Design and Access Statement

British Museum - Gallery 1 Chiller

Great Russell Street, Bloomsbury, London, WC1B 3DG 20 November 2020

Overview

The British Museum is in need of replacing an existing central chilled water plant which ages circa 20 years. The proposed replacement system is a like for like in terms of the fundamental arrangement. The full arrangement comprises of a liquid chiller located within room A/1/110, accompanied by a remote condenser. The condenser is located to the east side of the Museum, situated upon the roof of electrical substation A/1/104-6. The plant equipment currently serves the Enlightenment Gallery (Gallery 1). The Gallery holds the collection of King George III, comprising of approximately 65,000 volumes of printed books as shown within Figure 3. The location of the existing condenser is indicated within Figure 2 and Figure 4. Please refer to the planning submittal drawings for enhanced detail.



Figure 1 - Location plan showing site boundary

Figure 2 - Site plan showing location of proposed condenser



Figure 3 - Enlightenment Gallery (Gallery 1)

Existing Plant Equipment

Gallery 1 is a mechanically ventilated room containing no operable windows. The existing chiller servicing the gallery has reached the end of its technical lifespan, is running at 50% capacity and is in need of immediate replacement. This chiller caters as a reliable source of conditioning for occupants utilising the Gallery and also maintains a suitable room temperature to prevent deterioration of artefacts.



Figure 4 - Plan view of existing condenser Figure 5 - Side elevation of existing louvre

Proposed Plant Equipment

The proposed plant equipment (ThermoKey JKR2490.C5 W3EIEPA(EC)S) shown within Figure 6 and Figure 7 would reduce the energy consumption compared to the existing system, provide a better energy efficiency ratio (EER) and reduce the total quantity of refrigerant content in the system. The proposed equipment would also reduce the tonnes of CO_2 equivalent (tCO2e) of refrigerant content and avoid an increase in noise level over the existing condition. The dimensions of the proposed condenser are as follows;

Length - 5490mm (plus 450mm for the control panel) Width - 2400mm Height - 2262mm (plus 400mm for the EBM Axi-Top fan cowlings)

The proposed condenser would achieve sound power of 69 dB(A) at peak operating point. Further details on noise are outlined within the accompanying acoustic submittal.



Figure 6 - Front elevation of proposed condenser Figure 7 - Side elevation of proposed condenser

Design and Access

There would be no change to the operational use of the building, layout or use of space in the immediate vicinity of the proposed condenser. Access to the condenser would remain unchanged from the original unit. The cat ladder would provide access for all maintenance works. The proposed condenser would be for the most part hidden by the existing acoustic louvre and the brickwork façade of Drill Hall Hirayama Conservation Studio. The replacement condenser is higher in vertical height than the existing condenser. As such, it will not be completely concealed from the existing louvres. The extent of this visibility is demonstrated on the elevations accompanying this submittal. There will be a negligible impact on the external appearance in comparison with the existing position.

As evident on the existing and proposed planning drawing submittals, the replacement condenser is taller than the existing unit primarily due to a revision of the external design conditions the system is to operate too. In line with current standards, the system which includes both the chiller and condenser is expected to deliver 100% cooling capacity at an external ambient temperature of 35°C. This is an increase of 5°C over the system that was installed originally and reflects the elevated average summer temperatures being experienced in London. In order to maintain noise levels to compliant limits, an increase in the overall heat transfer area is required over the existing unit which results in an altogether larger device. Other contributing factors are the limited dimensions/footprint of the existing compound and the employment of a lower GWP refrigerant gas. The existing louvres do contribute sufficient attenuation performance, hence the proposal to retain them.

Appendix A - ThermoKey Technical Data

ThermoKey	Company	Date	30/10/2020
Heat Exchange Solutions Via dell'industria 1 33061 Rivarotta di Rivignano di Teor (UD) - ITALY Tel.: +39/0432772300 Fax.: +39/0432779734	Attention of	Sw Version	200331
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TECHNICAL DATA

REMOTE CONDENSERS (5) JKR2490.C5 W3EIEpA(EC)S

Number of circuits 124

PERFORMANCE (SINGLE UNIT)			
Real Capacity	267.70 k₩	At the real cond. temp. (13)	Middle 45.0 °C
TUBE SIDE			
Refrigerant	R454C	Overheating	1 2.5 K
Massic Fluid Flow	1.388kg/s	Subcooling	5.0 K
AIR SIDE			
Inlet Air Temp [MAX]	35.0 °⊂	Outlet Air Temp.	44.8 °C
Inlet relative hum.	50.0%	Outlet relative hum.	29.6 %
		Altitude	Om
		ESP	0.0 Pa
		Flow Direction	N/A
Air Flow	83469 m³/h	Air Velocity	1.25 m/s
FANS TECHNICAL DATA			
ERP	Yes	UL	Yes
Fan Number	8 N°	Fan Diameter	910 mm
Phases-Voltage-Frequency	3-400-50 N°/Volt/Hz	Fan type	34050R91ECB2C
Rpm [Nominal data]	570 Rpm	Link	EC
Power x 1 [Nominal data]	680 Watt	Current x 1 [Nominal data] (1)	1.28 A
Rpm [Working point]	401 Rpm	Rpm rate [working point / nominal]	70%
Power x 1 [Working point]	210 Watt	Current x 1 [Working point] (1)	0.48 A
Total Power x n° [Working point]/ [Nominal data]	1680/5440₩att	Total Current x n° [Working point]/ [Nominal data]	, 3.84/10.24A
Efficiency Energy Class:nominal calculation R4044	A 40°C/Air 25°C	Efficiency Energy Class:calculation c	on the working point
FANS NOISE DATA (7)			
Sound Pressure Level (4) [Working point]	36 dB(A)	Sound Power Level (4) [Working po	bint] 69 dB(A)
At the distance of	10 m	in accordance with EN 13487/EN IS	SO 3744 (7)
HEAT EXCHANGER DATA (3)			
Fin Material (2)	Aluminium Turbo	Tubes Material	Copper
Fin Spacing	1.8mm	Internal Volume	180.0 dm ³
Fin Thickness	0.1 mm	Casing material	Galvanized steel painted
Surface	2102.0 m ²	Number of passes	4
Inlet Connection	2x76 mm		
Outlet Connection	2x54 mm	Connections	Same side
Max Pressure Design	30 bar	Fluid Category	Group 2
DIMENSIONS AND WEIGHT (3)			
Length	5490mm	Weight (3)	2583 kg
Width	2400 mm	Number of fixing point	10
Height	2262 mm	LDM (Approximate data)	5.49 m

SOUND POWER LEVEL

	Tot.	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Δ [dB(A)]	55	39	41	46	50	50	47	46	36

Data refers to one fan. IMPORTANT: the tolerance in any single octave band is +/-5dB. The tolerance in the overall dB(A) level is +/-2dB.

In case of AC fans working point is defined by fan supplier in nominal curve (delta or star). In case of EC fans is simulated on working point of unit.

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REMOTE CONDENSERS (5) JKR2490.C5 W3EIEpA(EC)S

ACCESSORIES

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CODE	DESCRIPTION
PAT	Aluminium turbo finned pack
PAS	Special fin spacing
CBLW3E	Wiring 'W3E'
INTSERV	3 pole repair switch 'l'
RGEP	Fan speed controller Ec Plus 'Ep'
AMM_JUMB	Shock absorbers Jumbo 'A'
VENT_EC_S2	Fan EC 02

WARNING

W002: Non-standard fin spacing. Please ask Thermokey for delivery time

W007: Subcooling calculation as derating of the outlet temperature of the heat exchanger: the whole heat exchanger is a condenser

An inverter different from the one proposed by Thermokey must have omni polar sinusoidal filters, between phase and phase and phase and ground.

For any support please contact our Sales Department

Total Net Price	€ (EUR)				
Number of units					
Total Net Price	€ (EUR)				
Net price of the accessories	€ (EUR)				
Net price of the unit	€ (EUR)				
Discount	%	Thermokey sales conditions are available on the website www.thermokey.com			
Total Gross Price	€ (EUR)	Thermolecular conditions are	multiple on the such site		
Accessories Price	€ (EUR)	Lead time (9)	to be defined		

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(1) The voltage is referred to the supplier's nominal data: fans consumption may vary with the air temperature and voltage system.

(2) The unit may not be suitable for very corrosive atmosphere. For special applications contact Thermokey. If a special fin material is selected(copper,coating),all the other materials of the unit remain standard(for detailed information please check the Technical description of the unit).

(3) Dimensions and weight are not valid for all possible options! The overall dimensions on the data sheet relate to the units without controls /electrical panels (For more detailed information please refer to the Electrical Box Manual). In the case of horizontal air flow units the standard position of the connections is on the left looking at the finned pack.

(4) Any noise caused by control systems, adiabatic system and so on, is not considered in the fan noise declaration. Actual values can also be subject to changes depending on the conditions of the installation.

(5) The manual consists of 4 parts; IG = General instructions for safe use, IM = Instructions for handling and unpacking, TC = Instructions and technical specifications, IS = Specific use and maintenance instructions. If not expressly requested at the pre-Purchase Order stage, the TC and IS instructions must be downloaded by the user from www.thermokey.com as they will not be provided in paper format.

The installer is required to follow the instructions of the above manuals and of all the main electrical components' manuals (e.g. fans, pumps, regulators).

(6) The unit is equipped with fans that follow the efficiency requirements of ERP directive 2009/125/EC

(7) In accordance with EN 13487 the declared sound pressure level for this unit has been calculated in free-field conditions over a reflecting plane with a parallelepiped surface. With reference to ISO 3744, when the difference of measurement of the unit in on and off stage is < = 6 dB (A), the the sound measurement does not reach the accuracy as required by the Directive. Background noise values lower than 30dB (A) are typical of indoor and silent environments. The declaration of the sound pressure of the unit, stated on the Thermokey data sheets, considers the background noise negligible.

(8) S x x x x : id serial number of the combination of the standard options available on Archimede (listed and described in the ACCESSORIES section) and special on request. The code appears on the order confirmation (as a part of the model code description) and on the data plate of the unit . Note : For each range the available options are listed in the catalogue on the Table Options and Accessories . The register of combinations of options associated with the code S x x x x is available on request .

(9) Delivery time for standard unit is considered ex works. For any special terms and conditions (ex. Large quantities, special items..) please contact Sales dept.

(10) The standard unit is not self-draining: the choice of fluid (water / glycol) is closely related to the freezing point of the same and to the actual operating period of the unit. For a self-draining construction, please contact Thermokey for a special offer.

(12) The dimensioning is made through a simulation of the selection program which does not take into account the influence of the installation conditions.

(13) For the selection of the maximum operating pressure, the pressure related to the condensation temperature (i.e. middle point) is taken into account

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(14) For fan units with microchannel cores, it is mandatory to respect the procedures available on ThermoKey website (Indications for the use of Tk micro cores)

(15) Fluid Group related to Directive 2014/68 / CE.

(16) The data on the fan label do not represent the worst absorption conditions.

(17) The declared performances are suitable for HVAC applications with air flow in a free field on both coil and fan sides (e.g. avoid recirculation or any element that reduces airflow) and with uniform inlet temperatures to the coil (e.g. avoid conditions on which adjacent elements cause temperature variations at the unit inlet). For other critical applications (e.g. industrial, power) please contact Thermokey.

(18) Thermokey reserves the right to change the technical data, drawings and prices of the Archimede software at any time and without prior notice. Please refer to the software release and EULA of the software in Section "?".

(19) The Archimede software is based on Refprop's latest libraries of oils, refrigerants and blends. Data updates may result in different performances of the units than those of previous releases of Archimede.

(20) Pay attention that the overall dimensions and weight of the unit equipped with EPS system, indicated in the technical sheet, refer to the model without electrical part and mounted evaporative panels, for variation of the possible option combinations please refer back to the following indications!

Take into consideration that the evaporative modules mounted on the side of the model protrude of 440mm all together on the width of the model footprint, whereas they do not affect the length and height dimensions of the model, moreover the discharging tubes mounted on the models protrude of extra 320mm all together on the width of the model. Take into consideration that the control panels and connection piping protrude depending on the selected and requested combinations of 400mm from the extremities of the model.

Consider as 60 kilos each module (per fan) the operative weight of the evaporative modules mounted with wet panels. Pay attention that in the case of non optimal maintenance of the discharging drip-trays or of the discharging line, you should consider a possible store of water in the tray and of the sole discharging pipes of EPS system of about 30 kilos per module (per fan). Consider the pre-mounted connection piping of EPS system to water supply network on the model of about 25 kilos per unit. Consider weight of the possible pre-mounted control electrical panel of the EPS system on the model of about 35 kilos per unit.

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Model: JKR2490.C5 W3EIEpA(EC)S





Attention: Drawing and dimensions not valid for all accessory options!

The overall dimensions on the datasheet refer only to the unit without regulation (For more detailed information refer to Electrical box Manual). In the units with horizontal air flow the standard position of the connections is left looking at the finned pack (right looking at the fans).

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REMOTE CONDENSERS (5) JKR2490.C5 W3EIEpA(EC)S

ROUND COPPER TUBE REMOTE CONDENSER

Quality standard ISO 9001 Applied Directives: 2014/68/EU Pressure Equipment Directive (PED) 2014/35/EU Low Voltage Directive (LVD) 2014/30/EU Electromagnetic Compatibility Directive (EMC) 2006/42/EC Machinery Directive (MD) 2011/65/UE Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipments (RoHS)

FINNED PACK HEAT EXCHANGER

Optimised geometries for use of refrigerants with tube and fin materials designed to achieve the best performances. The coil is tested at a pressure of 33 bar (50 bar for R410A). For the purposes of the tests all circuits are supplied with Schrader valves. Coverplates and side plates made with customised material and painting depending on heat exchanger application. Fin spacing from 1.8 to 4 mm based on materials/applications (2.1 mm by default). Upon request, the whole finned pack can be subjected to different types of treatments/coatings based on the application.

Triangular geometry (30 x 25.98 mm) with backflow air-refrigerant circuits in order to optimise the thermodynamic capacity. Heat exchange tubes made of grooved copper (\emptyset 9.52 mm).

Aluminium louvered fins

CASING

The casing is made of hot-dip galvanised steel elements painted with a RAL 7035 powder coating to ensure excellent resistance to corrosion in the main applications. The units have been designed to be highly modular. The internal construction allows great air distribution using any type of controller thanks to inner partition walls which make each single fan air flow independent. The bends are protected by suitable panels. Components painting is done after any production operation so that protection against corrosion is guaranteed on all parts. All unpainted exposed components are made with materials having a level of resistance to corrosion either equal or superior to that of the painted casing. The casing is in compliance with corrosivity category C4-L (pursuant to standard UNI EN ISO 12944). Upon request, the casing can be manufactured following special painting, RAL and stainless steel specifications depending on the required application.

PACKAGING

Protective film packaging. Upon request, the units can be provided with dedicated packaging for special shipments (e.g. container with dedicated slides, barrier bags, etc.).

FANS

All fan units manufactured by Thermokey are fit with axial type fans featuring a motor with an external rotor directly built-in the axial propeller to create a compact, maintenance-free fan.Optimised efficiency and minimised noise level thanks to the fan blades aerodynamic design.Protective grids in compliance with EN 294.All the fans have to meet the requirements of balance quality grade Q 6.3 as prescribed in DIN ISO 1940.Motor protection class IP54.Windings in thermodynamic capacity class F, pursuant to DIN EN 60 034-1. The noise levels in use are those declared by the fan manufacturer according to DIN24166, precision grade 3, measured according to DIN 45635.The sound pressure level declared for this unit has been calculated in free field conditions on a parallelepiped reflecting reference surface in compliance with standard EN 13487.Upon request, fans with special features can be supplied (voltage, frequency, corrosion category, etc.).

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High efficiency and long durability EC fans (brushless) supplied with integrated control electronics: ideal for ongoing control of the rotation speed with a 0 to 10V signal or, alternatively, MODBUS RS485.They are the ideal design solution for high aeraulic efficiencies, the modulation of the number of speeds, self electric protection, monitoring/modification of the operating parameters of each individual fan.Three-phase motor(s) 380-480V-3ph+PE-50/60 Hz. Temperature range between -20.0 °C and 60.0 °C (average value depending on type of fan and fan power supply). Alarms are available in the terminal board to warn about motor faults.

HYDRAULIC CONNECTIONS

Copper headers.Weld on connections.

ACCESSORIES

A – SHOCK ABSORBERS

Shock absorbing elastic bases for industrial machineries having a galvanised steel body and NBR elastomer element.

I - 3-POLE SERVICE SWITCH

220V-690V, 50-60Hz.Voltage rating = 20A, 3 poles.Rotary switch installed on each fan / Red handle (black only in presence of mainswitch).Can be padlocked in stop position (padlock not included).Working temperature: $-25^{\circ}C/+40^{\circ}C.Protection$ class IP65.Plastic box with 4 inlets for M20 cables.Switches installed and wired on the fans (one switch per fan).

Ep - CONTROLLER FOR "EC-PLUS Ep" EC FANS

Controller Ep is a multifunction and multiple-input unit for the regulation of speed of three-phase electronically commutated motors installed on axial fans, which is designed to regulate different EC motors, in a simultaneous and coordinated way, using programmable input signals.Power supply: 2ph+PE 400Vac $\pm 20\%$ (other voltages upon request).Working temperatures: -20°C $\div 50^{\circ}$ C.Plastic UV-resistant junction box with protection class IP55.Input from external signal or transducer: 0- 20mA, 4-20 mA, 0-5V, 0-10V.Optional RS485 interface for MODBUS networking.Possibility to connect temperature probes (default) or pressure probes.Auxiliary contacts - contacts available: S1 - direct mode (by default with NO contact); - reverse (NC contact); SP - Selection of setpoints 1 or 2 (SP1 by default with NO contact; SP2 with NC contact); S5 - night speed limitation (by default OFF with NO contact; ON with NC contact); S2 - controller ON-OFF (by default ON with NO contact; OFF with NC contact).1 programmable relay; analog output 0-10V (for fan speed regulation).PID regulation principle.Optional proportional mode.Min. and Max. fan speed setting.Display showing the main operating parameters.LED indicator of controller status.Outputs for external signals: 5.0 Volt (Vrr) stable; 10.0 Volt (Vrr) stable; 0 Volt $\pm 10\%$.Controller mounted, wired and programmed according to the calculation board of the fan unit.NTC temperature probe(s) (10kOhm) fitted with silicone cable and stainless steel terminal.Storage temperature -20 °C $\div 70$ °C.Pressure transducer(s) 4-20mA fitted with silicone cable (2 wires), 7/16" 20UNF (8-28V) -25 °C $\div 80^{\circ}$ C (0-30bar (0-50bar upon request)).

W3E - THREE-PHASE ELECTRICAL PANEL FOR 400V-3-50HZ EC FANS

Short description: electrical panel for EC fans with plastic casing, fuse protection for groups of fans and external control 0-10V.Description:plastic UV-resistant box, protection class IP55.Electrical cables suitable for outdoor installation (connection of power and signals).Working temperatures: $-20^{\circ}C/40^{\circ}C$.Power supply: $3 \sim 400V / 50Hz + PE$.Main switch.Fuse protection for groups of fans.Suitable to connecti J + EN + EB + EP + EM controllers (to be mounted outside this panel).Fan speed regulation control with 0-10V signal.Free contact on main switch for ON7OFF indicator.Free fan alarm contact.MODBUS communication (fans-side).Quick power connectors for fans directly on panel (4-pole connectors made of plastic, protection class IP68, temperature $-50^{\circ}C/+110^{\circ}C$).Quick signal connector for fans directly on panel (6-pole connector made of plastic, protection class IP68, temperature $-50^{\circ}C/+110^{\circ}C$).Execution in compliance with CE regulations.Panel mounted and wired.

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