GUIDE SPECIFICATIONS

FOR

AIR HANDLING UNITS

VENTILATION UNITS &

HEAT RECOVERY UNITS

VAYHAN AIR CONTROLS PVT. LTD.
G-1, Park View Residency, Patwari Enclave
Gandhi Nagar (IDPL), Hyderabad – 500 037. INDIA
Phone: +91-40-2372 0455, Fax: +92-40-2372 0456
email: sales@vayhan.com; url: www.vayhan.com

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FLOOR MOUNTED AIR HANDLING UNITS - COMFORT APPLICATION

SCOPE
The scope of this section comprises of supply, installation, testing and commissioning double skin construction air handling units, conforming of these specifications and in accordance with drawings and of the schedule of quantities.

TYPE
The Air Handling Unit shall be double skin construction, draw - thru type comprising of various sections such as mixing box (wherever the fresh air & return air are ducted), filter section, coil section, humidification section (wherever required), fan section as per details given in the drawings and schedule of quantities.

CAPACITY
The air handling capacities, maximum motor H.P., static pressure shall be as shown on drawing and in schedule of quantities.

HOUSING / CASING
The housing/casing of the Air Handling Unit shall be of double skin construction. The frame-work shall be of extruded aluminum hollow sections. All the frame shall be assembled using pressure die cast aluminum/nylon joints to make a sturdy, strong and self supporting frame work for various sections.

25/43mm thick Double Skin Panels shall be made of 0.6mm Pre-coated GSS on outside and 0.6 mm Galvanized sheet inside with CFC/HCFC free polyurethane foam of 38-40 kg/m^3 density injected in between the panels. These panels shall be screwed from inside on to the frame work with soft rubber gasket in between to make the joints air tight.

Frame work for each section shall be joined together with soft rubber gasket in between to make the joints air tight. Suitable air tight access doors/panels with Nylon hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on heavy gauge GSS/heavy duty aluminum frame work having pressure die cast aluminum jointers.

Units requiring mixing boxes shall be complete with thermal break profile as well as double skin panels in thermal break construction.

FILTERS
Each unit shall be provided with a factory assembled filter section containing washable synthetic type air filters having extruded aluminum frame. The media shall be supported with HDPE mesh on one side and aluminum mesh on other side. Filter shall fit so as to prevent by pass. Filter face velocity shall not exceed 2.5m/sec Holding frames shall be provided for installing a number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels.

VAYHAN AIR CONTROLS PRIVATE LIMITED
G1, Park View Residency, Patwari Enclave, Gandhi Nagar(IDPL), Hyderabad-500 037, INDIA
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Whenever fine filters are required to be installed, unit shall be provided with factory fabricated plenum in similar construction as described above for casing specifications.

COOLING/HEATING COILS

Multi rows deep chilled / hot water coil, as per requirement, shall have 12.5 mm to 15 mm dia tubes and maximum 24G thick with aluminum fins maximum 36G thickness firmly bonded to copper tubes assembled in zinc coated steel frame. Face & surface areas shall be such as to ensure rated capacity from each unit & such that air velocity across each coil shall not exceed 2.5m/sec. The coil shall be fixed in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg per Sq.cm. air pressure under water. Tube shall be mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 11 to 13 fins per inch (4 to 5 fins per cm). The drain tray complete with necessary double slope and drain connection for proper drainage of water shall be fabricated out of 18 G stainless steel with welded joints. The drain tray shall be externally insulated with minimum 12mm thick closed cell polyethylene. Necessary arrangement shall be provided to slide the coil in the drain pan. The computerized coil selection and test certificate for the cooling coil shall be submitted by the supplier.

HUMIDIFIER

Each unit shall be equipped with pan type/steam humidifier located inside the unit. The pan type humidifier shall consist of water tank made of GSS with stainless steel perforated cover. Electronic water level sensor shall be interlocked with water heating element. The heating element shall work automatically with a humidistat. Spray type humidifier if specified in Schedule of Quantities shall consist of spray header, nozzles, vertical mounted spray pump. The water spray pump shall work automatically with a humidistat. The water pump shall be made of non-corrosive material with water strainer before pump. 2 bend PVC eliminator shall be provided after the spray to prevent water carry over to fan section.

FAN

The fan shall be AMCA certified forward/backward curved, double inlet, double width type. The fan shall be imported, factory tested and assembled by original manufacturer. The Wheel & housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing spider frame and heavy duty ball bearings. The impeller & fan shaft shall be statically and dynamically balanced. The fan shall be selected for a noise level less than 80db(A). The fan outlet velocity shall not be more than 12.0m/sec. Fan housing with Motor shall be mounted on a common extruded aluminum base mounted inside the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant fabric, mounted on aluminium extruded channels, acting as a flexible connection for anti-vibration.

MOTOR AND DRIVE

Fan motors shall be 415 ± 10% volts, 50 cycles, 3 phase, squirrel - cage, totally enclosed fan cooled with class F Insulation and IP - 55 protection. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt drive arrangement. Belts shall be of the oil-resistant type.

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FRESH AIR INTAKE
Extruded aluminium construction duly anodized (20 microns and above), fresh air louvers with bird screen and extruded construction dampers shall be in the clear openings in masonry walls of the air handling rooms having at least one external wall. Louvers, dampers, prefilters, ducts and fresh air fan with speed regulator shall be provided as shown on Drawings and in Schedule of Quantities.

SAFETY FEATURES
Each air handling unit must have safety features as under:

a) The fan access door shall be equipped with micro-switch inter locked with fan motor to enable switching off the fan motor automatically in the event of door opening.
b) The Access Door-shall further have wire mesh screen as on added safety feature bolted on to the unit frame.
c) Fan and motor base shall be properly earthed from the factory.

All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

ACCESSORIES
Each air handling unit shall be provided with manual air vent at high point in the cooling/heating coil and drain plug in the bottom of the coil. In addition, the following accessories may be required at air handling units, their detailed specifications are given in individual sections, and quantities separately identified in schedule of quantities.

Motorized three way mixing valves in chilled/hot water lines connecting to the coil. This valve shall be operated by the cooling/heating thermostat & shall control the flow of chilled/hot water. See the section "Automatic Controls and Instruments" for detailed Specifications.

Cooling/heating thermostats as per section " Automatic Controls Instruments" shall be located in return air stream.

Insulated butterfly valves/balancing valves "Y" strainer, union & condensate drain piping upto sump or floor drain in air handling unit room, as described in section "Piping".

Thermometers in the thermometer wells & pressure gauge (with cocks) within gauge ports in chilled/hot water supply and return lines as per the section" Automatic Controls and Instruments".

PERFORMANCE DATA
The Air Handling Unit shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data, with operation points clearly indicating shall be submitted and verified at the time of testing commissioning of the installation.

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TESTING

Cooling/heating capacity of various air handling unit models shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by an anemometer and temperature measurements by accurately calibrated mercury in glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

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CEILING SUSPENDED AHU – COMFORT APPLICATION

SCOPE
The scope of this section comprises the supply, erection, testing and commissioning double skin construction air handling units, conforming of these specifications and in accordance with Drawings and of the Schedule of Quantities.

TYPE
The Air Handling Unit shall be double skin construction, draw - thru type comprising of various section such as mixing box (wherever the fresh air & return air are ducted), filter section, Coil section, fan section as per details given Drawings and Schedule of Quantity.

CAPACITY
The air handling capacities, maximum motor H.P., static pressure shall be as shown on Drawing and in Schedule of Quantity.

HOUSING / CASING
The unit shall be Ceiling Mounted type. The housing/casing of the Air Handling Unit shall be of double skin construction. The frame work shall be of Extruded Aluminum hollow sections. All the frame shall be assembled using pressure die cast aluminum/nylon joints to make a sturdy, strong and self supporting frame work for various section.
25mm thick Double Skin Panels shall be made of 0.6mm Pre-coated GSS on outside and 0.6 mm Galvanized sheet inside with CFC/HCFC free Poly Urethane Foam of 38-40 kg/cum. in-house injected in between. These panels shall be screwed from inside on to the frame work with soft rubber gasket in between to make the joints air tight. The unit shall be suitably insulated from inside to avoid condensation on outer surface.
Units requiring mixing boxes shall be complete with thermal break profile as well as double skin panels in thermal break construction.

FILTERS
Each unit shall be provided with a factory assembled filter section containing 25mm thick washable synthetic type air filters having extruded aluminum frame. The media shall be supported with HDPE mesh on one side and aluminum mesh on other side. Filter shall fit so as to prevent by pass. Filter face velocity shall not exceed 2.5m/sec Holding frames shall be provided for installing a number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels.

COOLING/HEATING COILS
Multi rows deep chilled / hot water coil, as per requirement, shall have 12.5 mm to 15 mm dia tubes maximum 24 G thick with aluminum fins maximum 36 G thickness firmly bonded to copper tubes assembled in zinc coated steel frame. Face & surface areas shall be such as to ensure rated capacity from each unit & such that air velocity across each coil shall not exceed 2.5m/sec. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg per Sq.cm. air pressure under water. Tube shall be mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 11 to 13 fins per inch (4 to 5 fins per cm). The drain tray complete with necessary double slope and drain

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connection for proper drainage of water shall be fabricated out of 18 G stainless steel with welded joints. The drain tray shall be externally insulated with minimum 12mm thick closed cell polyethylene. Necessary arrangement shall be provided to slide the coil in the drain pan. The computerized coil selection and test certificate for the cooling coil shall be submitted by the supplier.

FAN

The fan shall be AMCA certified forward/backward curved, double inlet, double width type. The fan shall be imported, factory tested and assembled by original manufacturer. The Wheel & housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing spider frame and heavy duty ball bearings. The impeller & fan shaft shall be statically and dynamically balanced. The fan shall be selected for a noise level less than 80db(A). The fan outlet velocity shall not be more than 12.0m/sec. Fan housing with Motor shall be mounted on a common extruded aluminum base mounted inside the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant fabric, mounted on aluminium extruded channels, acting as a flexible connection for anti-vibration.

MOTOR AND DRIVE

Fan motors shall be 415 ± 10% volts, 50 cycles, 3 phase, squirrel - cage, totally enclosed fan cooled with class F Insulation and IP - 55 protection. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt drive arrangement. Belts shall be of the oil-resistant type.

FRESH AIR INTAKE

Air intake section shall be provided in the return air path. The air intake louvers shall be in extruded aluminium section mounted in extruded aluminium frame work.

SAFETY FEATURES

Each air handling unit must have safety features as under:

a) Fan and motor base shall be properly earthed from the factory.
b) All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

ACCESSORIES

Each air handling unit shall be provided with manual air vent at high point in the cooling/heating coil and drain plug in the bottom of the coil. In addition, the following accessories may be required at air handling units, their detailed specifications are given in individual sections, and quantities separately identified in Schedule of Quantities.

Motorized three way mixing valves in chilled/hot water lines connecting to the coil. This valve shall be operated by the cooling/heating thermostat & shall control the flow of chilled/hot water. See the section "Automatic Controls and Instruments" for detailed Specifications.

Cooling/heating thermostats as per section" Automatic Controls Instruments" shall be located in return air stream.

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Insulated butterfly valves/balancing valves "Y" strainer, union & condensate drain piping upto sump or floor drain in air handling unit room, as described in section "Piping".

Thermometers in the thermometer wells & pressure gauge (with cocks) within gauge ports in chilled/hot water supply and return lines as per the section" Automatic Controls and Instruments".

PERFORMANCE DATA

The Air Handling Unit shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data, with operation points clearly indicating shall be submitted and verified at the time of testing commissioning of the installation.

TESTING

Cooling/heating capacity of various air handling unit models shall be computed from the measurements of airflow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by an anemometer and temperature measurements by accurately calibrated mercury in glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

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VERTICAL AIR HANDLING UNIT – COMFORT APPLICATION

SCOPE
The scope of this section comprises the supply, erection, testing and commissioning double skin construction air handling units, conforming of these specifications and in accordance with Drawings and of the Schedule of Quantities.

TYPE
The Air Handling Unit shall be double skin construction, draw - thru type comprising of various section such as mixing box (wherever the fresh air & return air are ducted), filter section, Coil section, fan section as per details given Drawings and Schedule of Quantity.

CAPACITY
The air handling capacities motor H.P. Static pressure shall be as shown on Drawing and in Schedule of Quantity.

HOUSING / CASING
The unit shall be in vertical construction and suitable for floor mounting. The housing/casing of the Air Handling Unit shall be of double skin construction. The frame work shall be of Extruded Aluminum hollow sections. All the frame shall be assembled using pressure die cast aluminum/nylon joints to make a sturdy, strong and self supporting frame work for various section.

25mm thick Double Skin Panels shall be made of 0.6mm Pre-coated GSS on outside and 0.6 mm Galvanized sheet inside with CFC/HCFC free Poly Urethane Foam of 38-40 kg/cum. in-house injected in between. These panels shall be screwed from inside on to the frame work with soft rubber gasket in between to make the joints air tight. The unit shall be suitably insulated from inside to avoid condensation on outer surface.

Units requiring mixings boxes shall be complete with thermal break profile as well as double skin panels in thermal break construction.

FILTERS
Each unit shall be provided with a factory assembled filter section containing 25mm thick washable synthetic type air filters having extruded aluminum frame. The media shall be supported with HDPE mesh on one side and aluminum mesh on other side. Filter shall fit so as to prevent by pass. Filter face velocity shall not exceed 2.5m/sec Holding frames shall be provided for installing a number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels.

COOLING/HEATING COILS
Multi rows deep chilled / hot water coil, as per requirement, shall have 12.5 mm to 15 mm dia tubes maximum 24 G thick with aluminum fins maximum 36 G thickness firmly bonded to copper tubes assembled in zinc coated steel frame. Face & surface areas shall be such as to ensure rated capacity from each unit & such that air velocity across each coil shall not exceed 2.5m/sec. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be

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factory tested at 21 Kg per Sq.cm. air pressure under water. Tube shall be mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 11 to 13 fins per inch (4 to 5 fins per cm). The drain tray complete with necessary double slope and drain connection for proper drainage of water shall be fabricated out of 18 G stainless steel with welded joints. The drain tray shall be externally insulated with minimum 12mm thick closed cell polyethylene. Necessary arrangement shall be provided to slide the coil in the drain pan. The computerized coil selection and test certificate for the cooling coil shall be submitted by the supplier.

FAN

The fan shall be AMCA certified forward curved, double inlet, double width type. The fan shall be imported, factory tested and assembled by original manufacturer. The Wheel & housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing spider frame and heavy duty ball bearings. The impeller & fan shaft shall be statically and dynamically balanced. The fan shall be selected for a noise level less than 8db(A). The fan outlet velocity shall not be more than 12.0m/sec. Fan housing with Motor shall be mounted on a common extruded aluminum base mounted inside the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant fabric, mounted on aluminium extruded channels, acting as a flexible connection for anti-vibration.

MOTOR AND DRIVE

Fan motors shall be 415 ± 10% volts, 50 cycles, 3 phase, squirrel - cage, totally enclosed fan cooled with class F Insulation and IP - 55 protection. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt drive arrangement. Belts shall be of the oil-resistant type.

FRESH AIR INTAKE

Extruded aluminium construction duly anodized (20 microns and above), fresh air louvers with 'bird screen and extruded construction dampers shall be in the ·clear openings in masonry walls of the air handling rooms having at least one external wall. Louvers, dampers, prefilters, ducts and fresh air fan with speed regulator shall be provided as shown on Drawings and in Schedule of Quantities.

SAFETY FEATURES

Each air handling unit must have safety features as under:

a) Fan and motor base shall be properly earthed from the factory.

B) All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

ACCESSORIES

Each air handling unit shall be provided with manual air vent at high point in the cooling/heating coil and drain plug in the bottom of the coil. In addition, the following accessories may be required at air handling units, their detailed specification are given in individual sections, and quantities separately identified in Schedule of Quantities.

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Motorized three way mixing valves in chilled/hot water lines connecting to the coil. This valve shall be operated by the cooling/heating thermostat & shall control the flow of chilled/hot water. See the section "Automatic Controls and Instruments" for detailed Specifications.

Cooling/heating thermostats as per section" Automatic Controls Instruments" shall be located in return air stream.

Insulated butterfly valves/balancing valves "Y" strainer, union & condensate drain piping upto sump or floor drain in air handling unit room, as described in section "Piping".

Thermometers in the thermometer wells & pressure gauge (with cocks) within gauge ports in chilled/hot water supply and return lines as per the section" Automatic Controls and Instruments".

PERFORMANCE DATA

The Air Handling Unit shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data, with operation points clearly indicating shall be submitted and verified at the time of testing commissioning of the installation.

TESTING

Cooling/heating capacity of various air handling unit models shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering-and leaving the coil. Flow measurements shall be by an anemometer 'and temperature measurements by accurately calibrated mercury in glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

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VENTILATION UNITS

SCOPE
The scope of this section comprises the supply, erection, testing and commissioning double skin construction ventilation units, conforming of these specifications and in accordance with Drawings and of the Schedule of Quantities.

TYPE
The ventilation Unit shall be double skin construction, draw - thru type comprising of various section such as mixing box (wherever the fresh air & return air are ducted), filter section, fan section, fine filter plenum (wherever required) as per details given Drawings and Schedule of Quantity.

CAPACITY
The air handling capacities, maximum motor H.P., Static pressure shall be as shown on Drawing and in Schedule of Quantity.

HOUSING *I* CASING
The housing/casing of the Ventilation Unit shall be of double skin construction. The frame work shall be of Extruded Aluminum hollow sections. All the frame shall be assembled using pressure die cast aluminum/nylon joints to make a sturdy, strong and self supporting frame work for various section.

25mm thick Double Skin Panels shall be made of 0.6mm Pre-coated GSS on outside and 0.6 mm Galvanized sheet inside with CFC/HCFC free Poly Urethane Foam of 38-40 kg/cum. in-house injected in between. These panels shall be screwed from inside on to the frame work with soft rubber gasket in between to make the joints air tight.

Frame work for each section shall be joined together with soft rubber gasket in between to make the joints air tight. Suitable air tight access doors/panels with Nylon hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on heavy gauge GSS/heavy duty aluminium frame work having pressure die cast aluminium jointers.

FILTERS
Each unit shall be provided with a factory assembled filter section containing washable synthetic type air filters having extruded aluminum frame. The media shall be supported with HOPE mesh on one side and aluminum mesh on other side. Filter shall fit so as to prevent by pass. Filter face velocity shall not exceed 2.5m/sec Holding frames shall be provided for installing a number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels.

Whenever fine filters are required to be installed, unit shall be provided with factory fabricated plenum in similar construction as described above for casing specifications.

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FAN

The fan shall be AMCA certified forward/backward curved, double inlet, double width type. The fan shall be imported, factory tested and assembled by original manufacturer. The Wheel & housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing spider frame and heavy duty ball bearings. The impeller & fan shaft shall be statically and dynamically balanced. The fan shall be selected for a noise level less than 80db(A). The fan outlet velocity shall not be more than 12.0m/sec. Fan housing with Motor shall be mounted on a common extruded aluminum base mounted inside the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant fabric, mounted on aluminium extruded channels, acting as a flexible connection for anti-vibration.

MOTOR AND DRIVE

Fan motors shall be 415 ± 10% volts, 50 cycles, 3 phase, squirrel - cage, totally enclosed fan cooled with class F Insulation and IP - 55 protection. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM: -, Drive to fan "shall be provided through belt drive arrangement. Belts shall be of the oil-resistant type.

SAFETY FEATURES

Each air handling unit must have safety features as under:

The fan access door shall be equipped with micro-switch inter locked with fan motor to enable switching off the fan motor automatically in the event of door opening.

The Access Door shall further have wire mesh screen as on added safety feature bolted on to the unit frame.

Fan and motor base shall be properly earthed from the factory.

All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

PERFORMANCE DATA

The ventilation Unit shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data, with operation points clearly indicating shall be submitted and verified at the time of testing commissioning of the installation.

TESTING

The airflow measurements shall be by an anemometer and temperature measurements by accurately calibrated mercury in glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

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EVAPORATIVE COOLING UNITS

SCOPE
The scope of this section comprises the supply, erection, testing and commissioning double skin construction evaporative cooling units, conforming of these specifications and in accordance with Drawings and of the Schedule of Quantities.

TYPE
The evaporative cooling units shall be of double skin construction draw - thru type comprising of various sections such as filter section, humidifying section, fan section as per details given drawings and Schedule of Quantity.

CAPACITY
The air handling capacities, maximum motor H.P., Static pressure shall be as shown on Drawing and in Schedule of Quantity.

HOUSING / CASING
The housing/casing of the Air Handling Unit shall be of double skin construction. The frame work shall be of Extruded Aluminum hollow sections. All the frame shall be assembled using pressure die cast aluminum/nylon joints to make a sturdy, strong and self supporting frame work for various section.

25/43 mm thick Double Skin Panels shall be made of 0.6mm Pre-coated GSS on outside and 0.6 mm Galvanized sheet inside with CFC/HCFC free Poly Urethane Foam of 38-40 kg/cum. in-house injected in between. These panels shall be screwed from inside on to the frame work with soft rubber gasket in between to make the joints air tight.

Frame work for each section shall be joined together with soft rubber gasket in between to make the joints air tight. Suitable air tight access doors/panels with Nylon hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on heavy gauge GSS/heavy duty aluminium frame work having pressure die cast aluminium jointers.

FILTERS
Each unit shall be provided with a factory assembled filter section containing washable synthetic type air filters having extruded aluminum frame. The media shall be supported with HDPE mesh on one side and aluminum mesh on other side. Filter shall fit so as to prevent by pass. Filter face velocity shall not exceed 2.5m/sec Holding frames shall be provided for installing a number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels.

WET DECK HUMIDIFIER
Wet deck humidifier pads shall be of cellulose acetate paper minimum 200 mm deep to provide at least 90% saturation efficiency at not more than 2.5m/sec air face velocity. The cellulose paper pads shall be housed in a GSS casing complete with PVC water distribution header and inter-connecting PVC pipes between pump and distribution header.

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WATER SUMP
The water sump below the pad section shall be constructed out of 18 G. Stainless Steel with welded joints. The tank shall be complete with make up, quick fill, overflow and drain connections. A brass float valve shall be provided for make up water line ..

PUMP
Water circulating pumps shall be vertical type mono-block pump. The capacity and head shall be adequate for the intended duty. The suction portion shall be at the bottom with proper seal arrangement to directly pick up water from the sump. The pump shall be suitable to operate at 415±10% V, 50 Hz, AC supply.

Necessary water bleeding arrangements shall be incorporated with separate drain connection provided in the sump to bleed small percentage of total circulated water in order to ensure compulsory water change over during running of the system. The pumps shall have following specifications:

Casing:	CI
Impeller:	Bronze
Shaft:	High tensile steel
Shaft Sleeve:	MS/ Bronze
Bearing:	Heavy duty ball/ roller
Base Plate:	Fabricated carbon steel
Packing:	Graphite Asbestos

FAN
The fan shall be AMCA certified forward curved, double inlet, double width type. The fan shall be imported, factory tested and assembled by original manufacturer. The Wheel & housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing spider frame and heavy duty ball bearings. The impeller & fan shaft shall be statically and dynamically balanced. The fan shall be selected for a noise level less than 8db(A). The fan outlet velocity shall not be more than *12.0m/sec.* Fan housing with Motor shall be mounted on a common extruded aluminum base mounted inside the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant fabric, mounted on aluminium extruded channels, acting as a flexible connection for anti-vibration.

MOTOR AND DRIVE
Fan motors shall be 415 ± 10% volts, 50 cycles, 3 phase, squirrel - cage, totally enclosed fan cooled with class F Insulation and IP - 55 protection .. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt drive arrangement. Belts shall be of the oil-resistant type.

SAFETY FEATURES
Each Air handling Unit must have safety features as under:

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G1, Park View Residency, Patwari Enclave, Gandhi Nagar(IDPL), Hyderabad-500 037, INDIA
Phone: +91-40-2372 0455; Fax: +91-40-2372 0456; email: sales@vayhan.com; url: www.vayhan.com

a) The fan access door shall be equipped with micro-switch inter locked with fan motor to enable switching off the fan motor automatically in the event of door opening.
B) The Access Door shall further have wire mesh screen as on added safety feature bolted on to the unit frame.
c) Fan section shall have weatherproof light for illumination.
d) Fan and motor base shall be properly earthed from the factory.
e) All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

PERFORMANCE DATA

Air handling units shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data, with operation points clearly indicating shall be submitted and verified at the time of testing commissioning of the installation.

TESTING

Cooling capacity of various evaporative unit models shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by an anemometer and temperature measurements by accurately calibrated mercury in glass thermometers.

Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

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ENERGY RECOVERY UNITS

SCOPE
The scope of this section comprises the supply, erection, testing and commissioning double skin construction air handling units, conforming of these specifications and in accordance with Drawings and of the Schedule of Quantities.

TYPE
The Air Handling Unit shall be double skin construction, draw – thru type comprising of various section such as pre-filter section, Coil section (wherever specified), heat recovery section, supply air fan section with supply air dampers, fine filter plenum (wherever required), return air fan section with filters, R.A damper & discharge cowl with bird screen or gravity louvers, as per details given Drawings and Schedule of Quantity.

CAPACITY
The air handling capacities, maximum motor H.P., Static pressure shall be as shown on Drawing and in Schedule of Quantity.

HOUSING / CASING
The housing/casing of the Air Handling Unit shall be of double skin construction.
The frame work shall be of Extruded Aluminum hollow sections. All the frame shall be assembled using pressure die cast aluminum/nylon joints to make a sturdy, strong and self supporting frame work for various section.

25/43 mm thick Double Skin Panels shall be made of 0.6 mm Pre-coated GSS on outside and 0.6 mm Galvanized sheet inside with CFC/HCFC free Poly Urethane Foam of 38-40 kg/cum. In-house injected in between. These panels shall be screwed from inside on to the frame work with soft rubber gasket in between to make the joints air tight.

Frame work for each section shall be joined together with soft rubber gasket in between to make the joints air tight. Suitable air tight access doors/panels with Nylon hinges and locks shall be mounted on heavy gauge GSS/heavy duty aluminium frame work having pressure die cast aluminium jointers.

Units requiring mixing boxes shall be complete with thermal break profile as well as double skin panels in thermal break construction.

FILTERS
Each unit shall be provided with a factory assembled filter section containing washable synthetic type air filters having extruded aluminum frame. The media shall be supported with HDPE mesh on one side and aluminum mesh on other side. Filter shall fit so as to prevent by pass. Filter face velocity shall not exceed 2.5m/sec Holding frames shall be provided for installing a number of filter cells between guiding channels.

Whenever fine filters are required to be installed, unit shall be provided with factory fabricated plenum in similar construction as described above for casing specifications.

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COOLING/HEATING COILS

Multi rows deep chilled / hot water coil, as per requirement, shall have 12.5 mm to 15 mm dia tubes maximum 24 G thick with aluminum fins maximum 36 G thickness firmly bonded to copper tubes assembled in zinc coated steel frame. Face & surface areas shall be such as to ensure rated capacity from each unit & such that air velocity across each coil shall not exceed 2.5m/sec. The coil shall be pitched in the unit casing for proper drainage. Each coil shall he factory tested at 21 Kg per Sq.cm. air pressure under water. Tube shall be mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 11 to 13 fins per inch (4 to 5 fins per cm). The drain tray complete with necessary double slope and drain connection for proper drainage of water shall be fabricated out of 18 Gg stainless steel with welded joints. The drain tray shall be externally insulated with minimum 12 mm thick closed cell polyethylene. Necessary arrangement shall be provided to slide the coil in the drain pan. The computerized coil selection and test certificate for the cooling coil shall be submitted by the supplier.

FAN

The fan shall be AMCA certified forward/backward curved, double inlet, double width type. The fan shall be imported, factory tested and assembled by original manufacturer. The Wheel & housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing spider frame and heavy duty ball bearings. The impeller & fan shaft shall be statically and dynamically balanced. The fan shall be selected for a noise level less than 8 db (A). The fan outlet velocity shall not be more than 12.0m/sec. Fan housing with Motor shall be mounted on a common extruded aluminum base mounted inside the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant fabric, mounted on aluminium extruded channels, acting as a flexible connection for anti-vibration.

MOTOR AND DRIVE

Fan motors shall be 415‡ 10% volts, 50 cycles, 3 phase, squirrel – cage, totally enclosed fan cooled with class F Insulation and IP – 55 protection. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt drive arrangement. Belts shall be of the oil-resistant type.

HEAT RECOVERY SECTION

Heat Recovery Section shall house wheel matrix of pure aluminium foil so as to permit quick and efficient uptake of thermal energy, sufficient mass for optimum heat transfer and maximum sensible heat recovery at a low rotational speed of 20-25 rpm. Non metallic substrate will not be accepted for construction of wheel. The desiccant should be of “Ecosorb 340” type which combines the selectivity of a 3A molecular sieve desiccant for the 2.8A water molecules, and has the high diffusivity of the 4A molecular sieves, so as to ensure the exclusion of contaminants in the air stream, while transferring only water vapour molecules, resulting in selective and fast latent recovery.

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G1, Park View Residency, Patwari Enclave, Gandhi Nagar(IDPL), Hyderabad-500 037, INDIA
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The desiccant, of sufficient mass, shall be coated with non masking porous binder adhesive on the aluminium substrate so as to allow quick and easy uptake and release of water vapour. The rotor/wheel matrix shall have equal sensible and latent recovery.

With optimum heat and mass through matrix formed by desiccant, of sufficient mass, coated on an aluminium foil, the rotor shall rotate at lower than 20-25 rpm, thereby also ensuring long life of belts and reduced wear and tear of seals.

The rotor shall be made of alternate flat and corrugated aluminium foil of uniform width. The rotor honeycomb matrix foil should be so wound and adhered so as to make a structurally very strong and rigid media which shall not get cracked, deformed, etc., due to change of temperature or humidity.

The rotor having a diameter upto 2800 mm shall have spokes to reinforce the matrix. From 2000 mm diameter upwards, the option of a special wing structure, to prevent the rotors from wobbling or deforming due to the successive pressure differentials, will be available.

Sectioned wheels, with pie-segments, capable of being assembled in the field, shall be available as an option, above 2000 mm in diameter.

The surface of the wheel/rotor should be highly polished to ensure that the run out does not exceed ± 1 mm for every 1metre diameter, thereby ensuring, negligible
leakage, if labyrinth non-contact seals are provided, and minimal drag, if contact wiper seals are provided.

The radial run out shall not exceed ± 1 mm for every 1metre diameter, thereby minimizing the leakage/drag on the radial seals, and minimize the fluctuation in the tension of the drive belt.

The number of wraps (of alternate corrugated and flat foil) for every inch of rotor radii shall be very consistent so as to insure uniform air flow and performance over the entire face in the air steam. Flue height and pitch will be consistent to a very tight tolerance to ensure uniform pressure drop and uniform airflows across the rotor face.

The rotor shall be a non-clogging aluninium media, having a multitude of narrow aluminium foil channels, thus ensuring a laminar flow, and will allow particles upto 800 microns to pass through it.

The media shall be cleanable with compressed air, or low-pressure stream or light detergent, without degrading the latent recovery.

The recovery wheel cassette/casing shall be manufactured from tubular structure to provide a self supporting rigid structure, complete with access panels, purge sector, rotor bearings, seals, drive mechanism complete with belt.

The rotor/wheel should have a filed adjustable purge mechanism to provide definite separation of airflow minimizing the carryover of bacteria, dust and other pollutants, from the exhaust air to

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the supply air, It shall be possible, with proper adjustment, to limit cross contamination to less than 0.04% of that or the exhaust air concentration.

The face and radial seals shall be four (4) pass labyrinth seals for effective sealing between the two air streams, and also for a minimum wear and tear ensuring infinite life of the seals.

FRESH AIR INTAKE
Anodized extruded alumunium construction duly anodized (20 microns and above),fresh air louvers with bird screen and extruded aluminium low leakage construction dampers shall be provided for S.A. & R.A. Blades shall be of made of extruded aluminium construction and shall be rattle-free.

SAFETY FEATURES
Each air handling unit must have safety features as under.

a) The fan access door shall be equipped with micro-switch inter locked with fan motor to enable switching off the fan motor automatically in the event of door opening.

b) The Access Door shall further have wire mesh screen as on added safety feature bolted on to the unit frame.

c) Fan and motor base shall be properly earthed from the factory.

d) All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

ACCESSORIES
Each air handling unit shall be provided with manual air vent at high point in the cooling/heating coil and drain plug in the bottom of the coil. In addition, the following accessories may be required at air handling units, their detailed specifications are given in individual section, and quantities separately identified in Schedule of Quantities.

Motorized three way mixing valves in chilled/hot water lines connecting to the coil. This valve shall be operated by the cooling/heating thermostat & shall control the flow of chilled/hot water. See the section “Automatic Controls and Instruments” for detailed Specifications.

Cooling/heating thermostats as per section “ Automatic Controls Instruments” shall be located in return air stream.

Insulated butterfly valves/balancing valves “Y” strainer, union & condensate drain piping upto sump or floor drain in air handling unit room, as described in section “Piping”.

Thermometers in the thermometer wells & pressure gauge (with cocks) within gauge ports in chilled/hot water supply and return lines as per the section “ Automatic Controls and Instruments”.

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PERFORMANCE DATA

The Air Handling Unit shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data, with operation points clearly indicating shall be submitted and verified at the time of testing commissioning of the installation.

TESTING

Performance of air handling unit models shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by an anemometer and temperature measurements by accurately calibrated mercury in glass thermometers. Computed results shall conform to the specified capacities and· quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

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G1, Park View Residency, Patwari Enclave, Gandhi Nagar(IDPL), Hyderabad-500 037, INDIA
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AIR HANDLING UNITS – CLEAN ROOM APPLICATION

SCOPE
The scope of this section comprises the supply, erection, testing and commissioning double skin construction air handling units, conforming of these specifications and in accordance with Drawings and of the Schedule of Quantities.

TYPE
The Air Handling Unit shall be double skin construction, draw - thru type comprising of various section such as mixing box (wherever the fresh air & return air are ducted), filter section, Coil section, by pass damper section (wherever required), humidification section, fan section, fine filter plenum (wherever required) as per details given Drawings and Schedule of Quantity.

CAPACITY
The air handling capacities, maximum motor H.P., Static pressure shall be as shown on Drawing and in Schedule of Quantity.

HOUSING / CASING
The housing/casing of the Air Handling Unit shall be of double skin construction.

The frame work shall be of Extruded Aluminum hollow sections coved internally to avoid accumulation of dust. All the frame shall be assembled using pressure die cast aluminum/nylon joints to make a sturdy, strong and self supporting frame work for various section.

25/43mm thick Double Skin Panels shall be made of 0.6mm Pre-coated GSS on outside and 0.6 mm Galvanized sheet inside with CFC/HCFC free Poly Urethane Foam of 38-40' 'kg/cum. In-house" injected in between. These panels shall be screwed from inside on to the frame work with soft rubber gasket in between to make the joints air tight. No screws shall project inside the housing.

Frame work for each section shall be joined together with soft rubber gasket in between to make the joints air tight. Suitable air tight access doors/panels with Nylon hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on heavy gauge GSS/heavy duty aluminium frame work having' pressure die cast aluminium jointers.

Units requiring mixing boxes shall be complete with thermal break profile as well as double skin panels in thermal break construction.

FILTERS
Each unit shall be provided with a factory assembled filter section containing EU-4 grade flange type (90% down to 10 microns) air filters having anodized aluminum frame with non-woven synthetic media supported by HDPE and aluminium mesh duly epoxy sealed. The initial pressure drop shall not exceed 3mm when filter is clean.

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G1, Park View Residency, Patwari Enclave, Gandhi Nagar(IDPL), Hyderabad-500 037, INDIA
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Fine filters shall be of EU-7 grade flange type (99% down to 5 microns) air filters having anodized aluminum frame with non-woven synthetic media supported by HDPE and aluminium mesh duly epoxy sealed. The initial pressure drop shall not exceed 8mm when filter is clean.

Superfine filters shall be of EU-9 grade flange type (99% down to 3 microns) air filters having anodized aluminium frame with glass fiber media having aluminium separators duly epoxy sealed. Initial pressure drop shall not exceed 10mm when filter is clean.

Filter shall fit so as to prevent by pass. Filter face velocity shall not exceed 2.5m/sec Holding frames shall be provided for installing a number of filter cells in banks. These cells-shall be held within -the frames suitable for mounting flange type filters.

Whenever fine filters are required to be installed, unit shall be provided with factory fabricated plenum in similar construction as described above for casing specifications.
Magnehalic pressure gauges of suitable range shall be provided across each filter bank duly mounted on unit casing by the AHU manufacturer.

COOLING/HEA TING COILS
Multi rows deep chilled / hot water coil, as per requirement, shall have 12.5 mm to 15 mm dia tubes maximum 24 G thick with aluminum fins maximum 36 G thickness firmly bonded to copper tubes assembled in zinc coated steel frame. Face & surface areas shall be such as to ensure rated capacity from each unit & such that air velocity across each coil shall not exceed 2.5m/sec. The coil shall be pitched in the unit casing for proper- drainage .. Each coil shall be factory tested at 21 Kg per Sq.cm. air pressure under water. Tube shall be mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 11 to 13 fins per inch (4 to 5 fins per cm). The drain tray complete with necessary double slope and drain connection for proper drainage of water shall be fabricated out of 18 G stainless steel with welded joints. The drain tray shall be externally insulated with minimum 12mm thick closed cell polyethylene. Necessary arrangement shall be provided to slide the coil in the drain pan. The computerized coil selection and test certificate for the cooling coil shall be submitted by the supplier.

HUMIDIFIER
Each unit shall be equipped with pan type/steam humidifier located inside the unit. The pan type humidifier shall consist of water tank made of GSS with stainless steel perforated cover. Electronic water level sensor shall be interlocked with water heating element. The heating element shall work automatically with a humidistat. Spray type humidifier if specified in Schedule of Quantities shall consist of spray header, nozzles, vertical mounted spray pump. The water spray pump shall work automatically with a humidistat. The water pump shall be made of non-corrosive material with water strainer before pump. 2 bend PVC eliminator shall be provided after the spray to prevent water carry over to fan section.

FAN
The fan shall be AMCA certified forward/backward curved, double inlet, double width type. The fan shall be imported, factory tested and assembled by original manufacturer. The Wheel &

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G1, Park View Residency, Patwari Enclave, Gandhi Nagar(IDPL), Hyderabad-500 037, INDIA
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housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing spider frame and heavy duty ball bearings. The impeller & fan shaft shall be statically and dynamically balanced. The fan shall be selected for a noise level less than 80db(A). The fan outlet velocity shall not be more than 12.0m/sec. Fan housing with Motor shall be mounted on a common extruded aluminum base mounted inside the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant fabric, mounted on aluminium extruded channels, acting as a flexible connection for anti-vibration.

MOTOR AND DRIVE

Fan motors shall be 415 ± 10% volts, 50 cycles, 3 phase, squirrel - cage, totally enclosed fan cooled with class F Insulation and IP - 55 protection. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM Drive to fan shall be provided to through, belt drive arrangement. Belts shall be of the oil-resistant type.

FRESH AIR INTAKE

Extruded aluminium construction duly anodized (20 microns and above), fresh air louvers with bird screen and extruded construction dampers shall be in the clear openings in masonry walls of the air handling rooms having at least one external wall. Louvers, dampers, prefilters, ducts and fresh air fan with speed regulator shall be provided as show on Drawings and in Schedule of Quantities.

SAFETY FEATURES

Each air handling unit must have safety features as under:

a) The fan access door shall be equipped with micro-switch inter locked with fan motor to enable switching off the fan motor automatically in the event of door opening.
b) The Access Door shall further have wire mesh screen as on added safety feature bolted on to the unit frame.
c) Fan and motor base shall be properly earthed from the factory.
d) All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

ACCESSORIES

Each air handling unit shall be provided with manual air vent at high point in the cooling/heating coil and drain plug in the bottom of the coil. In addition, the following accessories may be required at air handling units, their detailed specifications are given in individual sections, and quantities separately identified in Schedule of Quantities.

Motorized three way mixing valves in chilled/hot water lines connecting to the coil. This valve shall be operated by the cooling /heating thermostat & shall control the shall control the flow of chilled/hot water. See the section "Automatic Controls and Instruments" for detailed Specifications.

Cooling/heating thermostats as per section" Automatic Controls Instruments" shall be located in return air stream.

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Insulated butterfly valves/balancing valves “Y” strainer, union & condensate drain piping upto sump or floor drain in air handling unit room, as described in section “Piping”.
Thermometers in the thermometer wells & pressure gauge (with cocks) within gauge ports in chilled/hot water supply and return lines as per the section “Automatic Controls and Instruments”.

PERFORMANCE DATA
The Air Handling Unit shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data, with operation points clearly indicating shall be submitted and verified at the time of testing commissioning of the installation.

TESTING
Cooling/ Heating capacity of various air handling unit models shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by an anemometer and temperature measurements by accurately calibrated mercury in glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

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