MITSUBISHI ELECTRIC

ASHP and Microbore
Installation Flowchart



ecodan®

Flowchart Information

List of Abbreviations

Microbore pipework = 6,8, 10, and 12mm pipework diameter

Existing heating system = Gas boiler (non-condensing or condensing)

New heating system = ASHP

Max. = Maximum

Temp. = Temperature

HT = High temperature

F&R = Flow and return

MWAT = Mean water to air temperature

LLH = Low loss header

Important Notes

The flowchart provides a comprehensive guide for installers retrofitting ASHPs for properties with existing microbore central heating systems (also suitable for new builds).

The flowchart is designed to match the operating conditions of the existing heating system (i.e. flow temperature and ΔT) with those of the ASHP. This minimizes the need for costly and disruptive property upgrades, like pipework changes, radiator replacements, or added insulation.

The results of the flowchart are based on an ASHP design temperature of -3°C.

The maximum operating temperature for the Ecodan R290 ASHP is 75°C.

The efficiency of ASHPs decreases at higher flow temperatures.

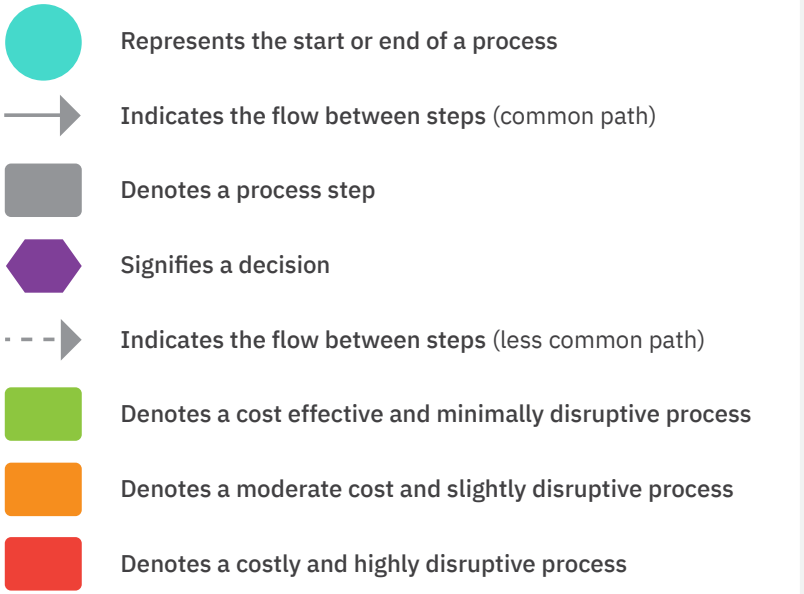
Assumptions

The existing heating system operated on a flow temperature ranging from 60°C to 75°C.

The new heating system (ASHP) includes anti-freeze valves and uses the freeze stat function on the main RC without glycol.

When commissioned, ASHP would run on weather compensation mode.

Legend



Data Logging Tables:

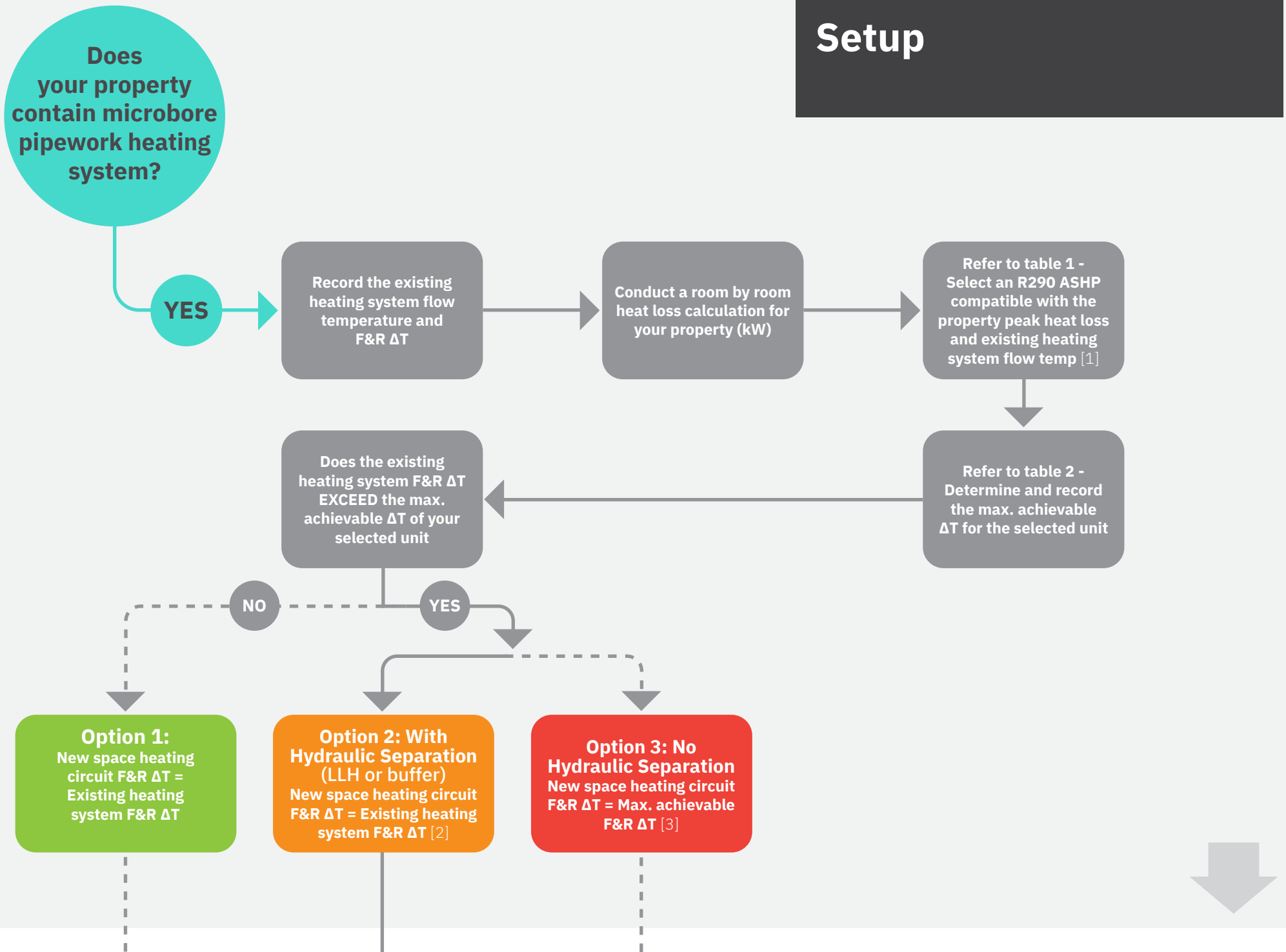
Record essential information & values as you progress through the flowchart.

Setup		Section 1			Section 2		Section 3
Room Name	**Heat Loss (kW)**	**Pipework Material**	**Pipework Diameter (mm)**	**Max. Heat Load Across Pipework (kW)**	**Equivalent Radiator (s) Output**	**Existing Radiator (s) Rated Output**	**Required Water Flow Rate, V (L/min)**
Total							

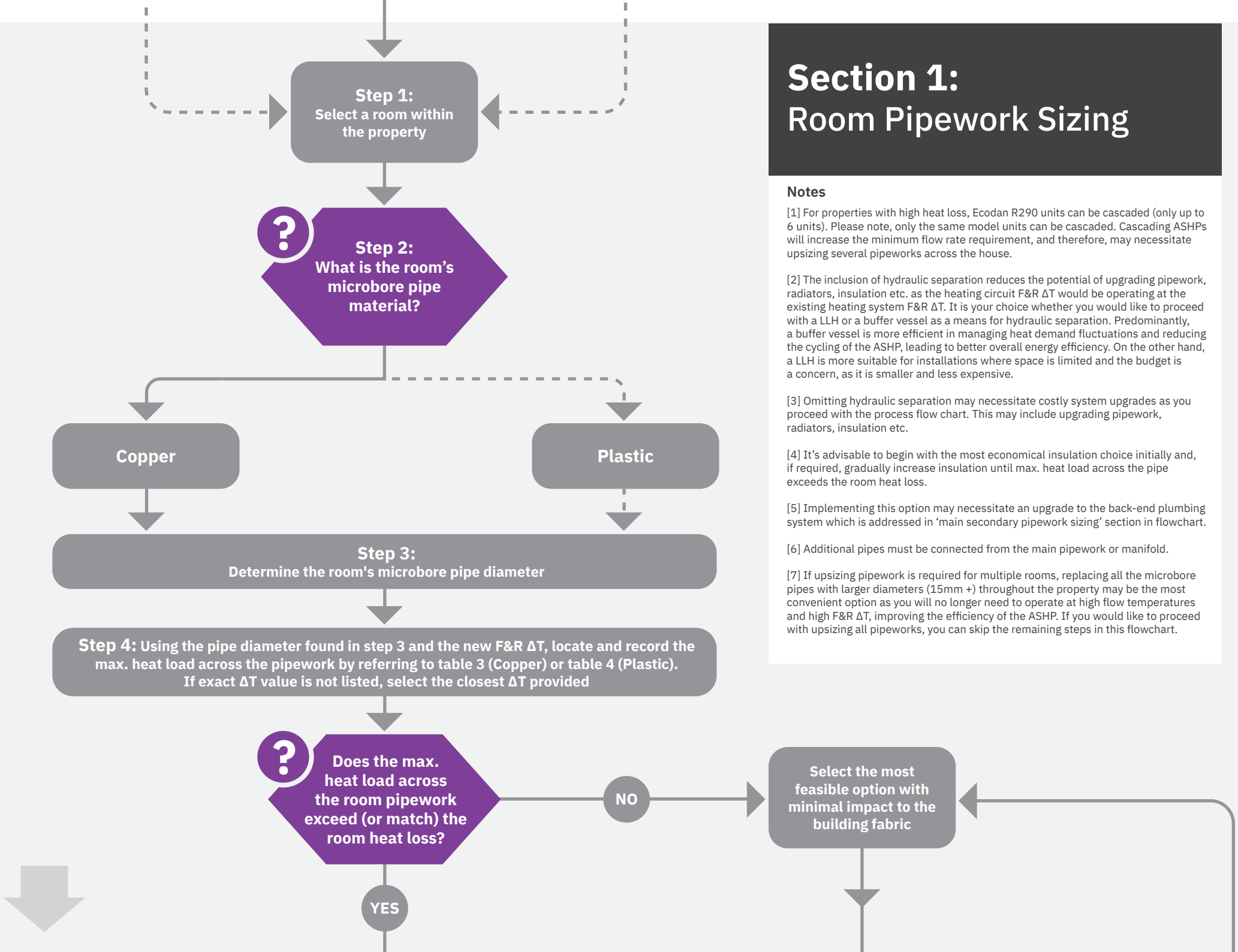
Setup				
Existing Heating System		**ASHP Unit Selected**		**New Space Heating Circuit F&R ΔT**
Flow Temperature (ºC)	F&R ΔT (ºC)	Model	Max. Achievable F&R ΔT (ºC)	Max. Achievable F&R ΔT **OR** Existing heating system F&R ΔT

Section 3			
Manifold Pipework Configuration		**Flow & Return Pipework Configuration**	
Main Pipework (mm)	Max. allowable water flow rate (L/min)	Main Pipework (mm)	Max. allowable water flow rate (L/min)
Pipework Before Manifold (mm)	Max. allowable water flow rate (L/min)	Spine Pipework (mm)	Max. allowable water flow rate (L/min)
Total water flow rate for pipework after manifold 1 (L/min)		Total water flow rate for room pipework connected to spine 1 (L/min)	
Total water flow rate for pipework after manifold 2 (L/min)		Total water flow rate for room pipework connected to spine 2 (L/min)	

Setup


Does your property contain microbore pipework heating system?
YES
Record the existing heating system flow temperature and F&R ΔT
Conduct a room by room heat loss calculation for your property (kW)
Refer to table 1 - Select an R290 ASHP compatible with the property peak heat loss and existing heating system flow temp [1]
Refer to table 2 - Determine and record the max. achievable ΔT for the selected unit
Does the existing heating system F&R ΔT EXCEED the max. achievable ΔT of your selected unit
NO
YES
Option 1: New space heating circuit F&R ΔT = Existing heating system F&R ΔT
Option 2: With Hydraulic Separation (LLH or buffer) New space heating circuit F&R ΔT = Existing heating system F&R ΔT [2]
Option 3: No Hydraulic Separation New space heating circuit F&R ΔT = Max. achievable F&R ΔT [3]

Section 1:
Room Pipework Sizing



Notes

[1] For properties with high heat loss, Ecodan R290 units can be cascaded (only up to 6 units). Please note, only the same model units can be cascaded. Cascading ASHPs will increase the minimum flow rate requirement, and therefore, may necessitate upsizing several pipeworks across the house.

[2] The inclusion of hydraulic separation reduces the potential of upgrading pipework, radiators, insulation etc. as the heating circuit F&R ΔT would be operating at the existing heating system F&R ΔT. It is your choice whether you would like to proceed with a LLH or a buffer vessel as a means for hydraulic separation. Predominantly, a buffer vessel is more efficient in managing heat demand fluctuations and reducing the cycling of the ASHP, leading to better overall energy efficiency. On the other hand, a LLH is more suitable for installations where space is limited and the budget is a concern, as it is smaller and less expensive.

[3] Omitting hydraulic separation may necessitate costly system upgrades as you proceed with the process flow chart. This may include upgrading pipework, radiators, insulation etc.

[4] It's advisable to begin with the most economical insulation choice initially and, if required, gradually increase insulation until max. heat load across the pipe exceeds the room heat loss.

[5] Implementing this option may necessitate an upgrade to the back-end plumbing system which is addressed in 'main secondary pipework sizing' section in flowchart.

[6] Additional pipes must be connected from the main pipework or manifold.

[7] If upsizing pipework is required for multiple rooms, replacing all the microbore pipes with larger diameters (15mm +) throughout the property may be the most convenient option as you will no longer need to operate at high flow temperatures and high F&R ΔT, improving the efficiency of the ASHP. If you would like to proceed with upsizing all pipeworks, you can skip the remaining steps in this flowchart.

Table 1: Max. capacity for Ecodan R290 range at various flow temps

	Max. Unit Capacity (kW)		
Flow Temp (°C)	PUZ-WZ50VAA (5kW)	PUZ-WZ60VAA (6kW)	PUZ-WZ80VAA (8kW)
75	3.28	3.83	5.67
70	3.48	4.08	6.16
65	3.97	4.67	6.76
60	4.27	5.11	7.16

Table 2: Max. achievable ΔT for Ecodan R290 range at various flow temps

	Max. Achievable F&R ΔT (°C)		
Flow Temp (°C)	PUZ-WZ50VAA (5kW)	PUZ-WZ60VAA (6kW)	PUZ-WZ80VAA (8kW)
75	7.4	8.6	12.8
70	7.8	9.2	13.9
65	8.9	10.5	15.2
60	9.6	11.5	16.1

Note: Max. heat load values presented in tables 1 & 2 were derived based on a design temperature of -3°C.

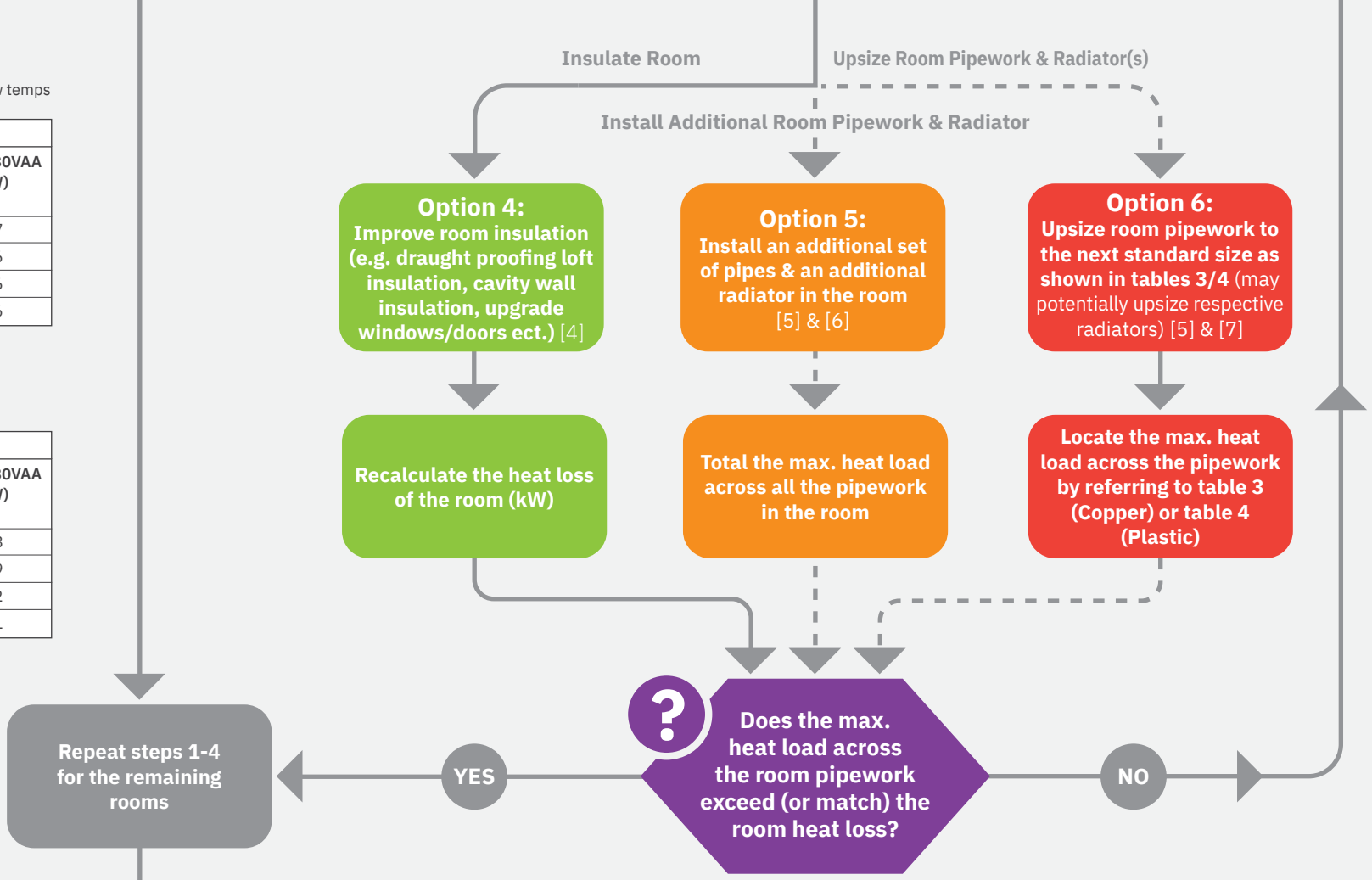


Table 3: Max. heat load across various **copper pipes** at varying F&R ΔT for secondary circuit.

	Max. Heat Load Across Room Pipework, Q (kW)						
Pipe Diameter (mm)	ΔT = 5°C	ΔT = 7.5°C	ΔT = 10°C	ΔT = 12.5°C	ΔT = 15°C	ΔT = 17.5°C	ΔT = 20°C
6	0.11	0.16	0.21	0.26	0.32	0.37	0.42
8	0.28	0.41	0.55	0.69	0.83	0.97	1.11
10	0.56	0.84	1.12	1.40	1.68	1.96	2.24
12	0.99	1.48	1.97	2.47	2.96	3.45	3.94
15	1.82	2.73	3.64	4.55	5.46	6.37	7.28
22	5.32	7.98	10.64	13.30	15.96	18.62	21.28

Table 4: Max. heat load across various **plastic pipes** at varying F&R ΔT for secondary circuit.

	Max. Heat Load Across Room Pipework, Q (kW)						
Pipe Diameter (mm)	ΔT = 5°C	ΔT = 7.5°C	ΔT = 10°C	ΔT = 12.5°C	ΔT = 15°C	ΔT = 17.5°C	ΔT = 20°C
6	0.09	0.14	0.18	0.23	0.28	0.32	0.37
8	0.26	0.38	0.51	0.64	0.77	0.89	1.02
10	0.32	0.48	0.64	0.81	0.97	1.13	1.29
12	0.63	0.94	1.25	1.57	1.88	2.20	2.51
15	1.31	1.96	2.61	3.27	3.92	4.57	5.22
22	4.46	6.70	8.93	11.16	13.39	15.62	17.86

Note: Max. heat load values presented in tables 3 & 4 are limited by a maximum pressure drop of 350 Pa/m and a maximum fluid velocity of 1 m/s (CIBSE recommendation).

Section 2:
Room Radiator Sizing

Which option did you select in section 1 above?

- **Option 1**
- **Option 2: With Hydraulic Separation**
- **Option 3: No Hydraulic Separation**

Using the existing heating system, did all radiators emit adequate heat to each room?

- YES
- NO

Are all the radiators in your property sized to meet the heat loss requirements of each room? [8]

- YES
- NO

Select a room within the property

Select the most feasible option with minimal impact to the building fabric

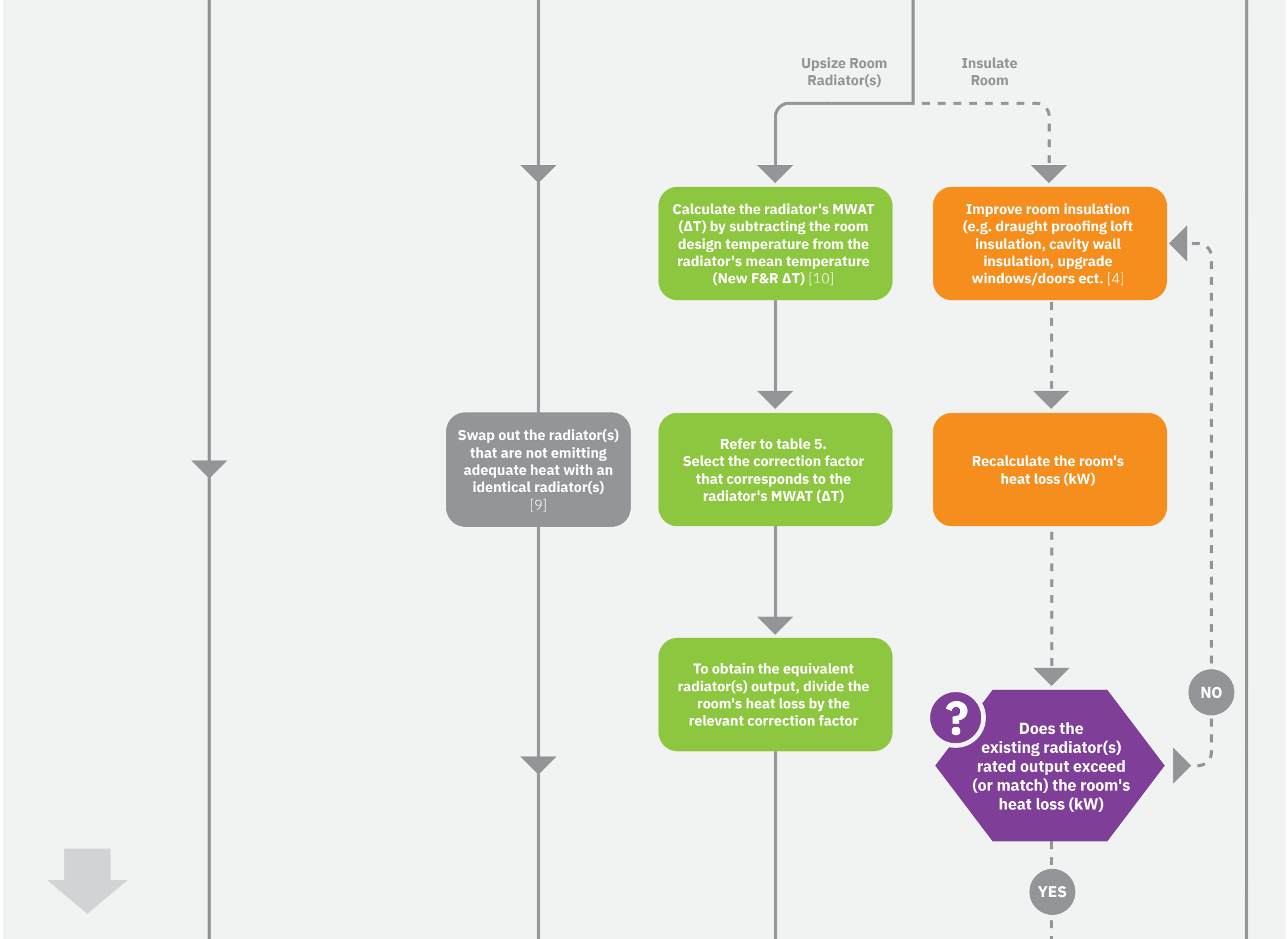
Notes

[8] If you are not sure, proceed with "No" and carry out the steps for upsizing room radiator(s).

[9] If the existing heating system was not operating as designed (i.e. not providing sufficient heat), this step may not be necessary.

[10] MWAT (ΔT) refers to the temperature difference between the water circulating in the radiator and the room's design temperature. For example, if the water entering the radiator is 75°C and the water returning is 65°C, the mean radiator temperature would be 70°C. By subtracting the room design temperature of 20°C from the mean radiator temperature of 70°C, the MWAT ΔT value would be 50°C.

[11] The existing radiator(s) rated output, at MWAT = 50°C (ΔT), can be obtained from the radiator manufacture.


Upsize Room Radiator(s)
Insulate Room
Calculate the radiator's MWAT (ΔT) by subtracting the room design temperature from the radiator's mean temperature (New F&R ΔT) [10]
Improve room insulation (e.g. draught proofing loft insulation, cavity wall insulation, upgrade windows/doors ect. [4]
Swap out the radiator(s) that are not emitting adequate heat with an identical radiator(s) [9]
Refer to table 5. Select the correction factor that corresponds to the radiator's MWAT (ΔT)
Recalculate the room's heat loss (kW)
To obtain the equivalent radiator(s) output, divide the room's heat loss by the relevant correction factor
Does the existing radiator(s) rated output exceed (or match) the room's heat loss (kW)
NO
YES

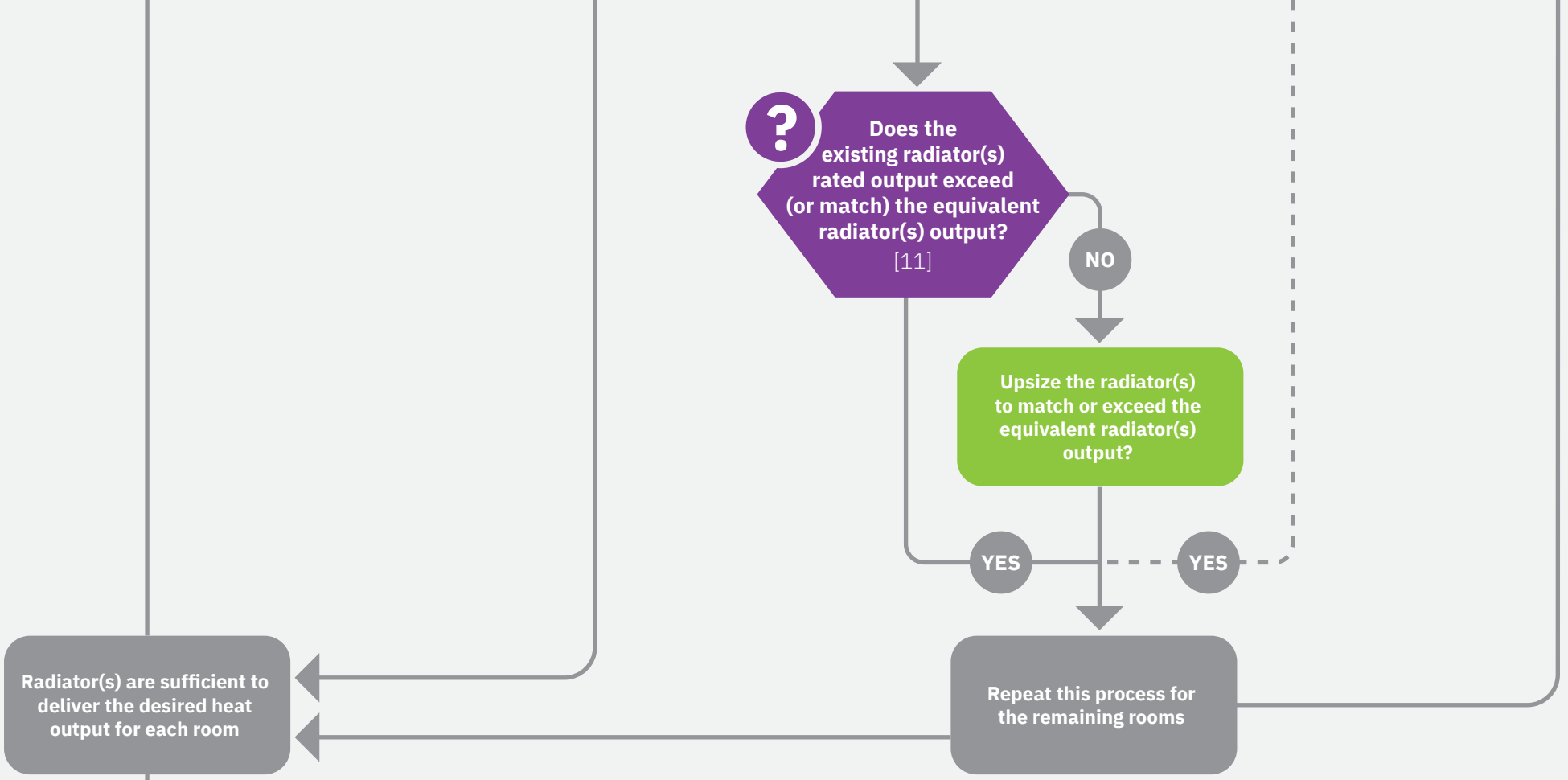
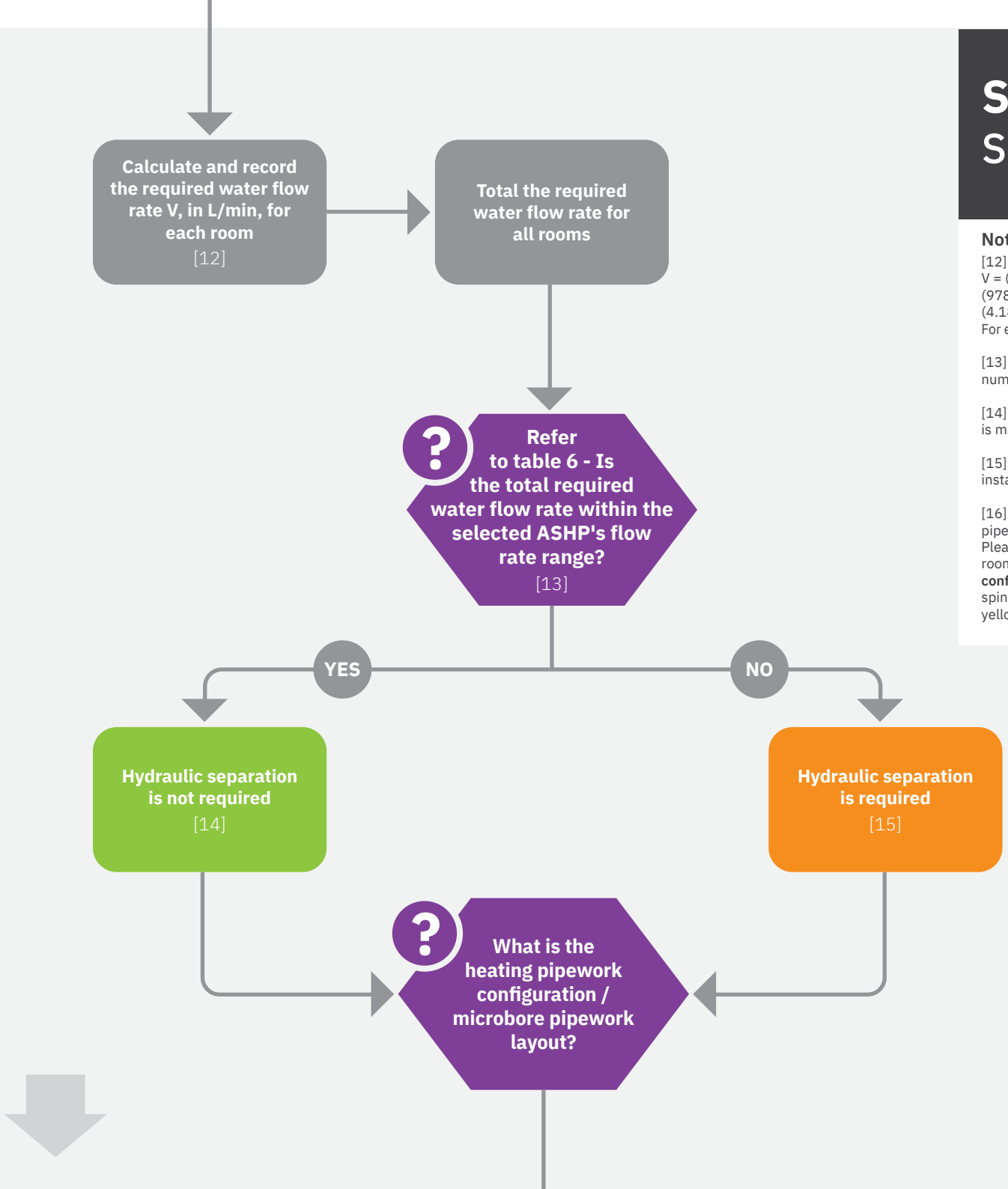


Table 5: MWAT (ΔT) correction factor for radiators

ΔT (°C)	Correction Factor	ΔT (°C)	Correction Factor	ΔT (°C)	Correction Factor	ΔT (°C)	Correction Factor
20	0.302	**32**	0.558	**44**	0.846	**55**	1.132
21	0.322	**33**	0.581	**45**	0.871	**56**	1.159
22	0.342	**34**	0.604	**46**	0.897	**57**	1.186
23	0.363	**35**	0.627	**47**	0.922	**58**	1.213
24	0.383	**36**	0.651	**48**	0.948	**59**	1.241
25	0.404	**37**	0.675	**49**	0.974	**60**	1.268
26	0.426	**38**	0.699	**50**	1	**61**	1.296
27	0.447	**39**	0.723	**51**	1.026	**62**	1.324
28	0.469	**40**	0.747	**52**	1.052	**63**	1.352
29	0.491	**41**	0.771	**53**	1.079	**64**	1.38
30	0.513	**42**	0.796	**54**	1.105	**65**	1.408
31	0.535	**43**	0.821	**54**	1.105		



Section 3: Section by Section Pipework Sizing

Notes

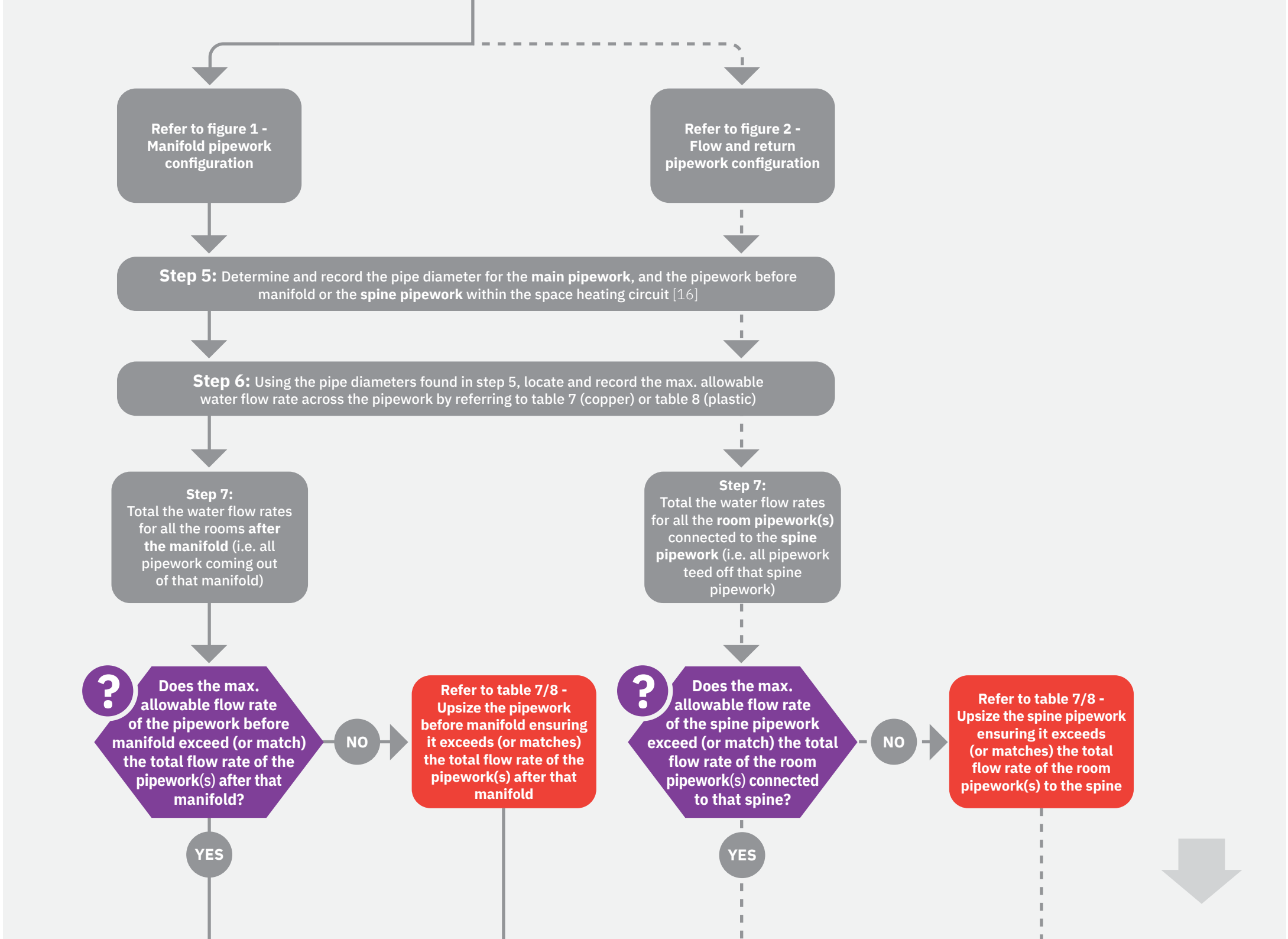
[12] To calculate the room's flow rate use the following equation: $V = (Q/(p*Cp*\Delta T))*60000$, Where Q is the room heat loss (kW), p is the density (978kg/m^3), V is the volumetric flow rate (L/min), Cp is the specific heat capacity (4.18kJ/kgK), and ΔT is the new secondary circuit F&R temperature differential (°C). For example, if Q is 2kW and ΔT is 15°, then $V = (2/(978*4.18*15)*60000 = 1.96$ L/min.

[13] If units were cascaded, then the flow rate range must be multiplied by the number of units cascaded.

[14] If option 2 'with hydraulic separation' was selected, then hydraulic separation is mandatory, Otherwise, proceed to the next step - See footnote [2] for more info.

[15] If option 1 or 3 were selected, hydraulic separation will now need to be installed. Otherwise proceed to the next step - See footnote [2] for more info.

[16] **For manifold pipework configuration**, see figure 1 as an example. Main pipework is highlighted red and pipework before manifold is highlighted blue. Please note that the pipework after manifold (highlighted yellow) refers to the room pipework sized in section 1 of the flow chart. **For flow and return pipework configuration**, see figure 2 as an example. Main pipework is highlighted red and spine pipework is highlighted blue. Please note that the room pipework (highlighted yellow) refers to the room pipework sized in section 1 of the flowchart.


Refer to figure 1 - Manifold pipework configuration
Refer to figure 2 - Flow and return pipework configuration
Step 5: Determine and record the pipe diameter for the main pipework, and the pipework before manifold or the spine pipework within the space heating circuit [16]
Step 6: Using the pipe diameters found in step 5, locate and record the max. allowable water flow rate across the pipework by referring to table 7 (copper) or table 8 (plastic)
Step 7: Total the water flow rates for all the rooms after the manifold (i.e. all pipework coming out of that manifold)
Step 7: Total the water flow rates for all the room pipework(s) connected to the spine pipework (i.e. all pipework teed off that spine pipework)
Does the max. allowable flow rate of the pipework before manifold exceed (or match) the total flow rate of the pipework(s) after that manifold?
NO
Refer to table 7/8 - Upsize the pipework before manifold ensuring it exceeds (or matches) the total flow rate of the pipework(s) after that manifold
YES
Does the max. allowable flow rate of the spine pipework exceed (or match) the total flow rate of the room pipework(s) connected to that spine?
NO
Refer to table 7/8 - Upsize the spine pipework ensuring it exceeds (or matches) the total flow rate of the room pipework(s) to the spine
YES

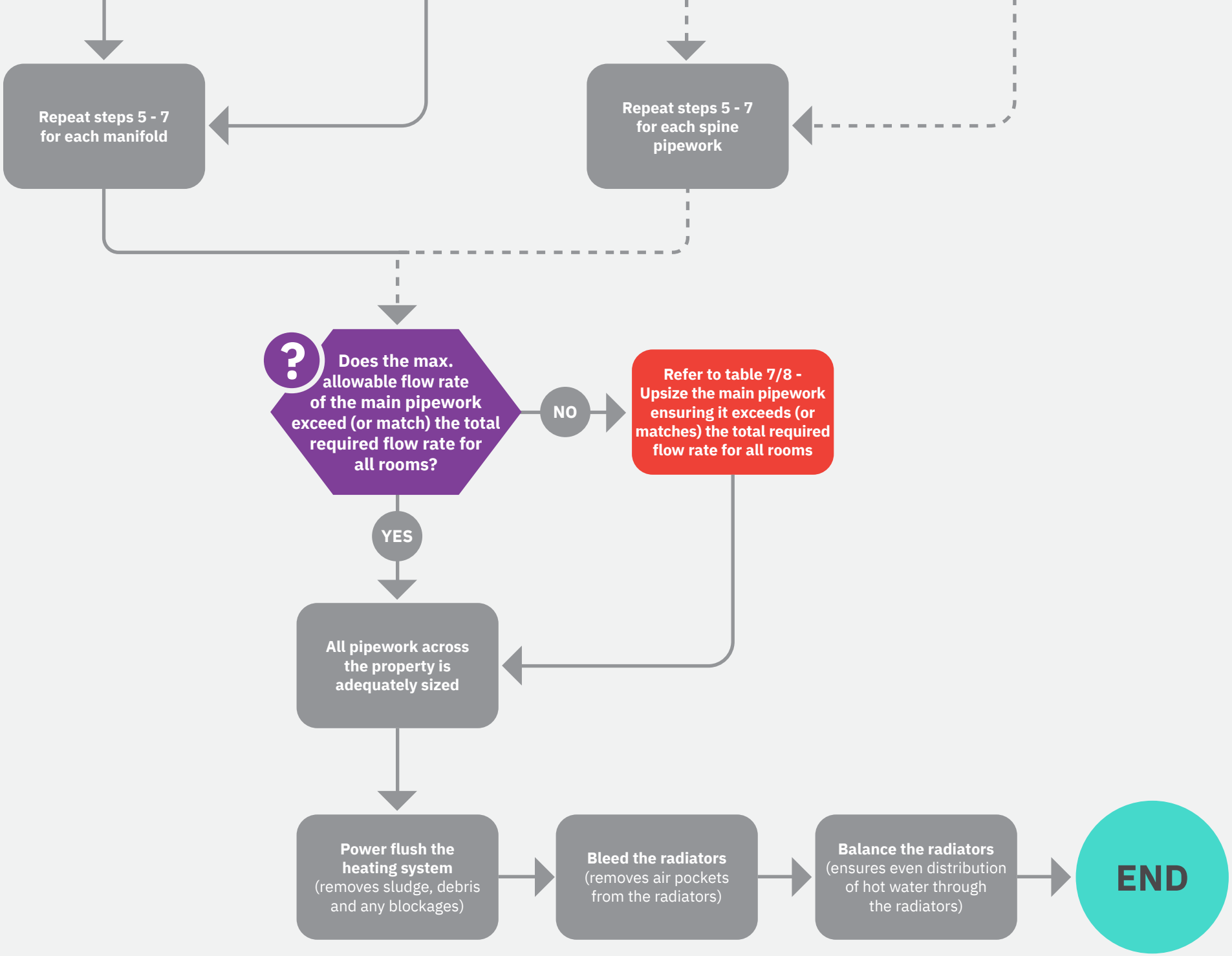

Repeat steps 5 - 7 for each manifold
Repeat steps 5 - 7 for each spine pipework
Does the max. allowable flow rate of the main pipework exceed (or match) the total required flow rate for all rooms?
NO
Refer to table 7/8 - Upsize the main pipework ensuring it exceeds (or matches) the total required flow rate for all rooms
YES
All pipework across the property is adequately sized
Power flush the heating system (removes sludge, debris and any blockages)
Bleed the radiators (removes air pockets from the radiators)
Balance the radiators (ensures even distribution of hot water through the radiators)
END

Table 6: Water flow rate range for Ecodan R290 ASHPs.

	PUZ-WZ50VAA (5kW)	PUZ-WZ60VAA (6kW)	PUZ-WZ80VAA (8kW)
Flow Rate Range (L/min)	6.5 - 14.3	6.5 - 17.2	6.5 - 22.9

Table 7: Max. allowable water flow rate across different **copper** pipe diameters.

Pipe Diameter (mm)	Water Flow Rate, V (L/min)
6	0.31
8	0.81
10	1.64
12	2.89
15	5.33
22	15.59

Table 8: Max. allowable water flow rate across different **plastic** pipe diameters.

Pipe Diameter (mm)	Water Flow Rate, V (L/min)
6	0.27
8	0.75
10	0.94
12	1.84
15	3.83
22	13.08

Note: Max. allowable water flow rate values presented in tables 7 & 8 are limited by a maximum pressure drop of 350 Pa/m and a maximum fluid velocity of 1 m/s (CIBSE recommendation).

Figure 1: Manifold pipework configuration - space heating circuit

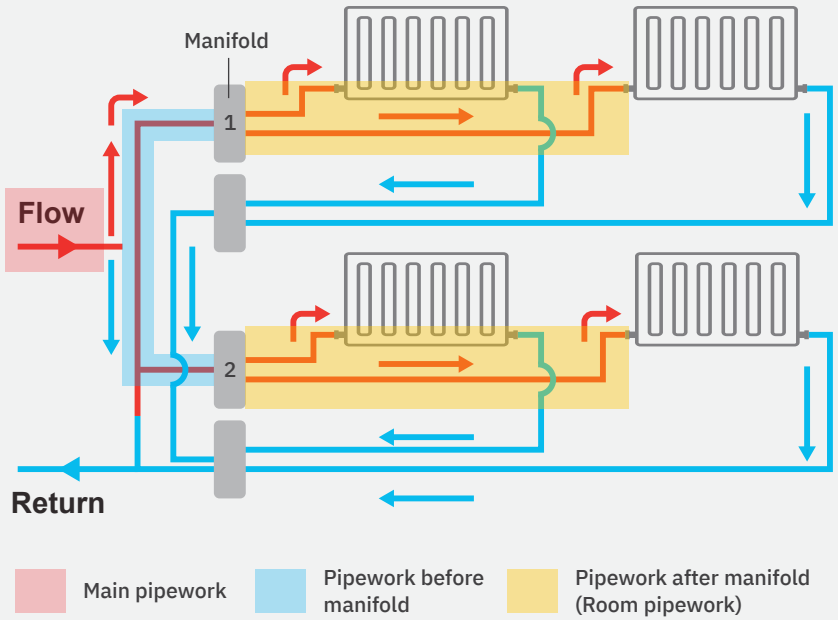
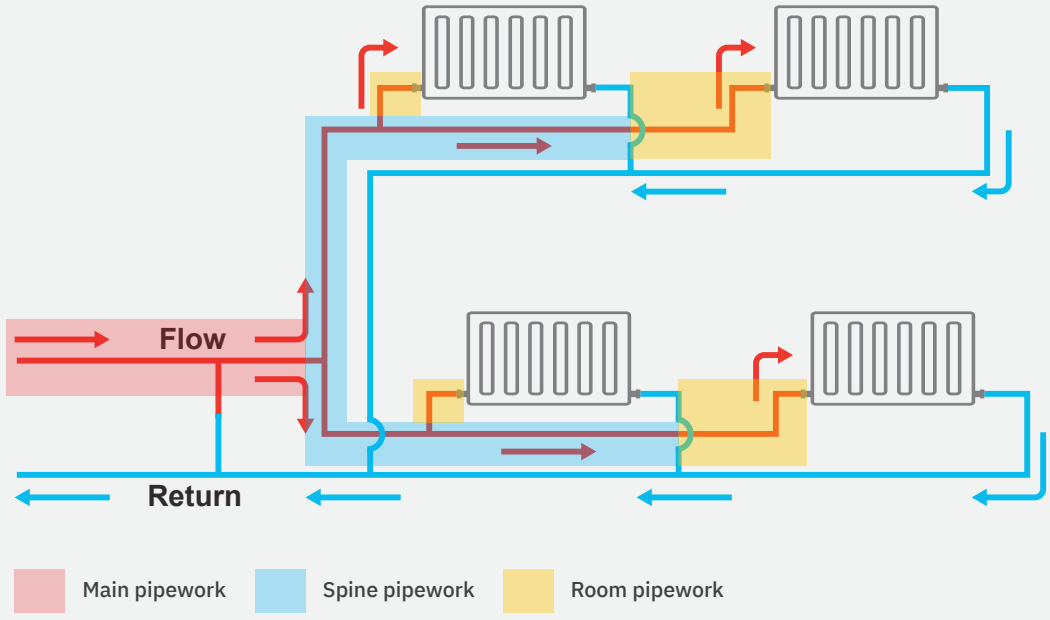


Figure 2: Flow and return pipework configuration - space heating circuit



Note: The figures above illustrate examples of heating pipework configurations. Each property may have slight variations in the pipework setup.

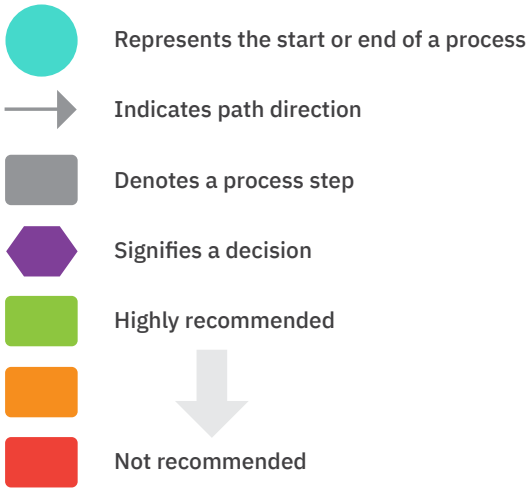
Microbore Solutions Flowchart

The **‘Microbore Solutions Flowchart’** builds on the step-by-step guidance outlined in the accompanying **‘ASHP and Microbore Installation Flowchart’**, which helps installers navigate the challenges of integrating our Ecodan R290 ASHPs with existing microbore central heating systems.

After determining the system configuration and requirements through the installation flowchart, the microbore solutions flowchart provides detailed insights into selecting the appropriate cylinder (if required), heating system mode(s) of operation, and thermostat(s), ensuring seamless and efficient installation process, as well as an optimised long term operation.

Please note the below process flowchart and recommendations are subject to local requirements.

Legend



Notes:

[1] The variable speed pump and water flow (ΔT) control functionality [4] is only compatible with our Packaged Cylinder (EHPT20X-MEHEW). If this functionality is desired, and if possible, please follow the ‘Space Heating & Domestic Hot Water’ path instead to determine whether your heating system is compatible.

[2] Hot water cylinders are sized according to the number of bedrooms in the property, with 45L allocated per bedroom, plus an additional 45L serving as buffer.

[3] The variable speed pump and water flow (ΔT) control functionality [4] is only compatible with our Packaged Cylinder (EHPT20X-MEHEW). As the required cylinder capacity is not part of our current range, this functionality will not be available.

[4] The water flow (ΔT) control feature allows setting the desired ΔT on the unit to match the heating system’s requirements. The variable speed pump will then automatically adjust its speed to achieve/maintain this ΔT - This functionality is only available in conjunction with our Packaged Cylinder (EHPT20X-MEHEW).

[5] The variable speed pump and water flow (ΔT) control functionality [4] is only compatible with our Packaged Cylinder (EHPT20X-MEHEW) as it does not include hydraulic separation (mixing tank). If hydraulic separation is necessary, refer to ‘ASHP and Microbore Installation Flowchart’, it is mandatory to follow the ‘No’ path instead.

[6] Calculate the system pressure drop. Refer to EHPT20X-MEHEW manual for pump characteristic curve to ensure the pre-wired primary pump can overcome the system pressure drops and achieve the required flow rates.

[7] Calculate the system pressure drop. Refer to Pre-Plumbed Cylinder manual for pump characteristic curve to ensure the pre-wired space heating and primary pump can overcome the system pressure drops and achieve the required flow rates.

[8] Since the pump isn’t sufficient to achieve the required flow rates, our Pre-Plumbed Cylinder range is the recommended option. Consequently, water flow control functionality is not complete.

[9] This mode provides the best efficiency by leveraging the ambient temperature, current room temperature, target temperature, and weather compensation curve, all of which guide the Ecodan control logic to effectively achieve the target room temperature. As a result, thermal comfort is maximised and energy savings are enhanced by preventing overheating. Additionally, the Ecodan heat pump operates only as much as necessary, minimising strain on the heating system, which helps lower maintenance costs and extend the product’s lifespan.

[10] This mode adjusts the flow temperature based solely on the ambient temperature. While it optimises energy use by adapting to changing weather conditions, its efficiency and ability to maintain thermal comfort is limited compared to auto adaptation mode.

[11] This mode is less efficient through keeping the flow temperature fixed, regardless of varying heating demands or external conditions.

[12] The wireless remote controller is used to monitor room temperature and can be used to make changes to the space heating settings, boost DHW (if applicable), and switch to holiday mode without directly using the main controller. This option requires a wireless receiver to be connected to FTC and paired to the wireless remote controller. DIP SW1-8 must be switched ON.

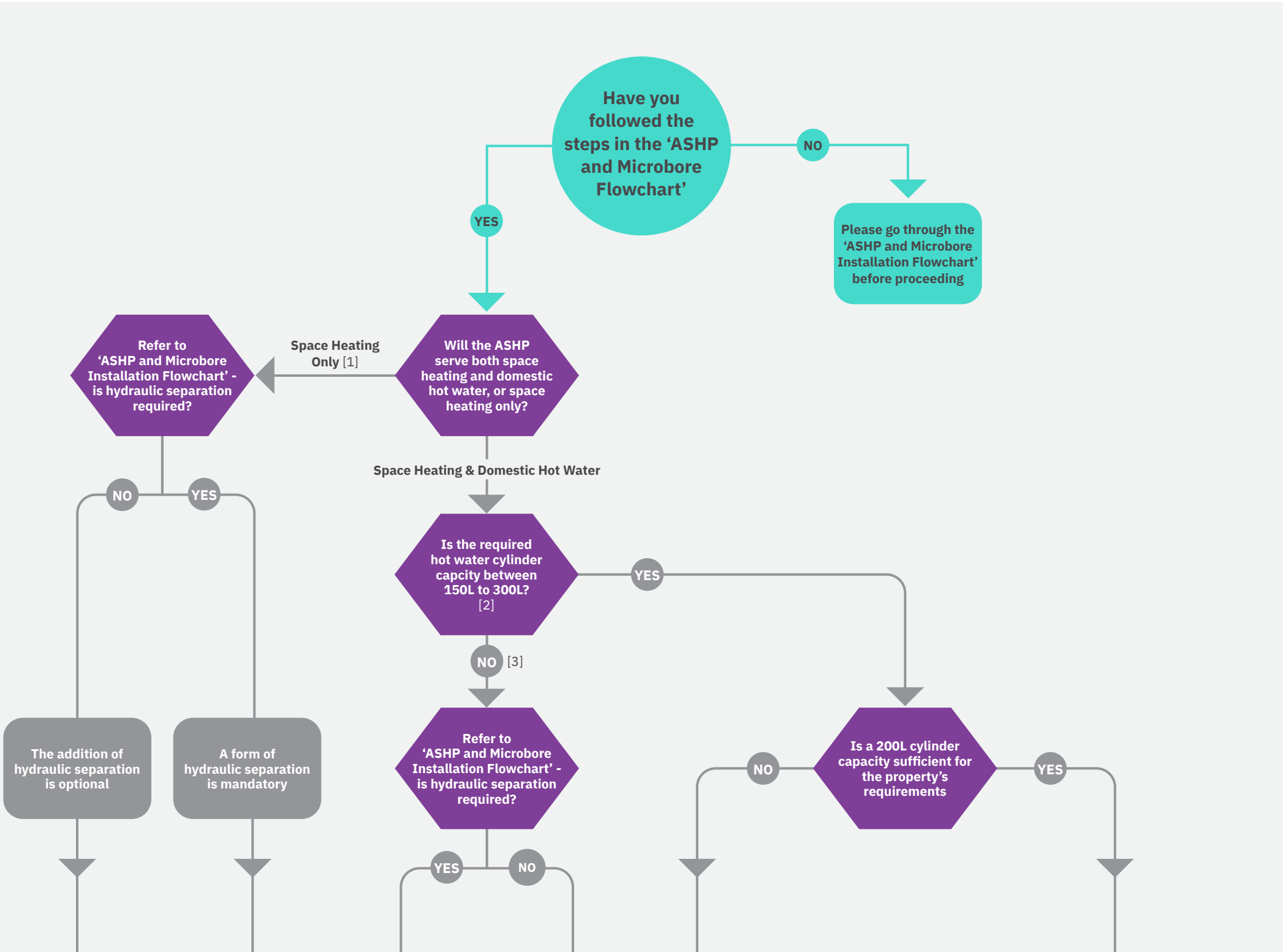
[13] A thermistor built in the main remote controller can be used for monitoring the room temperature for auto adaption mode. Ensure the main remote controller is connected to TB5 on FTC by a 2-core, 0.3mm^2, non-polar cable with a maximum length of 150m (local supply) - 10m wire is attached as an accessory. Place the main remote controller in an appropriate location to detect room temperature. Please note, there is potential risk of overheating the room in auto adaptation mode.

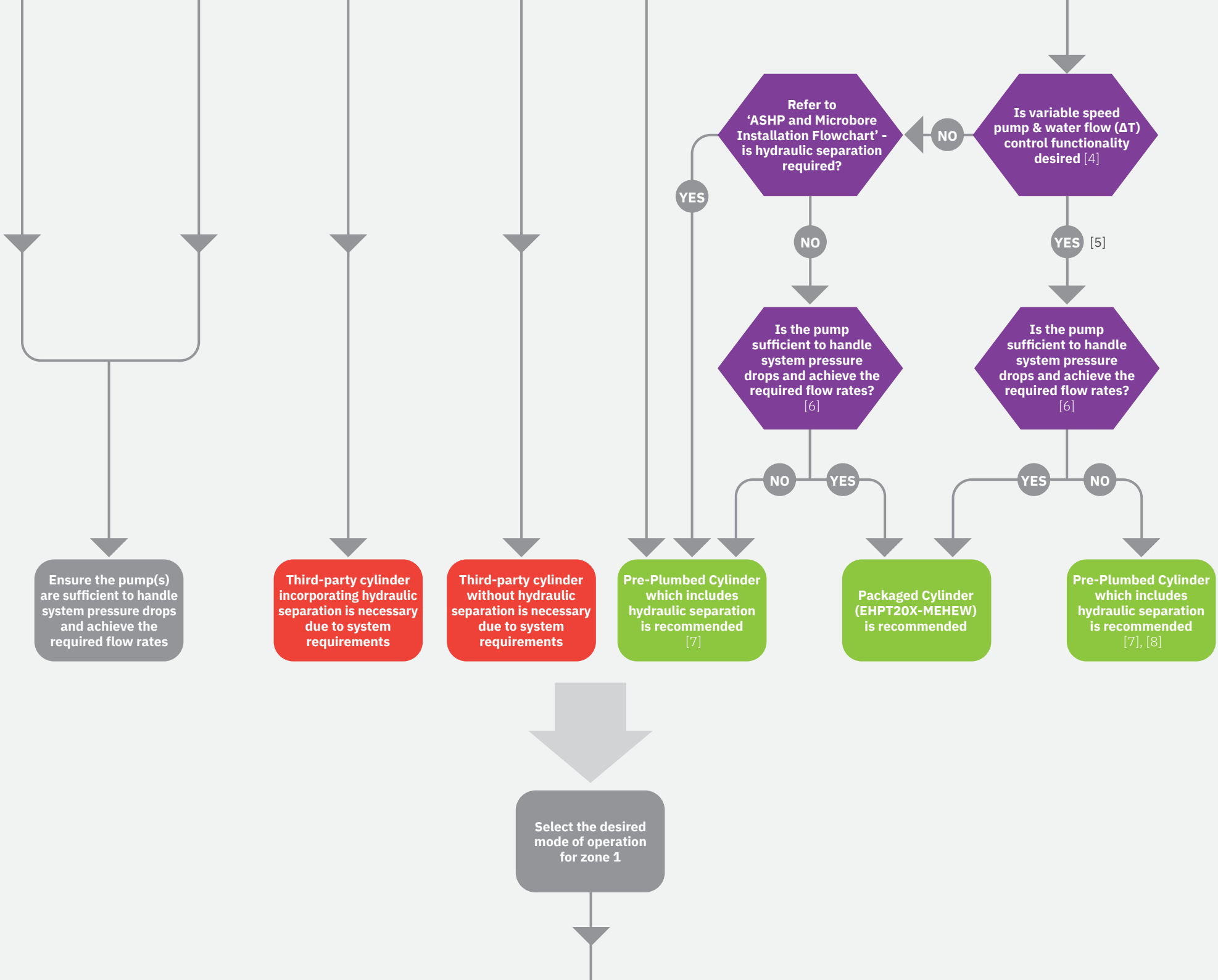
[14] The thermistor is used to monitor room temperature but can not make any changes in control operation. Only one room temperature thermistor can be connected to FTC. The thermistor must be wired to the CN20 connector on FTC.

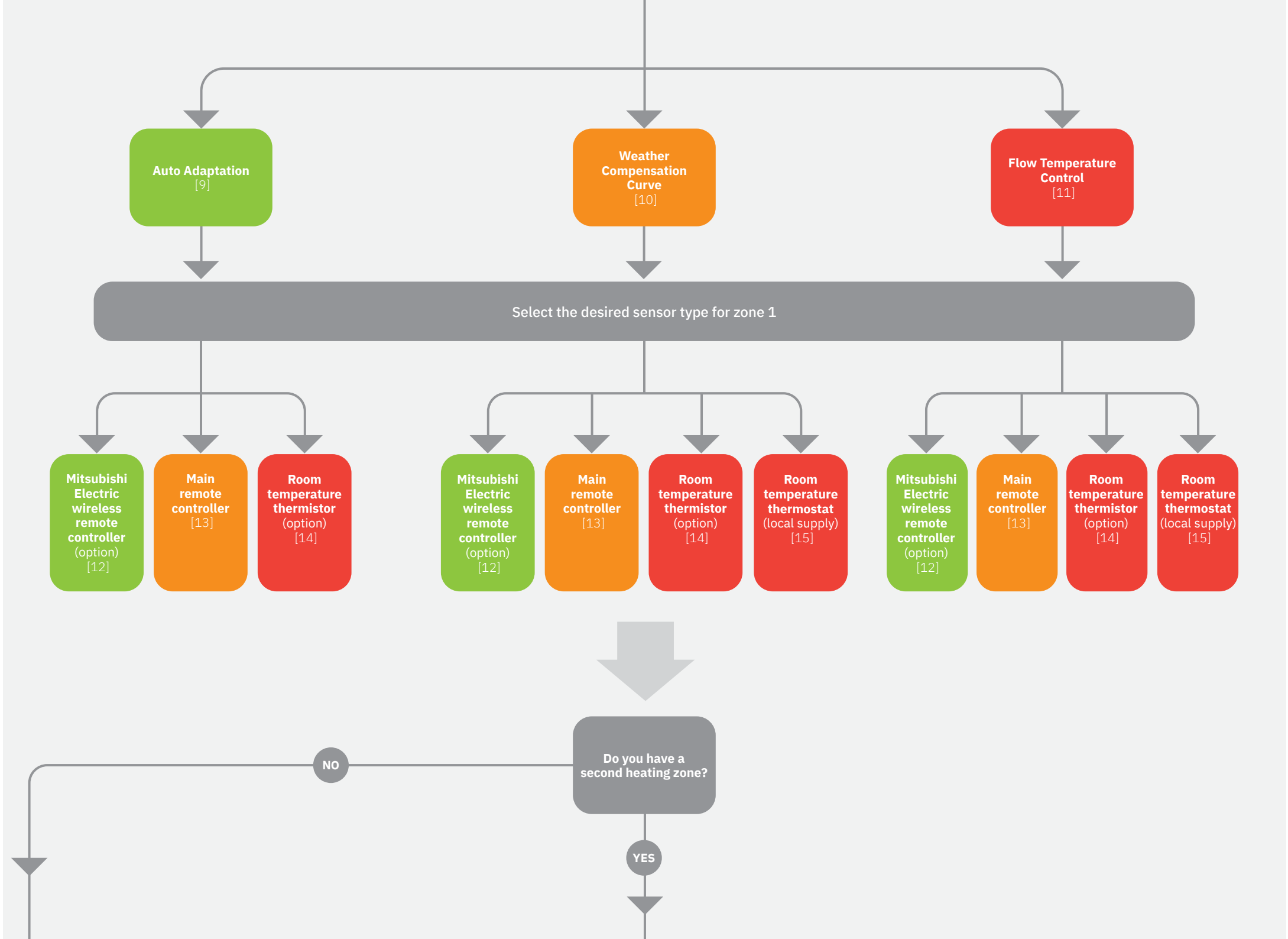
[15] The locally supplied thermostat is used to set the maximum room temperature. For zone 1, the thermostat should be wired to IN1 in TBI.1 on the FTC, and DIPSW2-1 must be switched on. For zone 2 (if applicable), the thermostat should be wired to IN6 in TBI.2 on the FTC, and DIP SW3-1 must be switched on. A single thermostat can be connected to FTC for each zone.

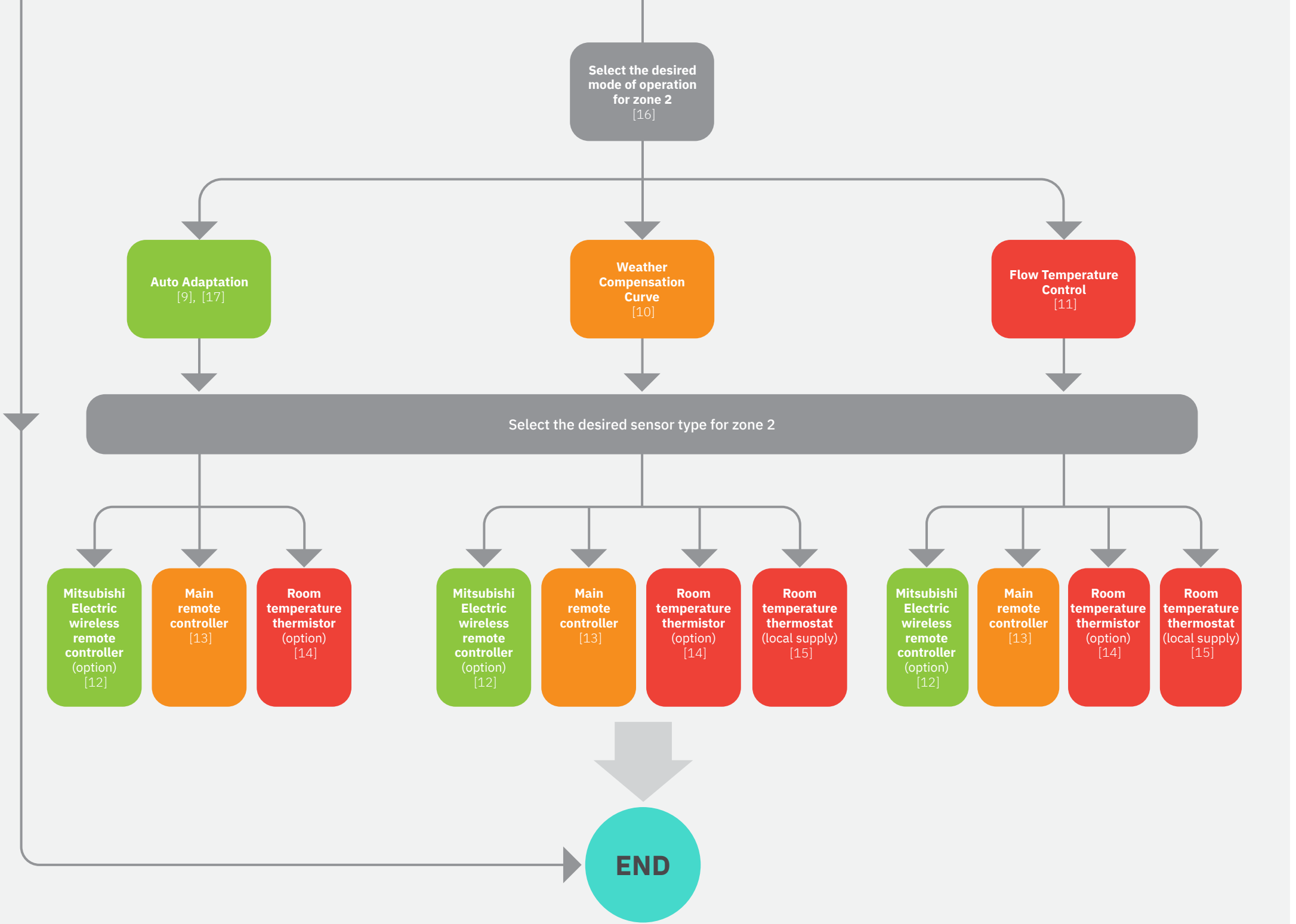
[16] In a 2-zone heating system, assign zone 1 to the zone with the highest design flow temperature between the two zones (e.g. radiators at 55°C in zone 1 and underfloor heating at 45°C in zone 2). This ensures the ASHP targets zone 1’s higher flow temperature when both zones call for heat, meeting the demand of both zones simultaneously.

[17] ‘Auto Adaptation’ can be applied to only one zone. If it is selected for zone 1, the options for zone 2 are limited to ‘weather compensation curve’ or ‘flow temperature control’ and vice versa.


Have you followed the steps in the 'ASHP and Microbore Flowchart'
NO
Please go through the 'ASHP and Microbore Installation Flowchart' before proceeding
YES
Will the ASHP serve both space heating and domestic hot water, or space heating only?
Space Heating Only [1]
Refer to 'ASHP and Microbore Installation Flowchart' - is hydraulic separation required?
NO
YES
The addition of hydraulic separation is optional
A form of hydraulic separation is mandatory
Space Heating & Domestic Hot Water
Is the required hot water cylinder capcity between 150L to 300L? [2]
YES
NO [3]
Refer to 'ASHP and Microbore Installation Flowchart' - is hydraulic separation required?
YES
NO
Is a 200L cylinder capacity sufficient for the property's requirements
NO
YES


Is variable speed pump & water flow (ΔT) control functionality desired [4]
NO
Refer to 'ASHP and Microbore Installation Flowchart' - is hydraulic separation required?
YES
NO
YES [5]
Is the pump sufficient to handle system pressure drops and achieve the required flow rates? [6]
Is the pump sufficient to handle system pressure drops and achieve the required flow rates? [6]
NO
YES
YES
NO
Ensure the pump(s) are sufficient to handle system pressure drops and achieve the required flow rates
Third-party cylinder incorporating hydraulic separation is necessary due to system requirements
Third-party cylinder without hydraulic separation is necessary due to system requirements
Pre-Plumbed Cylinder which includes hydraulic separation is recommended [7]
Packaged Cylinder (EHPT20X-MEHEW) is recommended
Pre-Plumbed Cylinder which includes hydraulic separation is recommended [7], [8]
Select the desired mode of operation for zone 1


Auto Adaptation [9]
Weather Compensation Curve [10]
Flow Temperature Control [11]
Select the desired sensor type for zone 1
Mitsubishi Electric wireless remote controller (option) [12]
Main remote controller [13]
Room temperature thermistor (option) [14]
Mitsubishi Electric wireless remote controller (option) [12]
Main remote controller [13]
Room temperature thermistor (option) [14]
Room temperature thermostat (local supply) [15]
Mitsubishi Electric wireless remote controller (option) [12]
Main remote controller [13]
Room temperature thermistor (option) [14]
Room temperature thermostat (local supply) [15]
Do you have a second heating zone?
NO
YES


Select the desired mode of operation for zone 2 [16]
Auto Adaptation [9], [17]
Weather Compensation Curve [10]
Flow Temperature Control [11]
Select the desired sensor type for zone 2
Mitsubishi Electric wireless remote controller (option) [12]
Main remote controller [13]
Room temperature thermistor (option) [14]
Mitsubishi Electric wireless remote controller (option) [12]
Main remote controller [13]
Room temperature thermistor (option) [14]
Room temperature thermostat (local supply) [15]
Mitsubishi Electric wireless remote controller (option) [12]
Main remote controller [13]
Room temperature thermistor (option) [14]
Room temperature thermostat (local supply) [15]
END