

TABLE 2 - Minimum Building Performance Evaluation (BPE) in use & Health and Comfort performance requirements (for Land led developments)

General: (1) The final extent and scope of BPE together with monitoring packages are to be determined by the design team in conjunction with client; (2) Refer to the Woodknowledge Wales guidance for full details of recommended compulsory 'Core BPE' & optional 'Detailed BPE'; (3) This table is to be read in conjunction with the Model ER's / Design Brief and table 1; (4) Optional requirements/ techniques are shown in blue and italics.

Criteria	Health and Comfort performance requirements	BPE				Additional design stage aims and considerations
		General/ source data	Frequency/ granularity (minimum)	Reporting requirements	Required and supporting techniques	
Thermal Comfort (temperature)						
Living room	(1) General occupancy 21°C living rooms, 18°C other rooms	(1) Temperature sensor with data loggers - stand alone, hard wired and/ or with internet connectivity allowing remote access to live data to suit client's requirements (2) Number of rooms with sensors and locations to be agreed by Design team - in no case less than main living area and principal bedroom (3) Sensor provision to communal areas to be agreed with client - a range or storey levels and orientations suggested if partial monitoring only with top floor mandatory - consider sensor anti tamper measures	(1) 30minute intervals; Daily/ weekly/ monthly/ seasonal and annual average, over min 12 month period	(1) To suit BPE proposals and in all cases included in a final report (2) Report to include at least monthly and annual figures, make comparison with design stage aims/ targets and shall quantify % time out of performance targets/ ranges (3) Source Data to be provided in .xls/tab delimited format (4) Refer also to WKW and LETI recommendations for BPE reporting	(1) Refer to WKW guidance (2) Air permeability tests carried out at min 3 stages of preliminary, follow up and final - see WKW p.49 (3) Occupant satisfaction POE survey (4) <i>Infrared Thermal imaging survey undertaken in accordance with BS EN 13187 and ISO 6781 if not conducted as part of Air Permeability Test</i> (5) <i>Spot and/or durational measurement of surface temperature measurements if not assessed as part of IRT survey</i> (6) <i>In-situ 'U-value' testing and verification in accordance with ISO 9869, ASTM C1046 and ASTM C1155</i> (7) <i>Co-heating test and/ or Heat Transfer Coefficient (HTC) - see also smart HTC test https://buildtestsolutions.com/thermal-performance/smarthtc/ (WKW p.120)</i> (8) <i>Spot or durational measurement of HAT differentials</i> (9) <i>User survey of occupancy patterns, or use of proxy data from monitoring (e.g. CO2 data) to identify occupancy hours monitoring</i> (10) <i>External temperature monitoring or local weather station data</i>	(1) Occupant type and vulnerability for year around comfort. (2) Location of heat emitters to provide even heat distribution. (3) Effective and user-friendly controls - thermostatic and temporal control (see also occupant handover guidance on heating system operation and controls). (4) Ventilation strategy compatible with thermal comfort (5) Overheating risk - see also ANC-AVO-Residential-Design-Guide-January-2020-v1.1-1
Master Bedroom	(1) General occupancy 21°C living rooms, 18°C other rooms (2) Heating levels maintained during occupied hours - Assumed 9 hours in 24 (3) For vulnerable groups (elderly/disabled) specific requirements to meet occupant comfort needs to be specified by client in project design brief, typically not lower than recommended 20°C General, 23°C Living rooms with heating levels maintained during occupied hours					
<i>Kitchen</i>	(4) Minimum 16 °C (24hr period) for general occupancy (5) Overheating risk - GHA 'Early design stage overheating risk level' assessment tool (Low/Med/High) (6) Design to mitigate overheating to satisfy LETI 'Climate Emergency Design Guidance' requirements					
<i>All rooms</i>	(7) Design to satisfy CIBSE TM59 criterion A and B - in accordance with findings and recommended action from both the GHA Overheating tool risk assessment and recommendations of GHA Overheating clauses (8) All housing schemes for vulnerable occupants to undergo CIBSE TM52 and or 59 as appropriate (9) <i>Minimisation of thermal bridging to maintain a minimum opaque surface temp >13 °C</i> (10) <i>Location of heating provision to provide ensure Head to Ankle Temperature (HAT) differential <3 °C</i>					

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Moisture						
Living room	(1) Relative Humidity 40-60% (2) Minimum 0.5 ACH, preferred 8 litres/second/person (3) RH over 24 hour period: - No more than 7 day period >65% - No more than 1 day >75% - No more than 1 min >85% (4) Absolute moisture <7g/kg 24 hour period	(1) RH sensor with data loggers - stand alone, hard wired and/ or with internet connectivity allowing remote access to live data to suit client's requirements (2) Number of rooms and locations to be agreed by Design team - in no case less than main living area, principal bedroom, bathroom and kitchen	(1) 30minute intervals; Daily/ weekly/ monthly/ seasonal and annual average, over min 12 month period	(1) To suit BPE proposals and in all cases included in a final report (2) Report to include at least monthly and annual figures, make comparison with design stage aims/ targets and shall quantify % time out of performance targets/ ranges (3) Source Data to be provided in .xls/tab delimited format (4) Refer also to WKW and LETI recommendations for BPE reporting	(1) Refer to WKW guidance (2) Ventilation commissioning and testing with specific verification of achievement of adequate supply and extraction flow rates and appropriately balanced system; confirmation of design performance targets in ACH or l/s/p preferred (3) Occupant satisfaction POE survey (4) <i>Condensation risk analysis in conjunction with assessment of air and surface temperatures and a focus on assessment of potential thermal bridge points</i>	(1) Ventilation strategy adequate to manage and control moisture with consideration and design response to location of moisture producing activities e.g. washing, cooking, laundry etc (2) Consideration and design response to moisture loads with increased provision for large households (3) Location of ventilation grilles and terminals to minimise draughts, nuisance and with consideration to location in relation to heating system (4) Selection of ventilation system should be appropriate to designed and achieved levels of air permeability. (5) Relationship between ventilation and heating system (6) Limitation on noise from ventilation systems - see Acoustics (7) Guidance for occupants about moisture production, control and ventilation provision - see also occupant guidance at handover (8) For timber construction refer to WKW guidance: Establish approach - permeable/not - and how timber elements will dry. Set design moisture levels for major timber elements
Master Bedroom						
Kitchen						
Bathroom						
<i>All rooms</i>						
Air quality (CO2 and pollutants)						
Living room	(1) CO2 <1000ppm during occupied hours (notionally 10pm - 7am) (2) <i>Maximum air supply velocity not greater than >0.2 m/s</i> (3) <i>TVOC <0.3mg/m³</i> (4) <i>Formaldehyde <0.1mg/m³</i> (5) <i>PM2.5 - selected pollutants to be 'design determined'</i>	(1) CO2 sensor with data loggers - stand alone, hard wired and/ or with internet connectivity allowing remote access to live data to suit client's requirements (2) Number of rooms and locations to be agreed by	(1) 30minute intervals; Daily/ weekly/ monthly/ seasonal and annual average, over min 12 month period	(1) To suit BPE proposals and in all cases included in a final report (2) Report to include at least monthly and annual figures, make comparison with design stage aims/ targets and shall quantify	(1) Refer to WKW guidance (2) Ventilation testing and commissioning as above for Moisture (3) <i>Occupant satisfaction POE survey</i> (4) <i>Occupancy monitoring e.g. duration and patterns</i> (5) <i>Ref to CIBSE TM40 'Health and Well-being in Building Services'</i>	(1) Ventilation strategy adequate to provide satisfactory IAQ taking account of occupancy loads and risks - i.e. ACH; flow and extract rates (2) Controls and advice for ventilation provisions - see also occupant guidance at handover (3) Consideration of airtightness on
Master Bedroom						

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<i>Kitchen</i>		Design team - in no case less than main living area and principal bedroom		% time out of performance targets/ ranges (3) Source Data to be provided in .xls/tab delimited format (4) Refer also to WKW and LETI recommendations for BPE reporting		selection of ventilation provision (4) Consideration of overheating risk on selection of ventilation provision including purge ventilation (5) Adequacy of extract ventilation to outside for cookers (6) Identification of ventilation systems for a) background minimum levels (currently 0.5ach in Building Regulations for moisture control), with preferred approach based on 8 l/s/person and b) purge ventilation to achieve 4ach (7) Selection of materials for source control of pollutants (8) WHO guidelines for pollutants (9) Other reference standards e.g. https://www.euro.who.int/data/asset/pdf/file/0009/128169/e94535.pdf (10) Limitation on noise from ventilation systems - see Acoustics (11) Avoid open flame appliances	
<i>All rooms</i>							
Acoustics							
External noise sources	(1) Performance targets to be 'design determined' and to achieve relevant statutory requirements	(1) Pre and post construction acoustic testing reports and results	(1) Pre design and on completion	(1) To suit BPE proposals and inclusion of results in final report (2) Comparison with design stage aims/ targets (3) Compliance with statutory minimums confirmed	(1) Refer to WKW guidance (2) Occupant satisfaction POE survey		(1) If noise conditions on site (day and night) require/ warrant an acoustic survey (2) Mitigate noise from external sources e.g. road, rail, industry, leisure activities etc. (3) ANC-AVO-Residential-Design-Guide-January-2020-v1.1-1 - including relationship to overheating risk

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Adjoining dwellings	(1) Performance targets to be 'design determined' and to achieve relevant statutory requirements i.e. BR Part E	(1) Post construction acoustic testing reports and results	(1) On completion	(1) To suit BPE proposals and inclusion of results in final report (2) Comparison with design stage aims/ targets (3) Compliance with statutory minimums confirmed	(1) Refer to WKW guidance (2) Occupant satisfaction POE survey	(1) Acoustic separation between adjoining units and communal areas - attenuation of airborne and impact sound - dB(A) (2) Reference to Building Regulations Part E for party walls and floors (3) Reduction of flanking transmission (4) Test requirements informed by designer BS EN ISO 16283 Part 1 & 2 re Airborne and Impact acoustic testing
Internal and external plant (Mechanical & Electrical)	(1) Performance targets to be 'design determined' and to achieve relevant statutory requirements (2) Noise from ventilation system or heating systems <30dBA (3) Limit noise from external equipment 42dBA (4) <i>For Passive House max noise from ventilation systems in occupied rooms ≤ 25 dBA</i>	(1) Post construction acoustic testing reports	(1) On completion	(1) To suit BPE proposals and inclusion of results in final report (2) Comparison with design stage aims/ targets (3) Compliance with statutory minimums confirmed - refer also to 'Additional design stage aims and considerations' note 4	(1) Refer to WKW guidance (2) Occupant satisfaction POE survey	(1) Noise from HVAC services - dB(A) (2) Consideration of noise from the whole system/ all M&E services e.g. calculated noise for multiple sources such as heat pump units (3) Avoid location of services/ appliances in or immediately outside of bedroom windows (4) When a mechanical ventilation system is running on its minimum low rate AD-F refers to BS 8233 and recommends, but does not require, that noise levels do not exceed 30 dB(A) in bedrooms and living rooms. AD-F prefers that noise levels should be lower. The standard for certified Passivhaus dwellings is a limit of 25 dB(A) in both living rooms and bedrooms. For all residential design, not just that using MVHR, BS EN 1525140 recommends a living room design range of 25 to 40 dB(A) with a default design value 32 dB(A) and a bedroom design range of 20 to 35 dB(A) with a default design value 26 dB(A).

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Daylight						
Natural light	(1) >2% average daylight factor to all habitable rooms and kitchen	(1) Design stage daylight factor calculations (2) Daylight measurement readings taken post completion	(1) Design stage and on completion	(1) To suit BPE proposals and inclusion of results in final report (2) Comparison with design stage aims/ targets	(1) Refer to WKW guidance (2) Occupant satisfaction POE survey	(1) Aim for view of sky from habitable rooms and kitchen from windows/ doors (2) Aim to achieve unobstructed view from windows (3) Consider use of rooflights and sun-pipes where appropriate (4) If concessions are necessary in order to mitigate overheating risk e.g. need for solar shading, solar glazing and 'g' value (5) Uniformity - the ratio of the minimum lighting level to the average lighting level in a specified area (6) CIBSE LG 9 - Lighting for communal residential buildings only e.g. hostels, care homes etc.

Minimum energy related monitoring criteria for BPE, compliance and reporting	Performance targets/ requirements	BPE				Additional monitoring aims and considerations	
		General/ source data	Frequency/ granularity (minimum)	Reporting requirements	Required and supporting techniques		
Energy and carbon compliance							
Total electricity	(1) LETI - see table 1	(1) Smart meter data (kWh) - dated monitoring start and finish readings	(1) Client and design team determined	(1) Minimum monthly and annual figures compared with LETI performance requirements, targets and design aims using source data (specified format) (2) Plug in loads calculated by subtracting heating sub meter.	(1) Refer to Health and Comfort for performance verification.	<i>(1) Monitoring of sanitary hot water energy (if not measured by heating sub-meter), flow meters (2) Immersion heater energy demand to cylinder, for heating back up (3) Heating metering and billing regulations i.e. HIU to each flat; circulation and standing heat losses (4) Solar thermal heat or flow metering Other forms of heating e.g. Biomass, non standard and innovation (5) Sub monitoring of EV charging points (6) On-site battery storage (7) Electrical circuit level monitoring, full heat and flow metering (8) OFGEM/ MCS/ MID approved meters re Smart Export Guarantee requirements -SEG, and eligible renewable heat type incentive funding requirements (9) Granularity of data should be increased e.g. daily, hourly etc for investigation; smart meter typically able to provide more granular data.</i>	
Annual space heating demand		(1) Sub meter (kWh) - converted to kWh/m ² /yr; dated monitoring start and finish readings;	(1) Monthly minimum for reporting purposes - smart meter capable of providing more granular data and is recommended				
Annual Carbon dioxide emissions		(1) Smart meter and heating sub meter data (kWh) x CO2 conversion factor	(1) On completion of 12 month monitoring				
Solar PV		(1) Smart meter data (2) Total generation meter (kWh) and export meter (kWh) - consider capability of data logging provided by smart meter	(1) Monthly and total on completion of 12 month monitoring				-
<i>Selected sub-metering e.g. MVHR; Solar thermal</i>		<i>(1) Design determined</i>	<i>(1) Design determined</i>				<i>(1) Design determined</i>
Annual running costs	(1) Affordability client determined	(1) Smart meter and sub meter data - £/pa	(1) Monthly and total on completion of 12 month monitoring	(1) Minimum monthly and annual figures compared with design stage aims using source data (specified format) (2) Plug in loads calculated by subtracting heating sub meter.	(1) Benchmarking of performance compared with similar units	(1) Actual tariff type and supply costs; standing charges, smart tariffs (2) Contribution of renewables as above	