REEF GROUP

UBB PLOT A

ST PANCRAS WAY, LONDON

ENERGY STATEMENT

APPLICATION REFERENCE 2017/5497/P

REVISION P03

Document History

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EXECUTIVE SUMMARY

Planning approval for the redevelopment of the Ugly Brown Building located at 2-6 St Pancras Way, London NW1 0TB was granted by the London Borough of Camden under application reference 2017/5497/P. Since making the original Planning application and receiving the conditional approval, the project has been through a process of rationalisation and technical development, including the energy strategy. This Energy Statement describes the revised energy strategy for Plot A of the development and is considered to be non-material amendment.

Since the development was designed and submitted for Planning there has been significant improvement in the carbon intensity of the National Grid. This has resulted in a move away from the use of natural gas in generating heat for buildings and this change is a key element of the Draft London Plan and the Mayor's zero carbon target by 2050. The energy strategy originally proposed for the building was heavily reliant on natural gas and is therefore not ideally suited to current and emerging energy strategies and policies.

In addition, emerging policies have a greater focus on air quality and minimising the impact of developments on local air quality. An alternative to CHP and boilers, such as heat pumps, would remove local sources of pollution associated with gas-fired plant, such as nitrogen oxide.

Electric-based heating technology offers an opportunity to reduce reliance on natural gas and the alternative energy strategy comprises air source heat pumps (ASHP) to provide heating and cooling to Plot A. The ASHP plant will be located within the rooftop plant areas, generally within the constraints of the approved roof layout, thereby minimising visual impact.

The alternative energy strategy is estimated to save at least **44%** of non-domestic regulated CO_2 emissions for Plot A compared to Part L 2013 compliance, using SAP10 Carbon Factors as suggested in the GLA Energy Assessment Guidance. This is in an increased saving in regulated carbon emissions over the original energy strategy.

The proposed alternative energy strategy will comply with the relevant Conditions of the Decision Notice and the Section 106 Agreement, with some requirements no longer being relevant, e.g. those relating to CHP.

1.0 INTRODUCTION

1.1 Project Background

Planning approval for the redevelopment of the Ugly Brown Building located at 2-6 St Pancras Way, London NW1 0TB was granted under application reference 2017/5497/P. The original Planning Application for the development was prepared by Bennetts Associates, with support documentation relating to energy provided by Max Fordham LLP. Reef Group subsequently appointed K J Tait Engineers to develop and design the MEP elements scheme, including the energy strategy.

1.2 Purpose of Report

Since the conditional approval was granted, the project has been through a process of rationalisation and technical development, including the energy strategy. This Energy Statement describes the revised energy strategy and follows guidance from the GLA with respect to preparing energy assessments for proposed developments within London, as well as comparing against the original energy strategy, the Planning conditions and the Section 106 Agreement.

The original energy strategy included within the planning application was set out in the Max Fordham document Sustainability and Energy Statement Rev E, dated 5th June 2018. This sets out the strategy and carbon savings for the whole site, i.e. Plots A, B & C, and provides a breakdown of the measures for each plot.

This new Energy Statement focuses only on Plot A, with some commentary where relevant on Plots B and C which will be designed in detail at a later date.

The non-domestic aspects of the development have been modelled using IES VE 2019 software to determine the following parameters:

- The baseline carbon emissions prescribed from Part L2A Building Regulations known as the Target Emission Rate (TER)
- The site's regulated CO_2 emissions from the 'Be Lean' analysis after passive energy saving measures are added
- The site's regulated CO_2 emissions from the 'Be Clean' analysis after investigating connections to existing district heating networks, etc.
- The site's regulated CO_2 emissions from the 'Be Green' analysis which involves the installation of low and zero carbon technologies.

1.3 Site Information

The development site comprises three plots, Plot A (Office and Retail), Plot B (Ted Baker HQ and Hotel), and Plot C1-4 (assumed residential with offices).

The proposed development at Plot A comprises a new 7-storey plus basement mixed-use building. The building will contain Retail/Food & Beverage units and Office accommodation and will be fitted out to Cat A standard with the Retail/F&B units to shell and core standard.

The gross internal area of the development is approximately 10,000m^2.

Plot A Location Plan

Visualisation of Proposed Development

1.3 Planning Conditions

Relevant energy and plant related conditions included within the Decision Notice reference 2017/5497/P were:

Ref.	Condition
25.	Prior to commencement of any development other than works of demolition, site clearance & preparation, full details of the proposed combined heat and power unit (CHP) plant that will serve Plots A and B and then Plot C and confirmation that the plant will comply with the Mayor's emission standards as set out in the Mayor's

Ref.	Condition
	Sustainable Design and Construction SPG (2014), and details of any necessary NO2 abatement mechanisms shall be submitted to and approved in writing by the Local Planning Authority.
26.	Prior to commencement of any above ground works, full details of the combined heat and power unit (CHP) stack and its height relative to the mechanical ventilation air inlet locations shall be submitted to and approved by the local planning authority in writing. Air inlet locations should be located away from roads and the CHP stack to protect internal air quality.
30.	Prior to first occupation of each building, detailed plans showing the location and extent of photovoltaic cells to be installed on the building shall have been submitted to and approved by the Local Planning Authority in writing. The measures shall include the installation of a meter to monitor the energy output from the approved renewable energy systems. The cells shall be installed in full accordance with the details approved by the Local Planning Authority and permanently retained and maintained thereafter.
31.	Prior to the commencement of works on Plot C an assessment into the implementation of further renewable technology on site shall be submitted to and approved in writing by the Local Planning Authority. Approved details shall be implemented prior to the occupation of any buildings within Plot C and permanently retained and maintained thereafter.

Requirements relating to the energy strategy were also included in the Section 106 Agreement, including:

- provision of on-site and off-site energy network studies and connections;
- minimum 35% carbon reduction compared to Part L 2013;
- target 20% carbon reduction through low and zero carbon technologies;
- provision of CHP sizing and specification information;
- carrying out a CHP Air Quality Assessment;
- decommissioning of the Plot A CHP once simple payback is achieved.

1.4 Legislation and Guidance

The energy performance and carbon emissions of the development is considered against national, regional and local planning guidance and within the context of the Planning Decision Notice. Legislation and guidance applicable to the revised energy strategy is generally as per the original application.

The consented energy strategy was based on the London Plan 2016 policies relating to energy reduction, including:

- Policy 5.2 minimising carbon emissions
- Policy 5.3 sustainable design and construction
- Policy 5.5 & 5.6 decentralised energy networks
- Policy 5.7 renewable energy
- Policy 5.8 innovative energy technologies
- Policy 5.9 overheating and cooling

The Camden Local Plan 2017 policies in Section 8 - Sustainability and Climate Change were also used, including:

- Policy CC1 climate change mitigation
- Policy CC2 adapting to climate change

2.0 ORIGINAL ENERGY STRATEGY

2.1 Overview

The original energy strategy for the project is set out in the Max Fordham document Sustainability and Energy Statement Rev E, dated 5th June 2018. The strategy followed the “Be Lean, Be Clean, Be Green” energy hierarchy set out in The London Plan.

In summary, the active elements of the proposed energy strategy included a community heating system with CHP and boilers in Plot A that would serve both Plots A and B. Plot C would be provided with its own community heating system with CHP and boilers. The heating plant in Plots A and C could be interconnected to provide a community heating network for the whole site. As noted in the S106 Agreement, any CHP is to be decommissioned once simple payback is achieved.

Cooling to Plot A was via chiller plant located in the roof and basement.

Roof mounted photovoltaic (PV) arrays were also proposed for the development where roof space was available, however no PV could be accommodated on Plot A due to space constraints.

Consideration was also given to connect to local district heat networks in the area and it was found that there were no existing networks close enough to connect to. Allowance was to be made to enable the development to be connected to potential future district heat networks via a connection to Plot C and clauses relating to this are included in the S106 Agreement.

2.2 Planning

The Max Fordham Sustainability and Energy Statement demonstrated that the proposed energy strategies met the London Plan target of a 35% reduction in carbon emissions compared to Part L and for Plot A this was achieved through demand reduction measures (Be Lean) and through use of CHP (Be Clean), as summarised in the extract below from the Max Fordham Energy Statement.

It is noted that Part L of the Building Regulations is based on SAP 2012 carbon intensity factors that do not reflect the recent decarbonising of the electricity supply and there are proposals to update these figures to those proposed under SAP10. At time of writing, SAP10 has not been implemented on non-domestic buildings and within Part L, however the GLA require all new planning applications to convert the Part L carbon calculations to SAP10 using their Carbon Emissions Spreadsheet. It is anticipated that the original energy strategy would not score favourably when converted to SAP10 figures.

Plot A	Carbon Dioxide emissions (Tonnes CO_2/year)	
	Regulated	Unregulated
Baseline Part L TER	239.37	227.32
After energy demand reduction	169.14	227.32
After CHP	155.29	227.32
After Renewable energy	155.29	227.32

Plot A	TonnesCO_2/year	Improvement %
Baseline Part L TER	239.37	
Savings by Passive means	70.23	29.3
Savings from CHP	13.85	5.8
Savings from renewables - 0^2 Photovoltaic panels	0.00	0.0
Total Cumulative Savings	84.08	35.1 (Actual)
London Plan Target Savings	83.78	35.0 (Target)
Annual Surplus	0.3	
Camden CC1 Target reduction by renewables	31.06	20% of energy provided by renewables
Element of energy consumption by renewables	0.00 (of 155.29)	0.0

Extract from Max Fordham Sustainability and Energy Statement Rev E dated 5th June 2018

2.3 BREEAM

A BREEAM pre-assessment was carried out and included within the Planning application and identified a target rating of Excellent. The Section 106 agreement stated that each plot is "*to achieve a target for non-residential use buildings of Very Good (minimum) with a target of achieving an Excellent rating and attaining at least 60% of the credits in each of Energy and Water and 40% of the credits in Materials categories*".

3.0 PROPOSED ALTERNATIVE ENERGY STRATEGY

3.1 Overview

Since the original energy strategy was completed there has been significant improvement in the carbon intensity of the National Grid, making natural gas a less attractive option for generating heat for buildings. The Draft London Plan (which was published following development of the original energy strategy and at time of writing is yet to be adopted) outlines the necessity to transition from traditional natural gas to low and zero carbon sources to meet the Mayor's zero carbon target by 2050. The energy strategy originally proposed for the building, comprising gas-fired boilers and gas-fired CHP to generate heating and hot water and chillers to generate cooling, was heavily reliant on natural gas and is therefore not ideally suited to current and emerging energy strategies and policies.

The carbon saving argument for gas CHP is based on the SAP 2012 carbon intensity of grid electricity. This case rapidly falls away when the significant improvement in the carbon intensity of the National Grid, as reflected in the new SAP10 figures, is considered.

Furthermore, CHP must be correctly sized to match the seasonal demands to provide peak efficiency – too small and it will run for longer hours but not have the output to offset enough heat that would otherwise be generated by boilers; too large and it will not run for enough hours for waste energy capture. The original strategy of sizing the Plot A CHP to also serve the future Plot B could result in potential operational and efficiency issues whilst the CHP is running at low load when only serving Plot A.

In addition, emerging policies have a greater focus on air quality and minimising the impact of developments on local air quality. An alternative to CHP and boilers, such as heat pumps, would remove local sources of pollution associated with gas-fired plant, such as nitrogen oxide. As part of the S106 agreement, a CHP air quality test will need to be carried out if a CHP strategy was to be implemented. This would not be a requirement with a heat pump solution.

3.2 Alternative Energy Strategy Options

An options review was carried out to assess whether the proposed energy strategy was still valid and the most appropriate approach for the development. Alternative energy technologies were reviewed, focussing on electric heat pumps.

The fundamental principles of the original energy strategy approach remain unchanged, i.e. optimising the building through the Be Lean, Be Clean, Be Green energy hierarchy. The focus remains on designing a comfortable, reliable, practical and flexible building, which minimises energy consumption and associated carbon emissions.

With the significant improvements on carbon intensity of grid supplied electricity, carbon factors of electricity are almost on par with natural gas, providing an incentive to invest in electrical based heating technologies, such as heat pumps which are highly efficient at converting electrical energy into useful heat energy. SAP10 offers a more realistic overview of the true annual carbon emissions compared to the SAP 2012 figures.

The key driver of the alternative strategy is to reduce the use of gas and the focus has been to omit the CHP and boiler plant through the use of electric systems, i.e. heat pumps, to generate heating and cooling for the building. Through the use of heat pumps that can provide heating and cooling, the originally proposed chiller plant can also be omitted.

Electric heat pump technology offers an opportunity to reduce reliance on natural gas which will reduce carbon emissions and improve air quality when compared to gas-fired plant. All heat pumps work on the same basic principle; they extract low-grade heat from a heat source (air, ground or water) and upgrade this to a higher-grade heat than can be used for heating and hot water. In the right conditions, they are highly efficient at converting electrical energy into useful heat energy and this is referred to as their Coefficient of Performance or COP.

An appraisal of applicable heat pump technology (air, ground and water) was carried out and air source heat pumps (ASHP) offer a viable and the most suitable alternative to provide heating and cooling to the building.

The ASHP plant is proposed to be located within the rooftop plant area and the intention is to limit the impact on the approved roof layout to minimise any Planning impact.

The ASHP system has been designed and selected through detailed analysis of the building's heating and cooling load profile. Technical details of the specified ASHP are included in the appendices.

The following strategies remain as per the original energy strategy:

- Building orientation and glazing size and position
- High thermal performance and air tightness of external envelope
- Heat recovery on primary air systems
- High efficiency plant, lighting and automatic controls
- Comprehensive energy metering
- BREEAM target rating
- Provision to enable connection to an on-site energy network

3.3 BREEAM

The BREEAM assessment has been developed for Plot A and the scheme is on target to meet the requirements set out in the Section 106 Agreement.

3.4 Commentary on Planning Conditions

The impact of the proposed alternative energy strategy on the relevant Planning Conditions and Section 106 Agreement are summarised in the table below. Further details of the implications on specific items are provided within the subsequent sections.

Ref.	Condition	Impact of Alternative Energy Strategy
Decision Notice reference 2017/5497/P		
25.	Provide details of the proposed combined heat and power unit (CHP) plant	CHP no longer proposed.
26.	Provide details of CHP stack w.r.t. air quality	CHP no longer proposed.
30.	Provide details of photovoltaic cells to be installed on the building	No PV proposed for Plot A in original or alternative strategy.
31.	Prior to the commencement of works on Plot C an assessment into the implementation of further renewable technology on site shall be submitted.	To be addressed as part of Plot C. No impact anticipated.
Section 106 Agreement		
2.35	Carbon Offset Contribution	No change anticipated.
2.42	CHP Air Quality Assessment	CHP omitted, no longer relevant.
2.59	DEN Off-site Feasibility and Connection Plan	Unaffected.
2.60	DEN Off-site Contribution	Unaffected.
2.61	DEN On-site Contribution	Unaffected.

Ref.	Condition	Impact of Alternative Energy Strategy
2.71	Energy Efficiency and Renewable Energy Plan	I. Overall CO_2 savings improved; II. Contribution from renewables increased; III. CHP omitted, associated requirements no longer relevant; IV. Connection to local energy network unaffected;
2.134	BREEAM Very Good with a target of Excellent	Unaffected.

4.0 DEMAND REDUCTION (BE LEAN)

In line with good design principles and London Plan requirements, the development will follow the energy hierarchy so that any low or zero carbon generation is not supplying energy to areas that could have been mitigated early in the design process. The relevant steps in this process are shown below:

Stage 1 - Maximise Passive Design

In the first instance the building design should be efficient, incorporating measures such as good fabric and glazing insulation levels, control of solar heat gain whilst providing good levels of day lighting.

Stage 2 - Minimise Active Design

Having reduced the energy demand, energy requirements then need to be minimised where possible by installing energy efficient plant and systems to meet the building's energy demands. Suitable control systems should be provided to ensure system energy efficiencies can be realised. Where mechanical intervention cannot be avoided, the design should incorporate the lowest possible level of intervention and energy use.

The Demand Reduction principles set within the original energy strategy have been retained and optimised.

4.1 Stage 1 - Maximise Passive Design

Passive design measures have been optimised across the development and in conjunction with active measures, such as efficient building services systems, will reduce demand (Be Lean). Building design has been optimised to limit heat loss, reduce cooling loads by limiting solar gain and optimise the use of natural light.

High performance building fabric has been specified. Improving the thermal performance standards of the building fabric beyond the minimum Building Regulations Part L standards has been applied to achieve reduction to the annual CO_2 emissions associated with the building heating systems by limiting the heat loss through the building fabric.

The air permeability rate of the development has been designed to 3.0m^3/hr.m^2 at 50Pa which is a large improvement over the current Part L2A Building Regulations minimum of 10.0m^3/hr.m^2.

Glazing has been carefully selected to ensure that solar gains have been limited to reduce the risk of overheating and to reduce the annual cooling loads.

Stage 2 - Minimise Active Design

The office areas of the development will be served by a mechanical ventilation with heat recovery unit. The air handling unit (AHU) will be fitted with a direct drive EC motor with low specific fan powers (SFP), with variable speed drives fitted to all pumps and fans. Automatic control of the HVAC system will include local time and temperature control along with an optimum start program. Fan coil units (FCUs) will be used to deliver heating, cooling and ventilation to the main spaces. Motors within FCUs will incorporate EC motor technology and low SFPs.

All lighting will be efficient LED fittings with a minimum efficacy of 100lm/W with automatic controls to suit the area served.

Where aspects of the development will be constructed as 'shell and core' units, guidance will be provided to Tenants so that their fit-out can meet the required carbon reduction target. Requirements for Tenant fit outs and their integration into the established energy strategy and performance requirements will be stipulated in Tenant Fit Out guides, specifications and lease agreements.

4.2 Summary of Be Lean Measures

Element	Building Regulations Minimum Standards (2013)	As Designed
Wall U-value (W/m^{2}K)	0.35	0.18 – 0.25
Ground Floor (W/m^{2}K)	0.25	0.15
Roof (W/m^{2}K)	0.25	0.13
Display Glazing (W/m^{2}K)	2.20	1.4 (0.5 g)
Glazing (W/m^{2}K)	2.20	1.4 (0.28 g)
Lighting Efficacy (lm/W)	65	100 (as minimum)
AHU Heat Recovery Efficiency (%)	0.65	0.73
AHU SFP (W/l/s)	1.6	1.57
Terminal Fan Coil Unit SFP (W/l/s)	0.15	0.12

4.3 Energy Demand Following Energy Efficiency Measures

The energy demand across the site, including unregulated electricity and gas following the implementation of energy efficiency measures is as follows:

Building use	Energy demand following energy efficiency measures (MWh/year)						
	Space Heating	Hot Water	Lighting	Auxiliary	Cooling	Unregulated electricity	Unregulated gas
Non-domestic	24.90	60.54	71.52	127.16	62.91	55.00	0.0

5.0 HEATING INFRASTRUCTURE (BE CLEAN)

5.1 Off-Site and On-Site Energy Networks

The Section 106 Agreement (S106) included requirements for the provision of on-site and off-site energy network studies and connection plans.

Clause 2.59 (a) of the S106 stipulates a requirement to safeguard Plot C for a future connection to an off-site decentralised energy network (DEN). Clause 3 of the S106 sets out the requirements for the DEN off-site feasibility study and connection plan.

The S106 Agreement stipulates that Plot C should be connected to Plots A and B to form an on-site energy network across all plots. The development is intended to be constructed in three phases; Plots A to C chronologically. As noted above, this Energy Statement is only for Plot A and the energy systems for Plots B and C will be developed in due course, however the principles set out here are anticipated to be applicable to the future plots. Under the alternative energy strategy it is proposed that heat pump systems are provided on a per plot basis, rather than Plot A & B sharing heating plant as per the original proposal.

Each plot’s individual heating/cooling plant can be interconnected to provide an on-site energy network, as per the original proposals and as required by the S106 Agreement. The heat pump system on each site could connect to a central energy buffer/store, which could be located in Plot B or C. With this configuration, there is potential to run the full development from a reduced number of heat pumps during periods of lower demand, e.g. only heat pumps in Plots B & C operating with Plot A drawing energy from the central buffer. The network would incorporate efficient monitoring and controls to enable an efficient on-site energy network.

The contribution to Plot A of the on-site energy network has not been quantified at this stage as it will be necessary to further develop and analyse Plots B and C to estimate the Be Clean contribution. This analysis will be carried out at a later date, however it should be noted that there will be some contribution to Plot A.

The S106 requirements for Off-Site and On-Site Energy Networks are unaffected and can be met by the alternative energy strategy proposals.

5.2 Secondary Heat Generation

Secondary heat can potentially be obtained from various heat sources such as infrastructure and environmental sources within the vicinity. Regents Canal, which runs behind the plot, could potentially be a source for heat generation, however this was discounted in the original Max Fordham energy strategy for various reasons, including low flow rate, shallow water depth, potential to be drained for maintenance, etc.

There are no other viable potential secondary heat sources known to be within the vicinity of the site.

6.0 RENEWABLE ENERGY (BE GREEN)

Due to the unique constraints of the development, there is limited scope to incorporate many of the available renewable energy technologies within the scheme. Plot A did not include renewable energy generation in the original proposals due to limitations of roof space to accommodate PV. This is still the case and no PV is proposed as part of the alternative energy strategy.

Heat pumps can be considered under the Be Green criteria as they are a low carbon technology.

The following LZC technologies have also been reviewed and the implications are summarised below:

Technology	Implications
Photovoltaics	- No roof space available
Ground source heat pump	- Complex borehole construction logistics beneath basement and adjacent to canal - Limited space for borehole array due to existing Thames Water sewer - Expensive
Water Source Heat Pump	- Canal has low flow rate, discharging heat to canal will cause canal water temperature to rise - Canal is periodically drained for maintenance - Potential of environmental harm to aquatic life
Wind turbines	- Not feasible in this location
Biomass boiler	- Air quality implications - Delivery and storage implications
Solar thermal hot water	- No roof space available - Limited hot water demand

7.0 ENERGY MODEL RESULTS

7.1 CO_2 Savings Summary

By utilising good design principles and the Be Lean, Be Clean, Be Green energy hierarchy, the non-domestic aspect of the development with the alternative energy strategy is estimated to save at least **44%** of non-domestic regulated CO_2 emissions compared to Part L 2013 compliance, using SAP10 Carbon Factors as suggested in the GLA Energy Assessment Guidance.

As identified in the Max Fordham Energy Statement, the originally proposed energy strategy was estimated to achieve total CO_2 savings of 35.1%. This was assessed under SAP 2012 carbon intensity figures and it is anticipated that the original energy strategy would not score favourably when converted to SAP10 figures. The proposed alternative energy strategy will therefore achieve even greater CO_2 savings when compared to the original scheme.

CO_2 emissions and savings from each stage of the energy hierarchy are detailed in the tables below.

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	111	55
After energy demand reduction	77	55
After heat network / CHP	77	55
After renewable energy	62	55

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	34	31%
Savings from heat network / CHP	0	0%
Savings from renewable energy	15	13%
Total Cumulative Savings	**49**	**44%**

As mandated within the current London Plan, the stipulation of a minimum 35% reduction in carbon emissions has been met with the proposed energy strategy.

7.2 Cooling Demand

In line with policy 5.9 of the London Plan – Overheating and Cooling, all developments should reduce potential overheating but also reduce its reliance on air conditioning systems.

To demonstrate compliance with this policy, non-domestic developments should aim for a cooling demand that is lower than the Building Regulations Notional Building. For this development, the actual building cooling demand is lower than the Notional Building as shown in the table below, therefore compliance with policy 5.9 has been achieved.

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	16.85	172,653
Notional	28.08	287,721

8.0 CONCLUSIONS

When considered against the reduction in carbon intensity factors, the drive to reduce use of natural gas and the need to improve air quality, an electric based energy strategy offers a more robust long-term solution over the original energy strategy, which was heavily reliant on natural gas.

It is proposed to alter the energy strategy and replace the CHP, boilers and chiller to Plot A with air source heat pumps to provide heating and cooling.

A detailed analysis of carbon emission savings and comparison against the original proposals has identified a 44% CO_2 saving using SAP10 carbon factors (compared to 35.1% with the original strategy, which used SAP 2012 factors).

It is proposed to provide electric heat pumps to both Plots B and C and to address these in detail individually at a later date.

The ASHP on all three Plots can be connected to form an on-site district heating network and Plot C could be connected to an off-site DEN as previously proposed and as required in the S06 Agreement.

APPENDIX 1 - BRUKL OUTPUT DOCUMENT (BE LEAN)

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

F1 Camden Plot A - Be Lean - 021220

As designed

Date: Wed Dec 02 17:22:27 2020

Administrative information

Building Details

Address: Address 1, LONDON, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	20.1
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	20.1
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	17.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.25	ST00000B:Surf[3]
Floor	0.25	0.15	0.15	RM00000F:Surf[0]
Roof	0.25	0.18	2.16	VN00000A:Surf[5]
Windows***, roof windows, and rooflights	2.2	1.25	1.29	RM00001F:Surf[2]
Personnel doors	2.2	1.5	1.5	ST000006:Surf[4]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	1.5	1.5	RM00001F:Surf[3]

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

KJ TAIT ENGINEERS

APPENDIX 2 - BRUKL OUTPUT DOCUMENT (BE GREEN)

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

E1 Camden Plot A - Be Green - 161120

As designed

Date: Mon Nov 16 10:17:50 2020

Administrative information

Building Details

Address: Address 1, LONDON, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	20.1
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	20.1
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	14.8
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.25	R100000D:Surf[0]
Floor	0.25	0.15	0.15	RM00000F:Surf[0]
Roof	0.25	0.18	2.16	VN00000A:Surf[5]
Windows***, roof windows, and rooflights	2.2	1.25	1.29	RM00001F:Surf[2]
Personnel doors	2.2	1.5	1.5	ST000006:Surf[4]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	1.5	1.5	RM00001F:Surf[3]

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

APPENDIX 3 – ASHP DATA

i-FX-Q2-G05 /SL-CA /1102

Software version: ELCA World 1.4.2.0
Database version: 1.5.2.0
User: Dean Ward
Print data: 18/06/2020 11:56
Calculation type: EN 14511 - EN 14825

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HEATING EC FAN SCREW R R513A

Code		i-FX-Q2-G05 /SL-CA /1102
Version		SL-CA
Size		1102
UNIT DESCRIPTION		INTEGRA unit for 4-pipe systems, air source, VSD screw compressors and EC fans, for outdoor installation
Power supply	V/ph/Hz	400/3/50

PERFORMANCE AT DESIGNED CONDITIONS

RUNNING CONDITIONS

CHILLED WATER HEAT EX. USER SIDE

Fluid inlet temperature (cooling mode)	°C	15.00
Fluid outlet temperature (cooling mode)	°C	9.00
Fluid type		WATER
Glycol	%	0
Fouling factor	m²K/kW	0.000

WARM WATER HEAT EX. USER SIDE

Fluid inlet temperature (heating mode)	°C	43.68
Fluid outlet temperature (heating mode)	°C	50.00
Fluid		WATER
Glycol	%	0
Fouling factor	m²K/kW	0.000

OUTDOOR CONDITION

Air temperature (cooling mode)	°C	35.0
Air temperature (heating mode)	°C	-5.0

COOLING (EN 14511)

Capacity control	%	100.0
Cooling capacity	kW	1060
Compressors power input	kW	312.6
Fans power input (cooling mode)	kW	34.00
Total power input	kW	352.2
EER	kW/kW	3.010
ESEER EN 14511 (referiment)	kW/kW	4.330

COOLING WITH HEAT RECOVERY (EN 14511 VALUE)

% part load CHREC	%	100.0
Cooling capacity	kW	1130
Recovery heat exchanger capacity	kW	1458
Total power input	kW	380.6
TER	kW/kW	6.799

HEATING (EN14511)

% Capacity control on heating	%	100.0
Total heating capacity	kW	686.0
Compressors power input (heating mode)	kW	292
Fan power input (heating mode)	kW	14.00
Total power input	kW	304.9
COP	kW/kW	2.250

SEER

i-FX-Q2-G05 /SL-CA /1102

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HEATING
EC FAN
SCREW
R R513A

SEER Official (Reg. EU 2016/2281)

Fan coil (12/7)

Type climate		Average
Temp. Plant side		Fan coil (12/7)
Type flow		Fixed
Type Temperature		Variable
Prated,c	kW	1048
T Design		35.00
Qce		147159.84
SEER		4.27
Performance ηs	%	168

SEER Editable (EN 14825)

Fan coil (12/7)

Type climate		Average
Temp. Plant side		Fan coil (12/7)
Type flow		Fixed
Type Temperature		Variable
Prated,c	kW	1048.00
T Design		35.00
Qce		147159.84
SEER		4.27
Performance ηs	%	168

PART LOAD DATA

COOLING PARTIAL LOADS

Load	%	100.0	90.0	80.0	70.0	60.0	50.0	40.0	30.0	20.0	10.0
Outdoor air temperature	°C	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Cooling load	kWh	1060	954	848	742	636	530	424	318	212	106
Fans power input (cooling mode)	kW	34.00	14.00	14.00	13.12	11.41	10.00	10.00	10.00	4.66	2.58
Total power input	kW	352.4	313.3	261.9	219.7	186.4	153.3	121.1	93.30	62.50	34.60
Temp. evaporator inlet	°C	15.00	14.39	13.79	13.18	12.58	11.97	11.37	10.76	10.25	10.25
Temp. evaporator outlet	°C	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Evaporator water flow	l/s	41.85	41.85	41.85	41.85	41.85	41.85	41.85	41.85	41.86	41.86
EER	kW/kW	3.010	3.050	3.240	3.380	3.410	3.460	3.500	3.410	3.390	3.060

HEATING PART LOAD

Load	%	100.0	90.0	80.0	70.0	60.0	50.0	40.0	30.0	20.0	10.0
Outdoor air temp.	°C	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Heating load	kWh	686	617	549	480	412	343	274	206	137	69
Total power input	kW	304.5	273.1	242.3	211.4	180.5	151.8	125.4	99.00	69.80	39.50
Condenser input temperature	°C	43.68	44.30	44.92	45.55	46.17	46.79	47.42	48.04	48.22	48.22
Condenser output temperature	°C	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Condenser fluid flow	l/s	29.70	29.70	29.70	29.70	29.70	29.70	29.70	29.70	29.70	29.70
COP	kW/kW	2.250	2.260	2.270	2.270	2.280	2.260	2.190	2.080	1.970	1.740

PART LOAD DATA INTEGRA

Refrigeration load	%	0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0
Heating load	%	100.0	90.0	80.0	70.0	60.0	50.0	40.0	30.0	20.0	10.0	0.0
Air temp.	°C	-5.0	-1.0	3.0	7.0	11.0	15.0	19.0	23.0	27.0	31.0	35.0
Cooling capacity	kW	0.000	106.0	212.0	318.0	424.0	530.0	636.0	742.1	848.1	954.1	1060
Heating capacity	kW	686.0	617.4	548.8	480.2	411.6	343.0	274.4	205.8	137.2	68.60	0.000
Total power input	kW	304.5	238.7	184.0	147.2	137.3	140.8	151.4	174.4	209.9	275.8	352.4
TER	kW/kW	2.250	3.030	4.130	5.420	6.090	6.200	6.010	5.440	4.690	3.710	3.010

i-FX-Q2-G05 /SL-CA /1102

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Calculation type:	EN 14511 - EN 14825

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HEATING
EC FAN
SCREW
R R513A

EXCHANGERS

CHILLED WATER HEAT EX. USER SIDE

Typology		SHELL&TUBE
Quantity	N°	1
Fluid type		WATER
Glycol	%	0
Fouling factor	m²K/kW	0.000
Type of connections		[H] - Grooved coupling with weld end counter-pipe user side
Diameter of connections		8"
Min flow	l/s	30.56
Max flow	l/s	72.22
K pressure drop		1.48
Water content	l	530

COOLING

Fluid inlet temperature (cooling mode)	°C	15.00
Fluid outlet temperature (cooling mode)	°C	9.00
Water flow	l/s	41.85
Pressure drop at the heat exchanger	kPa	33.6
Available unit's head	kPa	247

COOLING + HEAT RECOVERY

Water flow	l/s	44.82
Pressure drop at the heat exchanger	kPa	38.5

WARM WATER HEAT EX. USER SIDE

Typology		SHELL&TUBE
Quantity	N°	1
Fluid		WATER
Glycol	%	0
Fouling factor	m²K/kW	0.000
Type of connections		[H] - Grooved coupling with weld end counter-pipe user side
Diameter of connections		8"
Min flow	l/s	29.69
Max flow	l/s	75.69
K pressure drop		0.96
Water content	l	400

i-FX-Q2-G05 /SL-CA /1102

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HEATING EC FAN SCREW R R513A

HEATING

Fluid inlet temperature (heating mode)	°C	43.68
Fluid outlet temperature (heating mode)	°C	50.00
Water flow	l/s	29.70
Pressure drop at the heat exchanger	kPa	11.0
Available unit's head	kPa	314

FANS

Fans type		EC FAN
Fans number	N°	20
Fans power input	kW	1.70
F.L.I.	kW	1.780
F.L.A.	A	3

COOLING

Fans number	N°	20
Fans power input	kW	1.70
Air flow	m³/s	111.24
Fan available static pressure	Pa	0

HEATING

Quantity	N°	20
Fans power input	kW	0.70
Air flow	m³/s	80.03
Fan available static pressure	Pa	0

COMPRESSORS

Compressor type		SCREW
Compressors nr.	N°	2
No. Circuits	N°	2
Refrigerant		R513A
Number of capacity steps	N°	0
Min. capacity step	%	
Regulation		STEPLESS
Oil charge	kg	60.0
Refrigerant charge	kg	473
F.L.I. - Max absorbed power	kW	2x200
F.L.A. - Max absorbed current	A	2x321
L.R.A. - Locked rotor amperes for single compressor	A	1xna+1xna

i-FX-Q2-G05 /SL-CA /1102

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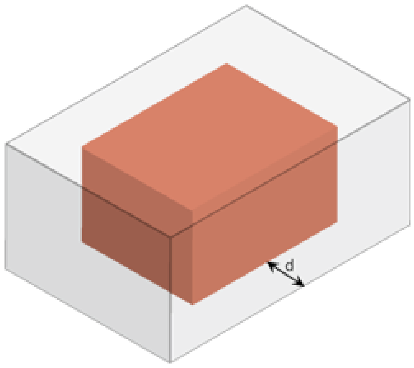
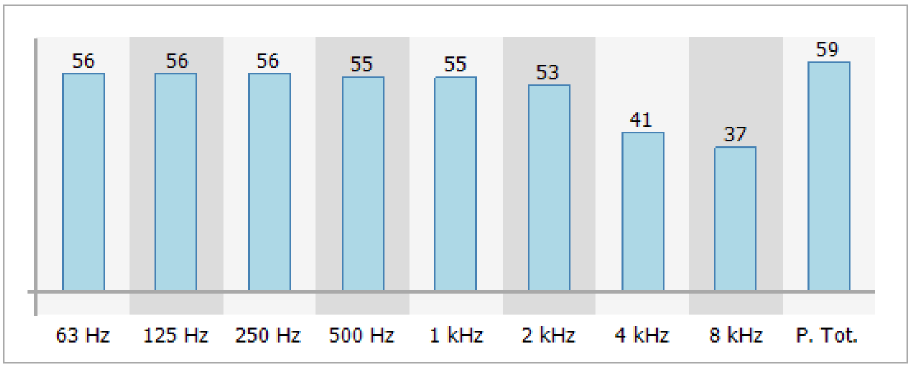
HEATING
EC FAN
SCREW
R513A

NOISE DATA

SOUND DATA COLD

Frequencies	Hz	63	125	250	500	1000	2000	4000	8000
Sound power (spectrum)	dB	89	89	89	88	88	86	74	70
Sound power level in cooling	dB(A)	92							
Sound pressure level (spectrum)	dB	56	56	56	55	55	53	41	37
Sound Pressure	dB(A)	59							





SOUND DATA OUTDOOR HOT

Sound power level in heating	dB(A)	92

Note

Distance	m	10
Note		Average sound pressure level at 10 m distance, unit in a free field on a reflective surface; non-binding value calculated from the sound power level. Sound power on the basis of measurements made in compliance with ISO 9614.

i-FX-Q2-G05 /SL-CA /1102

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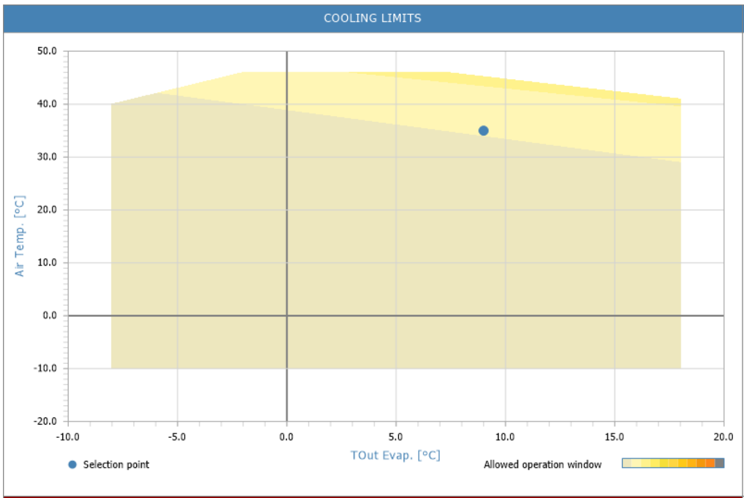
HEATING

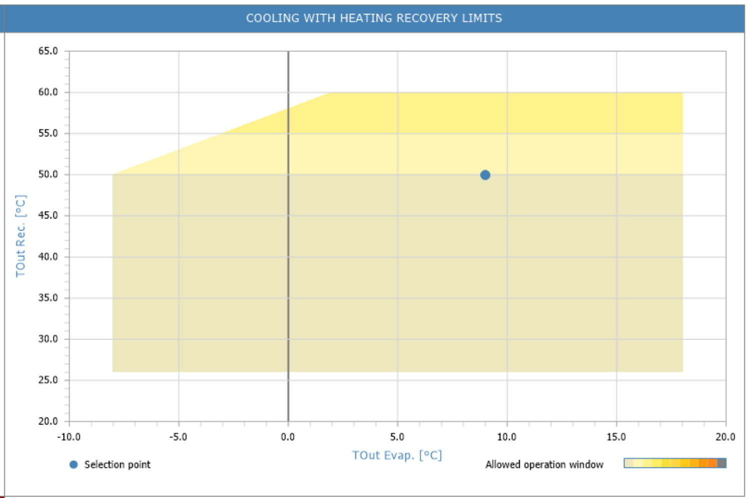
EC FAN

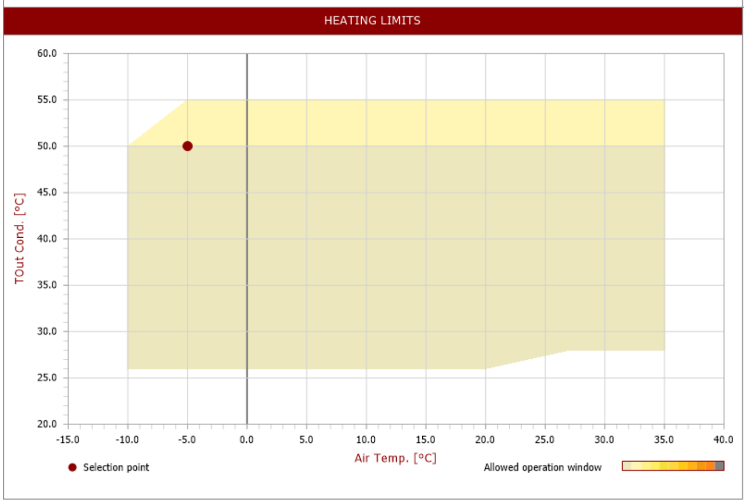
SCREW

R R513A

OPERATING LIMITS







Note	Warning ! The specified operation conditions do not allow the unit to work in silenzed mode for chiller operation!

ELECTRICAL DATA

Power supply	V/ph/Hz	400/3/50
F.L.I. - Max absorbed power	kW	480.0
F.L.A. - Max absorbed current	A	778
S.A. - Inrush current	A	-

ACCESSORIES

HYDRONIC GROUPS

CHILLED WATER HEAT EX. USER SIDE

Accessory code		4712
Accessoriy description		U - 2 PUMPS 2P HH (FIX SPEED)
Min flow	l/s	30.56
Max flow	l/s	72.22

COOLING

Water flow	l/s	41.85
Available unit's head	kPa	247

i-FX-Q2-G05 /SL-CA /1102

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HEATING
EC FAN
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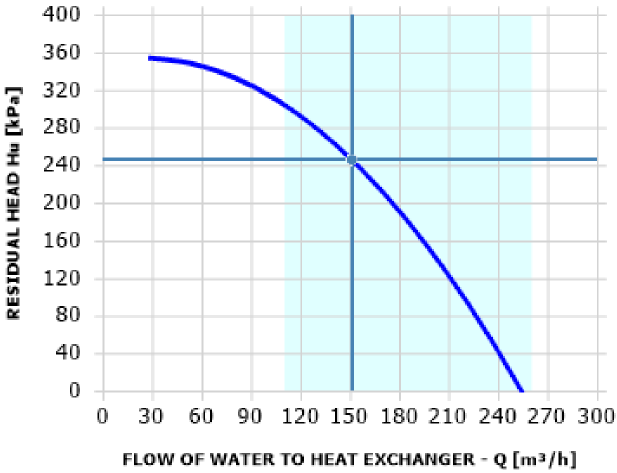
GRAPHIC RESIDUAL PRESSURE HEAD



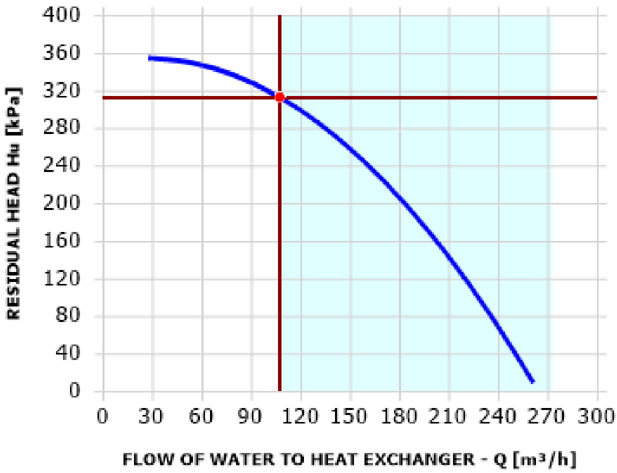
WARM WATER HEAT EX. USER SIDE

Accessory code		4772
Accessoriy description		CD - 2 PUMPS 2P HH (FIX SPEED)
Min flow	l/s	29.69
Max flow	l/s	75.69

HEATING

Water flow	l/s	29.70
Available unit's head	kPa	314

GRAPHIC RESIDUAL PRESSURE HEAD



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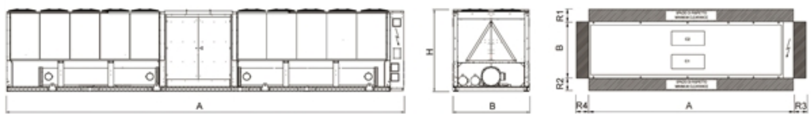
HEATING EC FAN SCREW R513A

DIMENSION AND ELECTRIC DATA VARIATION

Extra tot. FLA	A	79
Extra tot. FLI	kW	44.00
Extra tot. weight	kg	0
Extra length size	mm	0.00
Extra width size	mm	0
Extra height size	mm	0
Extra Sound pwr.	dB(A)	0.0
Total water tank	l	0.00
Note		Select same HYDRONIC MODULE for evaporator and condenser, different configurations require feasibility analysis. Dimensions and weights of the unit with accessory HYDRONIC MODULE: refer to the data book.

WEIGHT & DIMENSIONS

A	mm	11900
B	mm	2260
H	mm	2530
Operating weight	kg	14600
R1	mm	2000
R2	mm	2000
R3	mm	1500
R4	mm	1500



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TECHNICAL DOCUMENTATION - REGULATION (EU) N. 2016/2281 - Chillers for space cooling

i-FX-Q2-G05 /SL-CA /1102 -			
Outdoor side heat exchanger of chiller	air or water/brine		Air
Indoor side heat exchanger chiller	water		Water
Type	compressor driven vapour compression or sorption process		Compressor driven vapour compression
Driver of compressor	electric motor or fuel driven, gaseous or liquid fuel, internal or external combustion engine		Electric motor
Rated cooling capacity	Prated,c	[kW]	1048.0
Seasonal energy efficiency of the space cooling	ηs,c	[%]	168.0
Declared cooling capacity for part load at given outdoor temperatures Tj			
Declared cooling capacity at given outdoor temperatures Tj = 35°C	Pdc	[kW]	1048
Declared cooling capacity at given outdoor temperatures Tj = 30°C	Pdc	[kW]	772
Declared cooling capacity at given outdoor temperatures Tj = 25°C	Pdc	[kW]	496
Declared cooling capacity at given outdoor temperatures Tj = 20°C	Pdc	[kW]	278
Degradation coefficient for chillers	Cdc		0.9
Declared energy efficiency ratio or gas utilisation efficiency/auxiliary energy factor for part load at given outdoor temperatures Tj			
Declared energy efficiency ratio at given outdoor temperatures Tj = 35°C	EERd	[%]	2.66
Declared energy efficiency ratio at given outdoor temperatures Tj = 30°C	EERd	[%]	3.86
Declared energy efficiency ratio at given outdoor temperatures Tj = 25°C	EERd	[%]	4.87
Declared energy efficiency ratio at given outdoor temperatures Tj = 20°C	EERd	[%]	5.51
Power consumption in modes other than "active mode"			
Off mode	POFF	[kW]	0.000
Thermostat-off mode	PTO	[kW]	7.673
Crankcase heater mode	PCK	[kW]	0.570
Standby mode	PSB	[kW]	0.553
Other items			
Capacity control	fixed/staged/variable		Variable
Sound power level, outdoor	LWA	[dB(A)]	92.0
GWP of the refrigerant		[Kg CO2eq]	631
For air-to-water comfort chillers: air flow rate, outdoor measured		[m³/h]	288108.00
For water/brine-to-water chillers: Rated brine or water flow rate, outdoor side heat exchanger		[m³/h]	-
Standard rating conditions used:	low temperature application/medium temperature application		Low temperature application

Contact details: Mitsubishi Electric Hydronics & IT Cooling Systems S.p.A., via Caduti di Cefalonia 1 - 36061 Bassano del Grappa (VI) - Italy