the transport vehicles. This place has a safety distance to the surrounding buildings and plants.

Central station is designed according to the principle of simultaneous operation.

System is in accordance with ISO 7396 – EN 737-1 norm.

A nitrous oxide central station consists below units;

3.3.2.1 Automatic Control and Reducing Panel Board

3.3.2.2 Cylinder Ramp with Valve

3.3.2.3 Profile with Separator

3.3.2.4 Pigtail Connecting Ramps to Cylinders and Panel Board

3.3.2.5 Over Pressure Safety Valve and Emergency Outlet Unit

3.3.2.6 High Pressure Evacuation Valve

3.3.2.7 Audiovisual Alarm

3.3.3 Vacuum Central Station

It is designed according to the hospital's consumption capacity. The basic elements and their technical specifications are as mentioned below.

The vacuum central station must be placed in a well air rated ambience, in order to reduce the pumps heating. In this way decrease of the efficiency is prevented.

The supplying sources are installed to a place within a safe distance from the surrounding buildings and plants.

The discharging of air from the pumps to the outside is made by a pipe with an equivalent or bigger size pipe as the discharge pump. This discharge is directed in such a way that there is no air current to the residential areas.

The system is in accordance with ISO 7396 – EN 737 norm.

A vacuum central station consists below units;

3.3.3.1 Vacuum System Rotary Vane Electro-pump Group

3.3.3.2 Electrical Control Panel Board

3.3.3.3 Bactericide Filter Unit

3.3.3.4 Audiovisual Alarm

3.3.3.1 Vacuum System Rotary Vane Electro-pump Group

It is designed according to the necessary vacuum flow based upon the drawings and the calculations to supply 680 mm/Hg vacuum pressure in the system.

The electrical motors which operate the electro-pumps have sufficient power and amp for the calculated capacity. They operate with 380V alternative current.

Complementary elements of the rotating electro-pump group are as follows:

- 2 ea vacuostats adjusted to the desired nominal vacuum value of 680 mm/Hg vacuum pressure.
- 1 ea vacumeter with 0-760 mm/Hg indicator,
- 1 ea condensed water discharge valve system in tank,
- 2 ea pre-filters,
- 2 ea non-return valves.

The reserve tank produced from special cylinder steel is with its 300-500-1000 lt. Of volume appropriate for the calculated capacity.

Suctioning blades and blades between the rotator transmission parts are produced from a stable material.

A discharging tank for condensate water and discharged oil is placed at the exit of the electro-pumps.

PICTURE 24
Pump Group

Oil/gas separation is made by a special filter cartridge which also absorbs the evaporated oil at the same time.

3.3.3.2 Electrical Control Panel Board

The panel, receiving control from two vacuostats or three manostats, is capable of putting two or three each 380V electrical motors of adequate capacity in and out of operation.

Commanded by the electrical contact vacumeter on itself, the unit can send a warning signal to the vacuum audible and visible alarm unit if vacuum pressure within the system is deficient. In addition, the unit is complete with an "insufficient vacuum" warning light.

The main current switch (0–1–2 positions) which allows the selection of one of the two electro–pump groups, three each electro–pumps' current switches (0–1 positions) and three each warning lights for these switches are installed on the unit.

For each electro–pump group an operation time counter is present. In order to provide equal operation and wear of the electro–pump in one main and one reserve type of operation, at 50 hours of operation checked by these counters the main–reserve positions of the pumps should be alternated.

The operation of the electrical control panel board is able to guide the operation of the system as follows:

As vacuum is consumed within the network, the vacuostats detect the decrease in the pressure and the selected electro–pump automatically starts operating, it provides the desired vacuum pressure and then automatically goes out of operation automatically.

In cases of overloading or excessive consumption or in cases of initial start–up when reserve tank is full and vacuum is extremely deficient, no matter which position the main current switch is at, the system takes both of the electro–pump at once into operation and provides the necessary vacuum level rapidly. Once this level reaches a certain value, the main electro–pump is kept in operation and the spare one automatically is taken out of operation. In this manner, the main pump keeps on operating until

maximum requirement level is reached and then that unit is also taken out of operation.

A main switch is located on the unit in connection with the maintenance plate on the panel. For security reasons, it is only possible to open this maintenance plate when the main switch is turned off and thus any chances of hazard during maintenance are completed.

3.3.3.3 Bactericide Filter Unit

The system is composed of two filters, which are:

- Preliminary particle holder,
- Bactericide filter that can hold microorganisms up to 0.03 microns.

The filters are connected to each other by conical couplings in order to provide ease in replacement and maintenance.

The unit is equipped with three membrane vacuum valves, two of which are located at the input and output and the other at the by-pass line, in order to provide a filter by-pass.

Under the bactericide filter a sterilizable glass erlen is located. Dismounting this erlen for cleaning purposes is very easy.

PICTURE 25
Filter Unit

3.3.3.5 Audiovisual Alarm

The alarm unit is composed of two circuits. The first circuit is the alarm circuit, and the other is the circuit showing normal operating conditions of the system.

The color indications of the visual alarm are as follows:

Red warning light, indicates deficient vacuum within the primary network.

The audible alarm circuit operates in connection with the flashing of the warning light.

The audible alarm is equipped with an interception switch to cancel the alarm, but the warning light continues to flash in this case.

The interception switch has a timer circuit that puts the alarm back into operation every 20 minutes until the malfunctioning in the system is repaired.

The alarm is completely electronic and it operates on 9V electrical supply. The warning lights are LED.

The alarm is equipped with an electronic self-test system and test button.

3.3.4 Compressed Air Central Station

The main elements and their technical properties that make up the central station designed according to the hospital's consumption capacity are explained below.

The central station is installed at a well aerated site, in this way the over-heating and thus the decrease in output of the compressors are prevented.

The central station site is within a sufficient distance from the surrounding buildings for reasons of security.

The system is in accordance with ISO 7396 – EN 737 norms.

PICTURE 26
Compressed Air Central Station

A compressed air central station consists below units;

3.3.4.1 Rotary Screw Compressor

3.3.4.2 Electrical Control Panel Board

3.3.4.3 Automatic Condensate Drain Valve

3.3.4.4 Air Dryer “R 134A” Freon

3.3.4.5 Filter Chain

3.3.4.6 Audiovisual Alarm

3.3.4.1 Rotary Screw Compressor

It is designed to provide the necessary air flow determined following drawings and calculations and 10 bars pressure, and the nominal output calibration pressure.

The system, depending on capacity requirements, is composed of one main and one spare screw type compressors and they will be taken into operation together if needed.

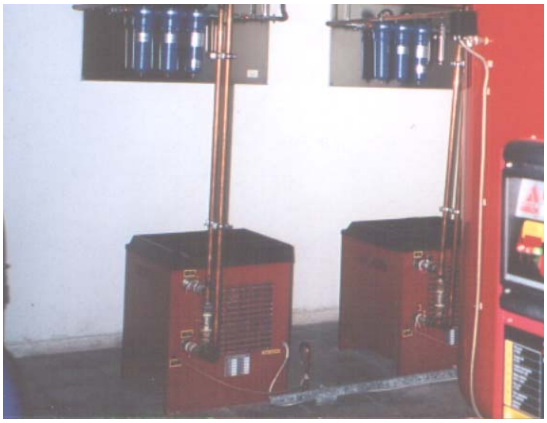
The electrical motors which will operate the compressors are of adequate power to meet capacity requirements, and operate on 380V alternating current.

The other complementary elements are two each manostats pre-adjusted to the 10 bars saymaca pressure, and one each manometer with valve and a 0-20 bars gauge.

Power of the compressors should determine according to project calculations.

The compressors group is encased in a sound isolated unit together with an air refrigerant and electrical connector panel.

The compressors are complete with 500-1000 lt. tank.



PICTURE 27
Screw Compressors

3.3.4.2 Electrical Control Panel Board

The panel, receiving control from two or three manostats, is capable of taking two or three each 380V electrical motors of adequate capacity into and out of operation.

Commanded by the electrical contact manometer on itself, the unit can send a warning signal to the compressed air audible and visible alarm unit if compressed air pressure within the system is deficient. In addition, the unit is complete with an insufficient air pressure warning light.

The main current switch (1–2 or 1–2–3 positions) that allows the selection of one of the two compressors is installed on the unit.

The operation of the electrical control panel board is able to guide the operation of the system as follows:

As compressed air is consumed within the network, the presostats detect the decrease in the pressure and the selected compressor automatically starts operating, it provides the desired compressed air pressure and then automatically goes out of operation automatically.

In cases of overloading or excessive consumption or in cases of initial start–up when reserve tank is empty and air pressure is extremely low, no matter which position the main current switch is at, the system takes the two compressors at once into operation and provides the necessary air pressure level rapidly.

Once this level reaches a certain value, the main compressor is kept in operation and the spare one automatically is taken out of operation. In this manner, the main pump keeps on operating until maximum requirement level is reached and then that unit is also taken out of operation.

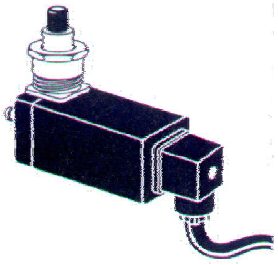
A main switch is located on the unit in connection with the maintenance plate on the panel. For security reasons, it is only possible to open this maintenance plate when the main switch is turned off and thus any chances of hazard during maintenance are eliminated.

The unit is complete with drier warning light and switch.

All of the above properties have been automatically controlled by contactors, thermal relays and other electrical devices.

3.3.4.3 Automatic Condensate Drain Valve

The unit is able to discharge the condensed water that results because of the decrease in the temperature of the air within the coolant.



The capacity of the unit 0,6 lt.

The diameter of the valve is 1/2".

The unit can be installed under the reserve tank.

PICTURE 28
Valve

3.3.4.4 Air Dryer “R 134A” Freon

The system has its own electrical control circuit that is equipped with hermetic type refrigeration compressor, evaporator, expansion valve and solenoid valve. There is direct heat exchange without glycol.

It is in accordance with the capacity determined by calculations.

Freon "R134A" is in accordance with CE norms. The unit is complete with separator and automatic condensate drainage unit. Maximum working pressure is 16 bars.

The unit is complete with a thermometer, on/off switch and manual water discharge button.

PICTURE 29
Air Dryers

3.3.4.5 Filter Chain

The system is composed of four filters, which are:

- Ceramic filter that holds particles up to 3 microns,
- Oil separating filter that holds particles up to 0,01 microns,
- Activated carbon filter that holds up to 0,003 p.f.m,
- Sterile filters that provide 100% effectiveness in bacteriological tests and can be sterilized up to 100 times.

The unit is equipped with a differential manometer in order to control the conditions of the filters within the system. The filters are connected to each other by conical couplings in order to provide ease in replacement and maintenance.

The unit is equipped with three gas ball valves, two of which are located at the input and output and the other at the by-pass line, in order to provide a filter by-pass.

PICTURE 30
Filters

The system is mounted on a completely enameled case and the differential manometer with glass window is placed also on this case which enables to be monitored easily.

3.3.4.5 Audiovisual Alarm

The alarm unit is composed of two circuits. The first circuit is the alarm circuit, and the other is the circuit showing normal operating conditions of the system.

The color indications of the visual alarm are as follows:
Red warning light, indicates deficient vacuum within the primary network.

The audible alarm circuit operates in connection with the flashing of the warning light.

The audible alarm is equipped with an interception switch to cancel the alarm, but the warning light continues to flash in this case.

The interception switch has a timer circuit that puts the alarm back into operation every 20 minutes until the malfunctioning in the system is repaired.

The alarm is completely electronic and it operates on 9V electrical supply. The warning lights are LED.

The alarm is equipped with an electronic self-test system and test button.

3.3.5 Equipments and Devices

Consists of;

3.3.5.1 Terminal Units

3.3.5.1.1 Oxygen Outlet

3.3.5.1.2 Vacuum Outlet

3.3.5.1.3 Medical Compressed Air, 5 Bar Outlet (Wall)

3.3.5.1.4 Nitrous Oxide Outlet

3.3.5.1.5 Medical Compressed Air, 10 Bar Outlet

3.3.5.1.6 Anesthetic Gas Scavenging (AGGS) Outlet

3.3.5.1.7 Sockets

3.3.5.2 OT Pendant Arm

3.3.5.2.1 Anesthesia Type, Rotating

3.3.5.2.2 Surgery Type Rotating

3.3.5.2.3 Interception Valve Group

3.3.5.3 Distribution of Plant

3.3.5.3.1 Area Control and Service Unit

3.3.5.3.2 Special Control Panel for OT

3.3.5.3.3 2nd Stage Pressure Control Unit with Manostats

3.3.5.3.4 Floor Alarm

3.3.5.3.5 Gas Ball Valves

3.3.5.3.6 Copper Pipes

3.3.5.4 Vertical Intensive Care Units

3.3.5.4 Terminal Units

3.3.5.4.1 Oxygen Outlet

The oxygen outlets meet the requirements of DIN 13260 part2. They accommodate all plugs and medical devices with corresponding nippel. All metal construction enables high reliability and ruggedness.

Parking position enables that the nippel can remain in the outlet without consuming gas thus being ready for immediate use.

It is possible to insert and de-clutch the plug with only one hand. Inner and outer protection against exchanging the gas by mistake when mounting or using the outlet.

Color codes are (Blue) according to ISO and DIN.

3.3.5.4.2 Vacuum Outlet

The vacuum outlets meet the requirements of DIN 13260 part 2. They accommodate all plugs and medical devices with corresponding nippel. All metal construction enables high reliability and ruggedness.

Parking position enables that the nippel can remain in the outlet without consuming gas thus being ready for immediate use.

It is possible to insert and de-clutch the plug with only one hand. Inner and outer protection against exchanging the gas by mistake when mounting or using the outlet.

Color codes are (White) according to ISO and DIN.

3.3.5.4.3 Medical Compressed Air, 5 Bar Outlet (Wall)

The medical compressed air (5 bar) outlets meet the requirements of DIN 13260 part 2. They accommodate all plugs and medical devices with corresponding nippel.

All metal construction enables high reliability and ruggedness. Parking position enables that the nippel can remain in the outlet without consuming gas thus being ready for immediate use.

It is possible to insert and de-clutch the plug with only one hand. Interior and external protection against exchanging the gas by mistake when mounting or using the outlet.

Color codes are (Yellow) according to ISO and DIN.

3.3.5.4.4 Nitrous Oxide Outlet

The nitrous oxide outlets meet the requirements of DIN 13260 part 2. They accommodate all plugs and medical devices with corresponding nippel. All metal construction enables high reliability and ruggedness.

Parking position enables that the nippel can remain in the outlet without consuming gas thus being ready for immediate use.

It is possible to insert and de-clutch the plug with only one hand. Inner and outer protection against exchanging the gas by mistake when mounting or using the outlet.

Color codes are (Grey) according to ISO and DIN.

3.3.5.4.5 Medical Compressed Air, 10 Bar Outlet

The medical compressed air (10 bar, air motor) outlets meet the requirements of DIN 13260 part 3. They accommodate all plugs and medical devices with corresponding nippel.

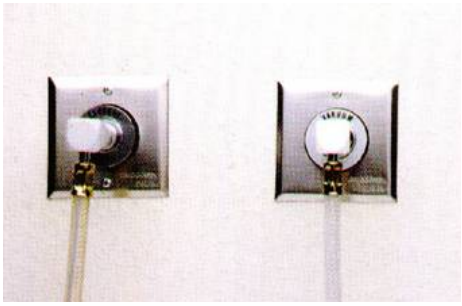
All metal construction enables high reliability and ruggedness.

Without having a plug engaged all connection pipes of the air motor coupling (compressed air and drain) are locked.

It is possible to insert and de-clutch the plug with only one hand. After inserting the air motor plug by softly pressing it in the coupling until it is fixed with a definite sound, a valve opens to let the compressed air flow through the supplying pipe towards the tool. The air expands and then flows back to the coupling. From here a pipeline goes directly to the exhaust channel.

Pulling back the grip-hull at the plug, the coupling plug connection is free again and the plug can be pulled off the outlet. Valves shut off automatically all connecting pipes and terminate the compressed air supply.

Interior and external protection against exchanging the gas by mistake when mounting or using the outlet.



PICTURE 31
Medical Air Outlets

3.3.5.4.6 Anesthetic Gas Scavenging (AGGS) Outlet

To exhaust the surplus of narcotic gases into an exhaust shaft anesthetic gas scavenging outlets are used.

Inserting a narcotic-gas-plug into the outlet compressed air flows to an ejector to generate the vacuum needed for the narcotic gas suction. Both the sucked gas as well as the compressed air are led into the exhaust shaft to make them harmless.

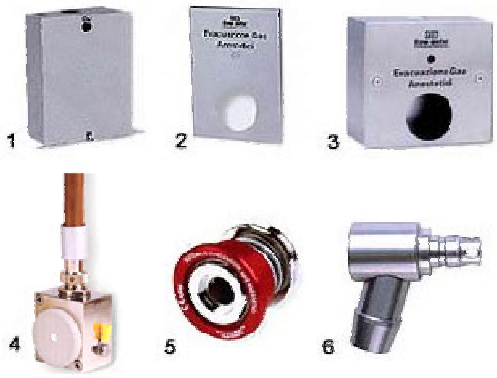
Systems are integrated into a high-grade steel housing with front plate and visual signal to control the application.

System can be operated with one hand.

The plug for the narcotic exhaust is a double plug, it has two connections to the outlet. One is for the propellent gas pipe

(compressed air 5 bar) and the second is for the exhaust gas pipe.

Inserting the plug into the outlet until a click occurs opens the propellent gas and the exhaust pipe simultaneously. The propellent gas flows through the ejector that is integrated into the plug. It generates a constant vacuum to suck the the frequently escaping gases and finally to lead it into the exhaust shaft by exhaust pipes or collecting pipes. To interrupt the suction the press-ring of the outlet is pressed and the double plug is pulled out of the coupling. The valves of the propellent pipe and the exhaust pipe close automatically.



PICTURE 32
AGGS Outlets

Suction capacity is 30 l/min.

Compressed air consumption is approximately 10 l/min.

3.3.5.4.7 Sockets

Zinc die casting, zinc chromate finished: black teflon coated: stainless steel rolling pins:

Fascia: White ABS

Surround: White ABS

Installed Height: Recommended installation height for all wall outlets is 1,3 m from the floor.

PICTURE 33
Sockets

Installed Size : Height: 85 mm, Width: 85 mm

Protrusion from wall : Flush: 23 mm, Surface: 73 mm

Depth into wall: Flush : 50 mm, Surface : Nil

3.3.5.5 OT Pendant Arm

3.3.5.5.1 Anesthesia Type, Rotating

The system has been manufactured from white enameled steel and stainless steel.

The system is complete with a ceiling plate and a counter–plate which enables rigid installation of the system to the ceiling.

The pendant column providing the connection to the concrete ceiling is suitable to the height of the operating theatre.

The rigid arm connected to the monitor holder shelf on rotating head is produced according to the ideal position.

The rotating head on which the gas outlets and the electrical sockets are mounted, is able to rotate about 3400.

PICTURE 34
Anesthesia Pendant Arm

The gas and electrical installations are completely and safely protected within the system and are not affected by the movements of the system.

The gas outlets and the electrical units on the main unit are as follows:

With connection design in accordance with ISO standards;

2 each oxygen outlet,

2 each vacuum outlet,

1 each nitrous oxide outlet,

1 each compressed air 5 bar outlet,

1 each anesthetic gas scavenging outlet,

6 each grounded electrical sockets, "Schuko" type, protected by automatic fuses.

6 each grounded equipotential (grounding) nodes

The gas installations within the unit are made with pressure resistant anti–static rubber pipes to provide mobility of the system.

3.3.5.5.2 Surgery Type Pendant Arm, Rotating

The system has been manufactured from white enameled steel and stainless steel.

The system is complete with a ceiling plate and a counter–plate which enables rigid installation of the system to the ceiling.

The pendant column providing the connection to the concrete ceiling is suitable to the height of the operating theatre.

The rigid arm connected to the monitor holder shelf on rotating head is produced according to the ideal position.

PICTURE 35
Surgery Pendant Arm

The rotating head on which the gas outlets and the electrical sockets are mounted, is able to rotate about 3400.

The gas and electrical installations are completely and safely protected within the system and are not affected by the movements of the system.

The gas outlets and the electrical units on the main unit are as follows:

With connection design in accordance with ISO standards;

1 each oxygen outlet,

2 each vacuum outlet,

2 each compressed air 5 bar outlet,

1 each compressed air 10 bar (air motor) outlet,

6 each grounded electrical sockets, "Schuko" type, protected by automatic fuses.

6 each grounded equipotential (grounding) nodes

The gas installations within the unit are made with pressure resistant anti-static rubber pipes to provide mobility of the system.

3.3.5.5.3 Interception Valve Group

These units will be installed at the operating theatre entrances on the supply lines of the pendant arms.

A group is composed of 4 each 3/8" ball gas valves and a panel with covering plate that allows easy intervention to the valves.

Each end of the valves are equipped with conical couplings for copper pipe connection.

3.3.5.6 Distribution of Plant

3.3.5.6.1 Area Control and Service Unit

For safety reasons, the piped medical gas system should be equipped with devices which permit the shutting-off of pipelines to operating theatres, wards, sections, etc. Repair works and extensions make it also necessary to shut-off some sections of the system.

The valves assigned for this purpose should be easily accessible and they should be installed in every floor and main pipeline. In order to achieve this, valve and control boxes are installed. It contains shut-off valves, contactors and pressure gauges.
The valve box is embedded in the wall. The box is closed by a lid, which is retractable in directions of the wall.

PICTURE 36
Control Unit

3.3.5.6.2 Special Control Panel for OT

The special control panel combines the manometers, valves, second stage pressure reducers, presostat and manostat units and by-pass valves for each 5 gases, namely oxygen, nitrousoxide, vacuum, compressed air 4 and compressed air 8 bars. The panel also includes an electronic alarm unit for 16 different signals with a liquid crystal display.

The panel can reduce the feeding pressure, which is between 6-12 bars, to between 3 and 6 bars with maximum starting load at 250 l/min. (15 m^3/h).

The panel is equipped with four manometers with 0–12 bars gauge, two pressure reducers and 2 valves with filters for gases under pressure indicating the input and output pressure of these gases.

For vacuum, the panel is equipped with two vacumeters with 0–76 cm Hg gauges showing the suction pressure and two membrane valves for regulation.

There are 3 each 3/4" and 12 each 3/8" gas ball valves in the panel for by–pass.

The pressure reducers keep the pressure within the limits of + 10 % of the nominal pressure in the secondary, i.e. the low pressure, network that supplies the gas outlets.

The filters in the valves are equipped with highly porous sintered bronze filters that allow minimum particle passage in order to prevent any foreign particulate matter reaching the pressure reducer and the gas outlets. These filters can be removed easily for cleaning or replacement, without necessity the total discharge of the gas within the system, through a synchronous operating obturator and hand–wheel.

The incorporated manostat units (pressure switches) detect low and high pressure fluctuations that may occur for gases under pressure, vacuostat units for deficiency in vacuum and only low pressure switches for compressed air 8 bar.

The above mentioned information is transformed to electrical signals and relayed to the alarm by low and high pressure manostats through the terminal bridge (clemens assambly) in the unit.

All parts making up the system are connected to each other and to the copper pipes network by conical couplings, and therefore maintenance is very easy.

The system is mounted inside an enameled steel panel with a lockable cover and a transparent window, through which the values on the manometers can be easily monitored and on which the names and the chemical symbols of the gases are inscribed and is mounted on the wall. The alarm is equipped with an electronic self-test system and requires 24 V AC.

PICTURE 37
Control Unit

3.3.5.6.3 2nd Stage Pressure Control Unit with Manostats

The second stage reducer can reduce the feeding pressure that is between 6-12 bars, to between 3 and 6 bars with maximum starting load at 250 l/min. (15 m^3/h).

The second stage reducer is equipped with two manometers with 0-12 bars gauge, one pressure reducer and one valve with filter for gases under pressure indicating the entrance and exit pressure of these gases.

For vacuum, the second stage reducer is equipped with one vacumeter with 0-76 cm Hg gauge showing the suction pressure and one membrane valve for regulation.

The pressure reducers keep the pressure within the limits of + 10% of the nominal pressure in the secondary, i.e. the low pressure, network that supplies the gas outlets.

The filter in the valve is equipped with a highly porous sintered bronze filter that allows minimum particle passage in order to prevent any foreign particulate matter reaching the pressure reducer and the gas outlets. This filter can be removed easily for cleaning or replacement, without necessity the total discharge of the gas within the system, through a synchronous operating obturator and hand-wheel.

The incorporated manostat unit detects low and high pressure fluctuations that may occur for gases under pressure and deficiency in vacuum.

The above information is transformed to electrical signals and relayed to the floor alarm by low and high pressure manostats via the terminal (Clemens) assembly in the unit.

PICTURE 38
Control Unit

All parts making up the system are connected to each other and to the copper pipes network by conical couplings and therefore maintenance is very easy.

The system, together with other second stage reducers, is mounted within an enameled steel panel with a lockable cover and a transparent window, through which the values on the manometers can be easily monitored and on which the names and the chemical symbols of the gases are inscribed, which is mounted on the wall. The alarm is equipped with an electronic self-test system.

3.3.5.6.4 Floor Alarm

An alarm system, providing audiovisual warning if each one of the gases connected to the valve box drops to a low pressure value of 3-3,5 bar is also integrated in the box. (For 10 bar compressed air this value is 6-7 bars). A button to cut-off the alarm tone is present on the alarm unit. If this button is pressed and the gas pressure is still below 3-3,5 bar (or below 6-7 bar for air motor, the visual alarm (flashing LED lights) continues and after 20 minutes the alarm tone starts again.

3.3.5.6.5 Gas Ball Valves

The valves are mounted within a box with plate in order to allow any necessary interventions to be made easily.

Each end of the valves are equipped with conical couplings for copper pipe connection.

PICTURE 39
Ball Valve

3.3.5.6.6 Copper Pipes

Copper pipe diameters are determined according to datum of the drawings and calculations. Copper pipe installations are made with silver alloy welding material T's, elbows, various reductions and couplings. Copper pipes used in medical gas plant installation are tempered and washed with trichloroethylene. Both ends of the pipes are closed during transportation. All copper pipes, independent of the diameter, are supplied as 5 meters long rods.

Copper pipe diameters are as follows according to the gas types:

For Oxygen	For Nitrous Oxide	For Compressed Air	For Vacuum
10-1 mm	10-1 mm	10-1 mm	12-1 mm
12-1 mm	12-1 mm	12-1 mm	14-1 mm
14-1 mm	14-1 mm	14-1 mm	16-1 mm
16-1 mm	16-1 mm	16-1 mm	22-1 mm
22-1 mm	22-1 mm	22-1 mm	28-1 mm
28-1 mm	28-1 mm	28-1 mm	42-1 mm

PICTURE 40
Copper Pipes

3.3.5.4 Vertical Intensive Care Units

PICTURE 41
Vertical Unit

Section 3.4

3.4 Hygienic Ventilation and Air Conditioning Equipments

3.4.1 Air–Handling Unit

3.4.2 Laminar Flow Unit

3.4.3 Variable Air Volume Regulator

3.4.4 HEPA Filter

3.4.5 HEPA Filter Housing

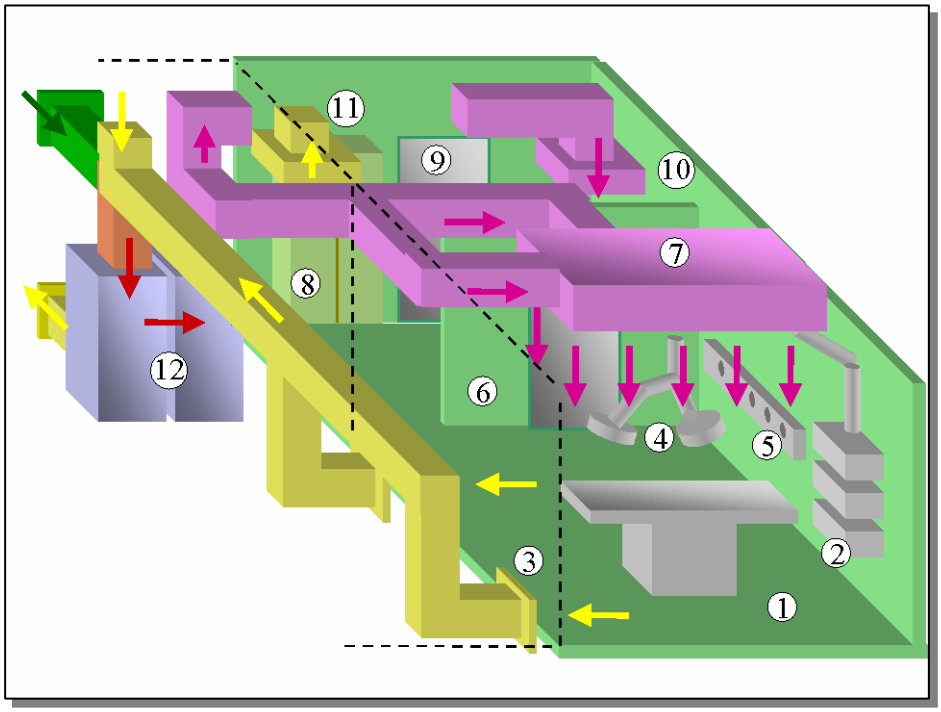
3.4.6 Shut–Off Damper

3.4.7 Fire Prevention Flap

3.4.8 Sound Absorber

3.4.9 Fluff Separators

3.4.10 Ducting System



Example of the layout of a "System Weiss" hospital air conditioning system

(1) Floor system,

(2) ceiling supply unit,

(3) OT fluff separator,

(4) OT lights,

(5) supply points for medical gases,

(6) wall and ceiling system,

(7) OT ceiling,

(8) furniture,

(9) doors and windows,

(10) ceiling ventilation outlet,

(11) ceiling discharge air inlet,

(12) air conditioning cabinet unit

Fresh air:

The ventilation system is designed as a mixed ventilation system with a fixed fresh air component, the whole conforming with DIN 1946, Part 4.

Fresh air can be sucked in via a hood (with a grid to protect against the weather) and fed to the hygiene air conditioning unit through an insulated duct.

Supply air:

The air can be subject to ideal, thermodynamic treatment in the air conditioning unit, due consideration being given to the system requirements which must be adhered to. Treatment includes the following sub-processes:

- cooling
- heating
- humidification
- dehumidification.

Air conditioned in this manner is supplied to the rooms via a duct system. Supply air can be introduced to the OT area through an OT ceiling and to the adjoining OT rooms via an air inlet in the ceiling.

Discharge air:

Discharge air is extracted at one side of the OT through OT fluff separator which can be fitted above the floor or under the ceiling. A choice of discharge air disk valves or other inlets can be installed in the adjoining rooms.

Circulating air:

Discharge air is partially

- mixed with fresh air and fed back to the hygiene air conditioner as circulating air, this in turn

⇒ leading to energy saving
⇒ increasing the service life of filters
⇒ reducing the introduction of contaminated air to a minimum

Extracted air:

- Blown as extracted air into the outdoor atmosphere via the duct
- through which it is extracted from rooms adjoining the OT

Provision of overpressure by overload current in the operation theatre, prevention of air penetration from adjoining rooms

Filtering:

Air filtering with preliminary and final stage filters ensures that the highest levels of air purity and freedom from micro-organisms in the OT area or other sensitive technical areas are achieved. An optimum balance between filter size, rated volume flow, pressure difference and dust absorption capacity ensures a long service life.

Control:

Control of climatic conditions in rooms is selectively achieved through the following:

- Supply air
- Discharge air
- Room air
- A discharge air cascade
- A room air cascade

The method employed depends on the required humidity and temperature consistency.

Air-conditioning times and durations of the hygiene air conditioner can be individually activated with a time switch to meet requirements (e.g.

- daytime operation,
- night operation,
- weekend operation,

....etc.).

Control of the overall system is governed by:

- the control unit integrated in the air conditioning system
- and / or a switching cabinet
- a primary process control system,

depend on the hygiene system version involved.

3.4.1 Air-Handling Unit

Contrary to conventional air conditioning centers, SYSTEM WEISS MEDICLEAN cabinet units are designed as air conditioning units which are ready for connection.

- The housing construction of the flexible modules is insulated, thus enabling the achievement of a high degree of housing stability and optimum noise suppression.

- Pipe connections for the supply air module, humidifier module and discharge module (for the cooling system) can be completed and commissioned by the manufacturer, thus dispensing with extensive on-site installation and commissioning work.

- Generously-dimensioned doors across the entire front of the unit enable optimum access for service and cleaning purposes, access being exclusively from the front.

- Large-dimensioned windows facilitate maximum visual control of fans, filters, etc.

- The interior surfaces of the unit are smooth and, consequently, easy to clean and disinfect.

- Generously-dimensioned bag and cassette filters ensure a high dust-absorption capacity, long service life and, consequently, lower service costs.

- Generously-designed evaporators and/or liquid coolers ensure a highly sensitive cooling capacity.

- Separate cooling circuits (with hot-gas bypass and electronic control valve) guarantee maximum operational safety and optimised efficiency.

- Directly-driven, single-sided suction fan impellers are adapted by frequency converters to suit the load, energy consumption thus being optimally controlled.

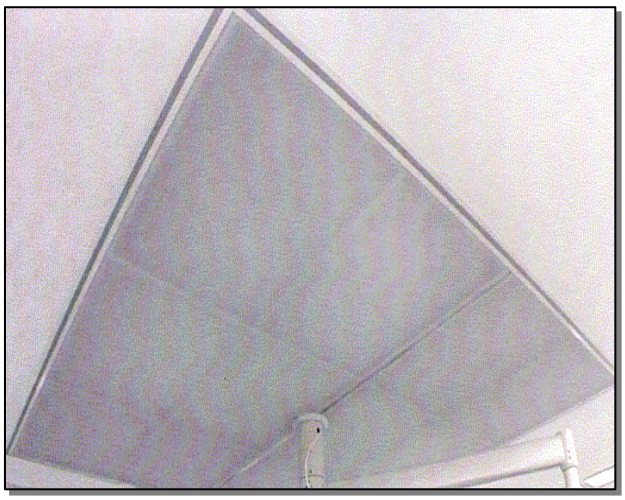
- The switching cabinet is integrated in the basic unit. The freely programmable DDC control allows adaptation to all necessary operational situations. However, an additional switching cabinet / switchbox can be necessary where an increased number of field units are involved.

They meet all DIN, VDI and hygiene regulation requirements.

Full automated air-handling unit details are enclosed to this booklet as Mediclean by Weiss.

3.4.2 Laminar Flow Unit

The type FFA area filter ceiling is designed for use in operating theatres, generating a vertical, laminar clean airflow at low levels of resistance. The unit is built into the ceiling cavity.



PICTURE 42
FFA Area Filter Ceiling

- Outlet and filter frames are manufactured of extruded profiles and anodised in aluminium. They hold the high-performance volatile particles filters positioned directly in front of the air outlet.

- The filters are installed with a double sealing system. An air-tight ventilation hood above the volatile particle filter ("raw" air side) acts as a multi-faceted, simple connection for the air ducts. The single-layer tissue shield distributor can be easily removed with the screwless fixing feature.

- There are no protruding fixing features (such as hinges or support webs) which could lead to fluff deposits. Such deposits could penetrate to the OT area.

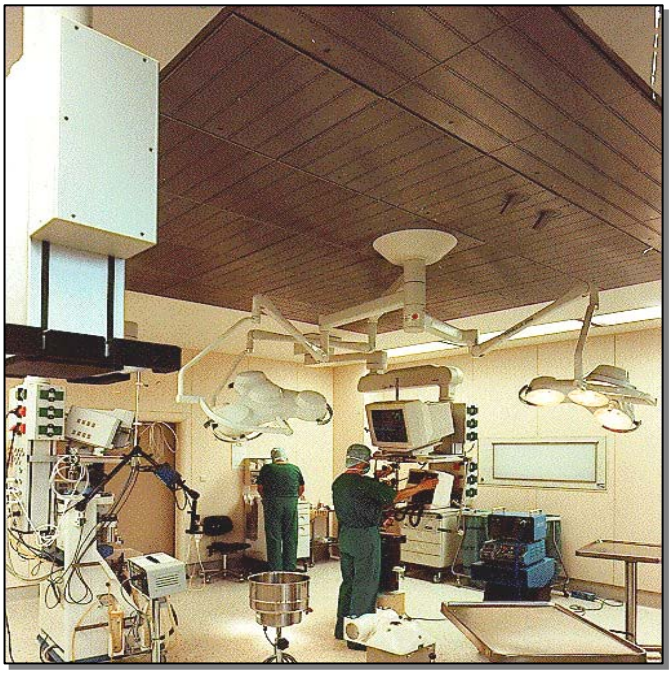
- The generously-dimensioned surface of the tissue shield distributor has a minimum number of webs and an aerodynamic extruded profile frame anodised in aluminium.

- The air-tight OT light inlet box can be easily accessed from the clean room to adjust the OT light supports.

- An OT light support can be inserted hygienically through the entire ventilation ceiling.

Laminar Flow Unit details are enclosed to this booklet as FFA by Weiss.

The airstream-assisted ceiling system has a variable modular construction and is used for operating theatre supply air systems in rooms of class 1, type A and/or B (high and/or particularly low germ-free requirements) and conforms with DIN 1946, part 4.



PICTURE 43
OPST Airstream-Assisted Ceiling System

- The optimized flow field of a broad vertical laminar flow serves to convey very high heat load (created by heat emanating from people, lighting and technical medical equipment) out of the operating theatre at low local temperature differences. This creates a physiologically-comfortable room air conditioning for the patient and operating team.

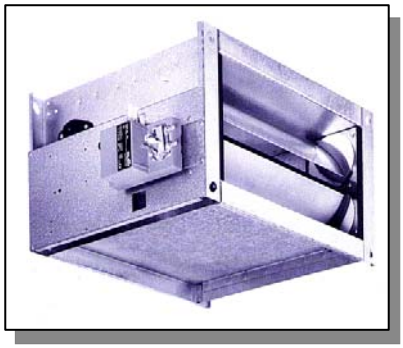
- The OPST OT system is designed for installation in ceiling cavities.

- The insertion of OT light supports and media supply connections can be realised with an air-tight sealed-off ceiling inlet in the pressure chamber located at any position (including two inspection openings and an adapted blank plate).

3.4.3 Variable Air Volume Regulator

These flow control units are utilised for variable flow systems, supply air or discharge air systems. They can be installed as volume flow regulators or room/channel pressure controllers.

They consist of a housing with an adjustable valve and a mean value differential pressure sensor for recording the volumetric flow. The adjustable valve has a plastic seal and is air tight in the direction of flow. These regulators are also available with a casing for noise suppression to reduce noise emissions.



PICTURE 44
Variable Volume Regulator

The control components (regulator, transmitter, adjustment drive) are also integral parts of the unit and are pre-fitted, hose-connected and wired. The flow regulators can be supplied with control components from most known manufacturers, these being selected to comply with the specified control design. The technical room air characteristics of each regulator are tested and the desired volume flow set by the manufacturer.

Variable Air Volume Regulator details are enclosed to this booklet as NA by Rucon Air.

3.4.4 HEPA Filter

Hepa filter elements are made of pleated fleece, which consists of micro-glass fibres. The folds are fixed applying the Hot-Melt-Technology, respectively using aluminium separators. Hepa filters are used, inter alia, in the following branches: microminiature electronics, semiconductor production, chemical and pharmaceutical industries, microbiology, medicine, and foodstuff industries. Besides the indicated standard sizes and standard frame materials, Hepa filters of different sizes, respectively of different frame materials are deliverable on demand.

MACROPUR-F
Principle of Function:
depth filters

PICTURE 45
HEPA Filter

Form of delivery:

HEPA filter

Design:

The medium is made of special paper-like fleece, consisting of the finest micro-glass fibres. This medium shows, depending on the filter class, various degrees of separation and permeability. The filter medium is processed into a stable fold pack and, due to the number of folds and their height, is laid out to suit the nominal operating point in an optimum way. Continuous thermo plastic fibres (Hot-Melt) provide spacing between each single fold even to its depth and result, due to a compact fold arrangement, in a high stability of the medium together with a uniform course of the folds at the same time. The filter medium seals off with the clean air side in a concise way. The fold pack is all around fused tight into the stable filter frame, a continuous sealing guarantees to seal the filter element safely against the pressure area of the intake-housing.

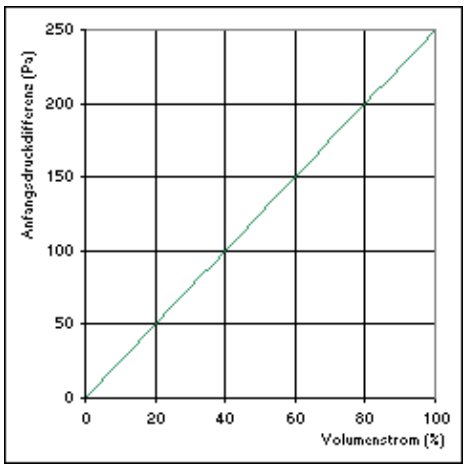
The standard type of the Hepa filter medium is equipped with a sealing on the dust-laden air side.The filter frame is made of MDF-wood.

Application:

Hepa filter elements in fibre type construction with a high separation efficiency for all types of aerosols are used as end filters of multi-stage filter combinations in air conditioning- and ventilation systems for the cleaning of process supply- and exhaust air, as well as for the separation of unhealthy dusts, virus and bacteria.

Special features:

- High mechanical stability due to a proved fibre-type construction
- High volume flow rates together with short mounting sizes
- Metal-free fold separation



Fields of application:

- Medicine
- Microbiology
- Chemical industries
- Pharmaceutics
- Foodstuff industries
- Electrical engineering
- Semiconductor production
- Nuclear power techniques

MACROPUR-F
Technical Data:

Filter class (DIN EN 779)	H13
Average arrestance (%)	> 99,95
Mounting depth (mm)	54 / 78 / 150
Initial pressure drop (Pa)	250
Final pressure drop (Pa)	750
Max. operating temperature (°C)	80
Max. relative humidity (%)	100

Admission filters for volatile particles are designed to meet the highest air cleanliness and germ-free requirements in medicine, biology, pharmacy and other sensitive technical fields. They can be supplied in various dimensions and in a variety of designs.

The filter housing consists of stove-enamel steel plate with a securely-sealing press-on fixture for the volatile particle filter cell (with or without a seal location testing device, but with fitted pressure measuring points).

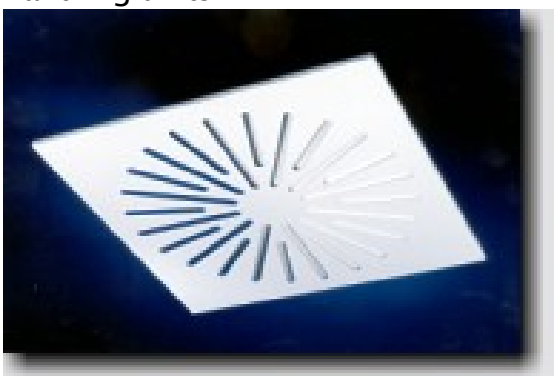
HEPA Filter details are enclosed to this booklet as Macropur by GEA Delbag.

3.4.5 HEPA Filter Housing

Powder coated galvanized steel body prevents the air leakages. Compiles with DIN 24184 standard.

Because of optional built-in shut-off dampers, the filters can be changed without stopping the air handling units.

PICTURE 46
HEPA Filter Housing



PICTURE 47
Swirl Diffuser

Diffusers are optionally can be chosen as swirl or perforated.

PICTURE 48
Ceiling Application of HEPA

3.4.6 Shut-Off Damper

Shut off dampers are designed such that they can isolate sections of a ventilation system with a very high level of sealing (gas tight). This can be required for safety reasons in certain operational conditions. Shut of dampers are designed so that after closure, even with failure of power supply to the actuator, the damper maintains the sealed closure.
Case and blades of sheet steel, bearing assemblies stainless steel or brass, seals neoprene foam rubber material, heat resistant to 80 °C- drive shafts, stops and other attachments in galvanized steel, hand wheel drive, with double acting pneumatic actuator (operating pressure 6 bar) and adjustable throttling valve should be asked for.

Shut-Off Damper details are enclosed to this booklet as DKL by Rucon Air.

3.4.7 Fire Prevention Flap

Fire prevention flaps are used to automatically seal off areas in room air systems which are subject to blazes. Their resistance is classified according to the use to which they are put, and they are suitable for installation:

- in walls and ceilings (concrete or masonry)
- in light-weight walls
- outside walls and ceilings

The triggering mechanism and fuse element can be removed from the exterior and easily inspected. All valves also have two additional inspection ports.

Fire Prevention Flap details are enclosed to this booklet as TA/PA by Officine Volta.

3.4.8 Sound Absorber

Rigid tubular sound absorbers are designed for use in air conditioning systems.

The outer casing and perforated interior tube are manufactured in galvanized sheet plate. The non-flammable absorption material is protected with fiberglass matting against abrasion caused by flowing air.

The inlet and outlet connections can be supplied with plug connection fittings, drilled flanges or lip seals.

Flexible tubular sound absorbers are designed for use in air conditioning systems. They can be used for suppressing fan noise emissions and reducing noise transmission to adjoining rooms (telephonic transmission) via the air conditioning supply. They are also suitable for use where space is limited.

The outer casing and interior tube are manufactured in aluminum, and the absorption material is non-flammable.

The inlet and outlet connection endings are equipped with canalur (beading) features to facilitate the fitting of a lip seal with a push-on fitting or flush collar.

Sound Absorber details are enclosed to this booklet as SIL by Officine Volta.

3.4.9 Fluff Separator

OT fluff separator designed for installation in discharge air admissions elements in rooms where there is a high level of fluff generated (e.g. OT rooms). It consists of a:

- fluff sieve manufactured from fine, level, stainless steel wire mesh
- sturdy, self-supporting frame.
- locating frame for the fluff sieve filter which can be installed in the respective discharge air aperture.
- A pair of knurled screws which ensure that the fluff sieve filter is securely sealed against the locating frame. This facilitates removal without the use of additional tools, along with cleaning and disinfecting.

Fluff Separator details are enclosed to this booklet as OPFA by Weiss.

3.4.10 Ducting System

All ducts should be Self Flanged System which prevents leakage in a high level, because it does not have a joint for flange.

Self Flanged System does not require point welding, screws, punching etc. installation tools and workmanship.

Self Flanged System provides strengthen ducts, safety, easiness and speed for installation.

Air friction in ducts is minimized in Self Flanged System.

PICTURE 49
Self Flanged System

Because of Self Flanged System provides a smooth and flat surface inside the duct system, it prevents residing of bacteria and particles.

PICTURE 50
Self Flanged Duct

Self Flanged System air ducts have no risk of fault caused by workmanship, because they all are produced with full automatic machines.

Depending on the place of application Galvanized, Stainless Steel and Aluminum ducts can be produced by Self Flanged System.

Section 3.5

3.5 Automation

All Hygienic Ventilation and Air-Conditioning System should be controlled by a computerized automation system.

The set-points parameters are being set up by the user into the automation software. The values of fresh air temperature and humidity, fresh air filters pressure difference, HEPA filter pressure difference, indoor air temperature and humidity and indoor air room pressure differences are being evaluated by the automation system and air-handling unit working parameters have been adjusting according to these values. All frequency invertors, three-ways or four-ways valves, frost protection system, cooling and heating system works as to belong to automation system.

Septic and aseptic areas pressure differences as negative and positive, insulation rooms and other sophisticated areas should be arranged by automation.

Most important points of the automation system are the harmony of the software and automation equipments.

Section 3.6

3.6 Multi Function Equipments

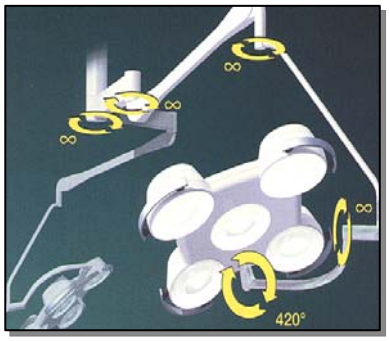
3.6.1 Energy Bridge

All necessary plugs, sockets, electrical and medical gas connections can be done on energy bridge. Everything is optional and all bridge can be produced according to the client requirements.

PICTURE 51
Energy Bridge

PICTURE 52
Detailed view of Energy Bridge

3.6.2 Operation Lights



The lamps are distinguished by their extensive exploitation of light. A central light source generates the required illumination strength.

The extraordinarily extensive light emission level results in the following advantages:

PICTURE 53
Operation Light

- Direct shadows from the surgeon's head or hand (or from instruments) are illuminated by lateral lighting from the marginal area of the light source and eliminated directly just behind the object.

- Refocusing of the lamp is not necessary where there are changes in distance. The polygon reflector generates a distributive intensity in the operating area which remains practically unaltered at different distances.

- The size of the illuminated area can be continuously adapted to suit requirements. The symmetrical structure of the lens ensures that a homogenous, circular cone of light is achieved, regardless of the diametrical size of the lighted area.

Enclosures

Air–Handling Unit	Mediclean, Weiss
Laminar Flow Unit	FFA, Weiss
Variable Air Volume Regulator	NA, Rucon Air
HEPA Filter	Macropur, Gea Delbag
Shut–Off Damper	DKL, Rucon Air
Fire Prevention Flap	TA/TP, Officine Volta
Sound Absorber	SIL, Officine Volta
Fluff Separators	OPFA, Weiss