

Department Construction
Name REHAU Web Design New Zealand
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Date 27/09/2016

WARMNZ
Todd Bowmast
5 Waimana Road
Takanini, Auckland

REHAU Hydronic System detailed design - Heating
Project: 15-145 Mainfreight Freezer, Christchurch

Dear Todd,

We have pleasure in submitting our detailed design documents for your above mentioned project. This design and the associated data have been prepared according to the information, diagrams and/or drawings provided. Please check and confirm all parameters and results prior to using them.

By utilising our design service and the results you recognise the current REHAU Terms and Conditions of Sale, which are available on request or at www.rehau.com/LZB.

In case this design requires amendments, please send an email with all required changes to FHDesign.ANZ@rehau.com

Additional charges may apply for design changes or required corrections not caused by us.

We thank you for your interest in the REHAU Hydronic System detailed design and look forward to the application of our products.

Please do not hesitate to contact us if you require any further clarification or assistance.

Kind regards

REHAU Web Design New Zealand
REHAU Pty Ltd

Attachments: Performance overview (proposed final)
 Hydraulic Balancing Data for each manifold
 Bill Of Material (proposed final)
 Circuit layout as CAD drawing

REHAU HYDRONIC SYSTEM DESIGN NOTES

PROJECT NO.	15-145
PROJECT NAME	Mainfreight Freezer, Christchurch
INSTALLER	WARMNZ
DATE	27/09/2016

These design notes shall provide guidance on obviously conflicting parameters. Please read them carefully.

	Parameter	Design Notes
System Details	Heat Source	Confirm if the supply temperature of 22°C for the floor circuits in heating mode suits to your energy source. Refer to page 'Performance Overview'.
System Details	Pipe Diameter	Pipe size 20mm chosen due to the design parameters, which have taken into consideration the flow and pressure loss of the system.
System Details	Anti Freeze	The calculation is based on a ratio of 30% anti-freeze in water. It has been assumed the anti-freeze will be Ethylene Glycol with corrosion inhibitor.
System Details	Anti Freeze	When selecting anti-freeze make sure it includes corrosion inhibitors and is suitable for all metal materials used in the installation, ie. brass, steel etc. Anti-freeze with corrosion inhibitors must be maintained regularly in accordance with manufacturer's instruction.
Manifold Details	Flow Temperature Control Components	Assure the required design supply temperature and flow rate can be provided directly from the heat source as no Flow Temperature Mixer Unit was specified.
Manifold Details	Flow Temperature Control Components	A Flow Temperature Mixer Unit is recommended. Please advise if the REHAU Mixer Unit is required as this has not been included in the Bill of Materials.
Manifold Details	Flow Temperature Control Components	Further Control Components may be required for this application, check the Bill of Material and confirm the included control components suit your requirements.
Floor Structure	Floor Structure	The floor structure has been assumed since there was insufficient information provided. Refer to section "Floor Structure" on page "Performance Overview" for details.
Control Details	Zone Control	Further Control Components may be required for this application, check the Bill of Material and confirm the included control components suit your requirements.
Performance Details	Required Output	The target output (heat load/cooling load) reflects the information provided by the requesting party. REHAU has not verified if it covers the load requirements of the building or of particular areas of the building. We recommend to verify the load requirements by conducting a heat load / cooling load calculation.

REHAU HYDRONIC SYSTEM
PERFORMANCE OVERVIEW - PROPOSED FINAL *



V.7.7

PROJECT NO.	15-145
PROJECT NAME	Mainfreight Freezer, Christchurch
INSTALLER	WARMNZ
DATE	27/09/2016
DESIGN BY	REHAU Design Team

Freezer (R=4.9 m².K/W)	N/A	N/A
Floor layer: L (mm)	Floor layer	L (mm)
Wear slab	150	N/A
Insulation 150mm	150	
Concrete Cover	50	
----- Pipe center -----	----	
Concrete Cover	75	
Sand	2000	

Pipe type	RAUTHERM S 20
Heating Flow temp	22 °C
Cooling Flow temp	NA °C

No. of zones	4
No. of circuits	16
Conditioned Area	806.0 m ²

Room Parameters								Heating Performance								Cooling performance												
Room(s)	Zone	Area m ²	Room Thermostat	Floor System	Floor type	Floor Covering	Pipe spacing mm	Temp above/inside °C	Temp below/outside °C	ΔT flow/return °C	Area flow rate L/min	Floor Surface Temp °C	Target Heat Output W/m ²	Heat output up W/m ²	Heat output down W/m ²	Percent Covered %	Total Slab Output W	Temp above/inside °C	Temp below/outside °C	ΔT flow/return °C	Area flow rate L/min	Floor Surface Temp °C	Target Cooling Output W/m ²	Cooling output up W/m ²	Cooling output down W/m ²	Percent Covered %	Total Slab Output W	
Freezer	1	102.0	None	Freezer	Slab on ground	None	400	-25.0	5.0	6.0	5.5	-24	9	9	11	101	2096											
Chiller A	2	102.0	None	Freezer	Slab on ground	None	400	-25.0	5.0	6.0	5.5	-24	9	9	11	101	2096											
Chiller B	3	102.0	None	Freezer	Slab on ground	None	400	-25.0	5.0	6.0	5.5	-24	9	9	11	101	2096											
ELA	4	500.0	None	Freezer	Slab on ground	None	400	-21.0	5.0	6.0	25.6	-20	8	8	11	103	9851											
																	16138											
		4	806.0														16138											

* This design and the associated data have been prepared in accordance with the information provided by the requesting party. Please check if the parameter suits to your project. For minimum insulation requirements for the floor refer to the Building Code of Australia / New Zealand Building Code. When considering to use Tacker sheet, please check that the thermal and physical properties (eg. compressive stress) suit to your project. The advice is based on experience and the most recent know how but does not represent any obligation on our part.

Explanatory Notes:

PIPE SPACING	Proposed pipe laying distance. Laying the pipes in a different spacing will influence the performance of the system.	TARGET HEAT/COOLING OUTPUT	Target Heat/Cooling output as per the information provided by the requesting party.
TEMPERATURE ABOVE/INSIDE	Target temperature for the conditioned area above the slab (typically "Room Temperature").	HEAT/COOLING OUTPUT UP	Heating/Cooling performance upwards in Watts per square meter.
TEMPERATURE BELOW/OUTSIDE	Temperature of the area below the slab (ie. ground temperature or room below).	HEAT/COOLING OUTPUT DOWN	Heating/Cooling performance downwards in Watts per square meter (in slab-on-ground constructions = "Downward losses")
ΔT FLOW/RETURN	Temperature difference between supply and return for the conditioned area.	PERCENT COVERED	Coverage of Target Heating/Cooling output in %
NO. OF CIRCUITS	Number of circuits required to cover the conditioned area.	TOTAL SLAB OUTPUT	Output (upwards + downwards) of the conditioned slab in Watts.
FLOOR SURFACE TEMPERATURE	Surface temperature of the finished floor.		

REHAU HYDRONIC SYSTEM

MANIFOLD VALVE SETTINGS - HYDRAULIC BALANCING



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	Project N°:	15-145					Project Name:	Mainfreight Freezer, Christchurch				Installer:	WARMNZ			
2	Manifold M1 - Ground Floor													Date	27/09/2016	
3	Circuit Fluid Properties				Circuit Pipe Details				Flow and Return Pipe				RESULTS - Manifold			
4	Heating Temperature	22.0	°C	Manifold Stainless HKV-D				Length	76 m			Number of circuits: 10				
5	Cooling Temperature	NA	°C	Pipe RAUTHERM S 20				Flow/Ret pipe	RAUTITAN Pink 40			Total Length of circuits: 1221 m				
6	Mean water temp	19.0	°C	Mixing Unit Details				Flow rate	1503 l/h			Total Flow: 1503 l/h				
7	% Ethylene Glycol	30.0	%					Type	None			v	0.6 m/s			Pressure Loss @ Manifold: 11.6 kPa
8	viscosity	0.0024	Pa.s	Supply t	22.0 °C			ΔP/r	22.0 kPa			Total pressure including F/R: 33.6 kPa				
9									%Fitting losses	20% (estimate)						
10	INPUT - Manifold							RESULTS - Floor Circuits								
11	<i>Note: ** pressure drop when valves fully open!</i>		Circuit length Σ	Flow		Velocity	Head Loss	Head Losses			Balancing					
12				Δp _{pipe}	Flow and Return Valves			Total Loss	Turn direction:							
13			v	v			Δp _{Flow/Return valves, full open}	Δp _{total**}		Closed => Open						
14	Circuit Name	No.	m	l/min	l/s	m/s	Pa/m	Pa	Pa	Pa	Pa	Kv	Turns			
15												m ³ /h				
16	Circuit	M1.1	124	2.5	0.042	0.211	79	9,808	1,699	11,507	1,820	1.13	2			
17	Circuit	M1.2	125	2.6	0.043	0.212	80	9,915	1,712	11,628	1,712	1.17	2 1/4			
18	Circuit	M1.3	122	2.5	0.042	0.207	76	9,304	1,634	10,938	2,324	0.98	1 2/4			
19	Circuit	M1.4	120	2.5	0.041	0.205	75	8,997	1,594	10,591	2,630	0.91	1 1/4			
20	Circuit	M1.5	119	2.4	0.041	0.202	73	8,737	1,559	10,296	2,891	0.86	1			
21	Circuit	M1.6	120	2.5	0.041	0.203	74	8,837	1,573	10,409	2,791	0.88	1			
22	Circuit	M1.7	121	2.5	0.041	0.205	75	9,079	1,604	10,683	2,549	0.93	1 1/4			
23	Circuit	M1.8	122	2.5	0.042	0.208	77	9,387	1,644	11,031	2,241	1.00	1 2/4			
24	Circuit	M1.9	124	2.5	0.042	0.211	79	9,744	1,690	11,435	1,883	1.11	2			
25	Circuit	M1.10	125	2.6	0.043	0.212	80	9,915	1,712	11,628	1,712	1.17	2 1/4			
26	Circuit	M1.11														
27	Circuit	M1.12														
28	Circuit	M1.13														
29	Circuit	M1.14														
30	Circuit	M1.15														
31	Circuit	M1.16														
32	Circuit	M1.17														
33	25.0															

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This design and the associated date have been prepared in accordance with the information provided by the requesting party.

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REHAU HYDRONIC SYSTEM

MANIFOLD VALVE SETTINGS - HYDRAULIC BALANCING



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	Project N°:	15-145					Project Name:	Mainfreight Freezer, Christchurch				Installer:	WARMNZ			
2	Manifold M2 - Ground Floor													Date	27/09/2016	
3	Circuit Fluid Properties				Circuit Pipe Details				Flow and Return Pipe				RESULTS - Manifold			
4	Heating Temperature	22.0	°C	Manifold Stainless HKV-D				Length	24 m			Number of circuits: 2				
5	Cooling Temperature	NA	°C	Pipe RAUTHERM S 20				Flow/Ret pipe	RAUTITAN Pink 25			Total Length of circuits: 248 m				
6	Mean water temp	19.0	°C	Mixing Unit Details				Flow rate	318 l/h			Total Flow: 318 l/h				
7	% Ethylene Glycol	30.0	%					Type	None			v	0.3 m/s			Pressure Loss @ Manifold: 12.9 kPa
8	viscosity	0.0024	Pa.s	Supply t	22.0 °C			ΔPf/r	4.6 kPa			Total pressure including F/L 17.5 kPa				
9									%Fitting losses	20% (estimate)						
10	INPUT - Manifold							RESULTS - Floor Circuits								
11	<i>Note: ** pressure drop when valves fully open!</i>		Circuit length	Flow		Velocity	Head Loss	Head Losses			Balancing					
12			Σ	v	v			Δp _{pipe}	Δp _{Flow/Return valves, full open}	Total Loss	Turn direction:					
13							Pa	Pa	Pa	Closed => Open						
14	Circuit Name	No.	m	l/min	l/s	m/s	Pa/m	Pa	Pa	Pa	Pa	Kv	Turns			
15												m ³ /h				
16	Circuit	M2.1	126	2.7	0.045	0.224	87	11,026	1,911	12,937	1,911	1.17	2 1/4			
17	Circuit	M2.2	122	2.6	0.043	0.216	82	9,951	1,771	11,722	2,986	0.90	1 1/4			
18	Circuit	M2.3														
19	Circuit	M2.4														
20	Circuit	M2.5														
21	Circuit	M2.6														
22	Circuit	M2.7														
23	Circuit	M2.8														
24	Circuit	M2.9														
25	Circuit	M2.10														
26	Circuit	M2.11														
27	Circuit	M2.12														
28	Circuit	M2.13														
29	Circuit	M2.14														
30	Circuit	M2.15														
31	Circuit	M2.16														
32	Circuit	M2.17														
33	5.3													CT ANZ / syd536		

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REHAU HYDRONIC SYSTEM

MANIFOLD VALVE SETTINGS - HYDRAULIC BALANCING



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	Project N°:	15-145					Project Name:	Mainfreight Freezer, Christchurch			Installer:	WARMNZ				
2	Manifold M3 - Ground Floor													Date	27/09/2016	
3	Circuit Fluid Properties				Circuit Pipe Details			Flow and Return Pipe			R E S U L T S - Manifold					
4	Heating Temperature	22.0	°C	Manifold Stainless HKV-D			Length	10 m		Number of circuits:					4	
5	Cooling Temperature	NA	°C	Pipe RAUTHERM S 20			Flow/Ret pipe	RAUTITAN Pink 25		Total Length of circuits:					519 m	
6	Mean water temp	19.0	°C	Mixing Unit Details			Flow rate	666 l/h		Total Flow:					666 l/h	
7	% Ethylene Glycol	30.0	%	Type None			v	0.7 m/s		Pressure Loss @ Manifold:					15.9 kPa	
8	viscosity	0.0024	Pa.s	Supply t 22.0 °C			ΔPf/r	6.8 kPa		Total pressure including F/L					22.6 kPa	
9							%Fitting losses	20% (estimate)								
10	I N P U T - Manifold							R E S U L T S - Floor Circuits								
11	<i>Note: ** pressure drop when valves fully open!</i>		Circuit length	Flow		Velocity	Head Loss	Head Losses			Balancing					
12			Σ	v	v			Pipe	Flow and Return Valves	Total Loss	Turn direction:					
13							Δp _{pipe}	Δp _{Flow/Return valves, full open}	Δp _{total**}	Closed => Open						
14	Circuit Name	No.	m	l/min	l/s	m/s	Pa/m	Pa	Pa	Pa	Pa	Kv	Turns			
15												m ³ /h				
16	Circuit	M3.1	126	2.7	0.045	0.224	87	11,026	1,911	12,937	4,840	0.74	3/4			
17	Circuit	M3.2	122	2.6	0.043	0.216	82	9,951	1,771	11,722	5,915	0.64	2/4			
18	Circuit	M3.3	137	2.9	0.049	0.242	100	13,631	2,235	15,866	2,235	1.17	2 1/4			
19	Circuit	M3.4	134	2.9	0.048	0.238	97	12,967	2,154	15,121	2,900	1.01	1 2/4			
20	Circuit	M3.5														
21	Circuit	M3.6														
22	Circuit	M3.7														
23	Circuit	M3.8														
24	Circuit	M3.9														
25	Circuit	M3.10														
26	Circuit	M3.11														
27	Circuit	M3.12														
28	Circuit	M3.13														
29	Circuit	M3.14														
30	Circuit	M3.15														
31	Circuit	M3.16														
32	Circuit	M3.17														
33														11.1	CT ANZ / syd536	

This design and the associated data have been prepared in accordance with the information provided by the requesting party.
The advice is based on experience and the most recent know how but does not represent any obligation on our part.

REHAU HYDRONIC SYSTEM

BILL OF MATERIAL - PROPOSED FINAL *



V.7.7

PROJECT NO. 15-145
 PROJECT NAME Mainfreight Freezer, Christchurch
 INSTALLER WARMNZ

Date 27/09/2016
 Department Construction

PROJECT OVERVIEW:

Project Type Commercial
 System in-slab
 Pipe RAUTHERM S 20
 Heat Source To be clarified
 Total output Heating 16.1 kW
 Cooling Source None
 Total output Cooling 0 kW
 Covered Floor Area 806 m²
 Number of Zones 4
 Number of manifolds 3
 Number of circuits 16
 Manifold type Stainless HKV-D
 Flow Temp. system None

Further details see page "Performance Overview"

Category	Sub Category	Product Description	Availability	Article Number	Units	Est. Qty	Order Quantity
Floor Systems	RAUTITAN Pink	Pipe 25 x 3.5 mm - 6m straight	Standard	136062-006	m	34	36
Floor Systems	RAUTITAN Pink	Pipe 40 x 5.5 mm - 6m straight	Standard	136082-006	m	76	78
Floor Systems	RAUTHERM S	Pipe 20 x 2.0 mm - 400m coil	Standard	139800-400	m	1988	2400
Floor Systems	Stainless Manifold	Stainless Steel Manifold 2-port	Standard	208021-003	ea	1	1
Floor Systems	Stainless Manifold	Stainless Steel Manifold 4-port	Standard	208041-003	ea	1	1
Floor Systems	Stainless Manifold	Stainless Steel Manifold 10-port	Standard	208101-003	ea	1	1
Floor Systems	Stainless Manifold	Ball valve set 1"	Standard	208122-001	ea	3	3
Floor Systems	Manifold	Manifold Stand	Lead Time	216636-001	ea	3	3
Accessories	Manifold	Manifold Union for RAUTHERM S 20 x 2.0 mm	Lead Time	250617-001	ea	34	34
Accessories	Conduit	Conduit for RAUTITAN Pipe 20 mm (yellow)	Standard	180262-050	m	64	100
Accessories	RAUTITAN Fittings	Polymer Profile Bend Bkt 90 Deg 20 mm	Standard	297892-001	ea	33	33
Accessories	RAUTHERM S Fittings	No. 1 Straight Coupler 20 x 2.0 mm	Lead Time	250317-002	ea	6	6
Accessories	RAUTHERM S Fittings	Compression Sleeve 20 x 2.0 mm	Lead Time	250307-002	ea	12	12

Further Hydronic Components that may be required*:

- Suitably sized energy source(s)
- Suitably sized supply and return pipe work from the energy source to the manifold(s)
- An external pump (check the internal energy source pump curve)
- Suitably sized expansion vessel
- Safety Valves and Isolating Valves
- Air Bleeding Valve
- Other

The above are only suggestions from REHAU and a proper design considering the whole hydraulic system is required to determine if the above material estimation will be sufficient to condition the space adequately.

Category	Sub Category	Product Description	Availability	Article Number	Units	Est. Qty	Order Quantity
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**This is an estimate only based on the information provided to us at the time of completing this proposal. The estimate assumes the building has sufficient thermal insulation to meet local building requirements, e.g. NZBC, BCA or BASIX, prior to the installation of the REHAU components. REHAU does not accept any liability for omissions of hydronic components, installation tools and accessories, or for any discrepancy in terms of quantity of materials (overestimate or underestimate) compared to the actual requirements. This material list terminates at the UFH manifold and may not include all components required to condition the space adequately. The amount and sizes for each article may change during the final design.*

Our verbal and written advice relating to technical applications and this quote is based on experience and is to the best of our knowledge correct but is given without obligation.

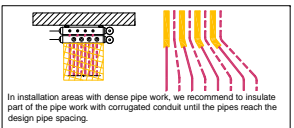
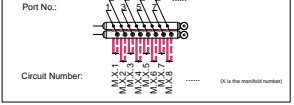
LAYING INSTRUCTIONS

Regardless of the graph indicated in this document, the minimum radius of curvature of the piping shall not be less than 5 x diameter.

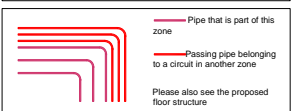
Ø 16 mm	min. 80 mm
Ø 20 mm	min. 100 mm
Ø 25 mm	min. 125 mm



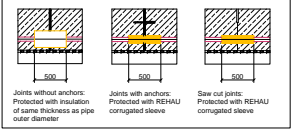
Typical Floor Structure: In-Slab
(general example only - not intended to satisfy the installation requirements for any particular project)



Note: Depending on the structural load a minimum distance between the pipes needs to be considered, refer to a structural engineer for further advice.



Only connecting lengths to and from floor loops are allowed to cross construction joints. Pipes which do cross joints must be protected as shown below



1. PIPE LAYING INSTRUCTIONS

- Check that the passages indicated in the table are open, i.e. free from obstacles or other obstructions.
- Check that the thickness of the available floor conforms to the drawing.
- In the areas near the manifolds, where the circuits' delivery and return pipes are concentrated, it is recommended to insulate the pipes alternating, so as to prevent any excessive heat emission, and subsequently any uneven floor temperature.
- The expansion joints must be installed in the positions and according to the instructions specified. For screed / topping slab applications a single bay is not recommended to exceed either 40 m² or a maximum side length of 10m.

2. PRESSURE TESTING

Once the plant piping has been laid, it is necessary to proceed with the hydraulic testing as follows:

PRESSURE TEST WITH WATER

- Close ball valves at circuit and visually check all connections
- Fill each ball at heating circuits individually one after another and deaerate system
- Apply test pressure: minimum 4 bar (400kPa), maximum 6 bar (600 kPa)
- Hold pressure for 2 hours, or the pressure may drop due to expansion of the pipe
- Test time 3 hours. The pressure test has been passed if water does not exit from any point of the pipeline and the test pressure has not dropped more than 0.1 bar (10kPa) per hour.

Warning:
A pressure drop may occur based on any temperature variations. The pressure is likely to change by approx. 1 bar in case of differences of +/- 10°C.

PRESSURE TEST WITH AIR

- Consult REHAU for further advice on pressure testing with air

On completion of the pressure test the pipe circuits can be covered with concrete/screed. Keep the system under operating pressure during pouring of the screed to detect any leaks straight away.

3. INITIAL WARM-UP

- In case of cement based screeds the initial warm-up must only be carried out after 21 days after laying (or as per manufacturer advice) to ensure the screed is correctly cured.
- In case of anhydrite screeds the warm up can be carried out after 7 days
- The initial warm-up comprises the following two stages:
- Stage 1: operating the system for at least 3 days with a water temperature of 20°C to 25°C
- Stage 2: increasing the water temperature to the max. design temperature and maintaining it for a minimum of 4 days
- It is recommended to document and record this test

NOTE: The initial warm-up must NEVER be used to accelerate the drying / curing of the concrete / screed mix.

4. PLANT START-UP

- Let the air out of the plant, and carefully fill circuit by circuit
- Install a drain pipe on the hose adapter and, after closing all circuits, fill a single circuit at a time, by opening the vented isolation valve.
- Repeat the same operation for all the other circuits.
- Set the regulator curve of the heating/cooling control station.
- Set the regulator curve of the heating/cooling control station.
- Perform the hydraulic balancing of the circuits.
- Start-up and operate the plant.

Manifold No.: M.1

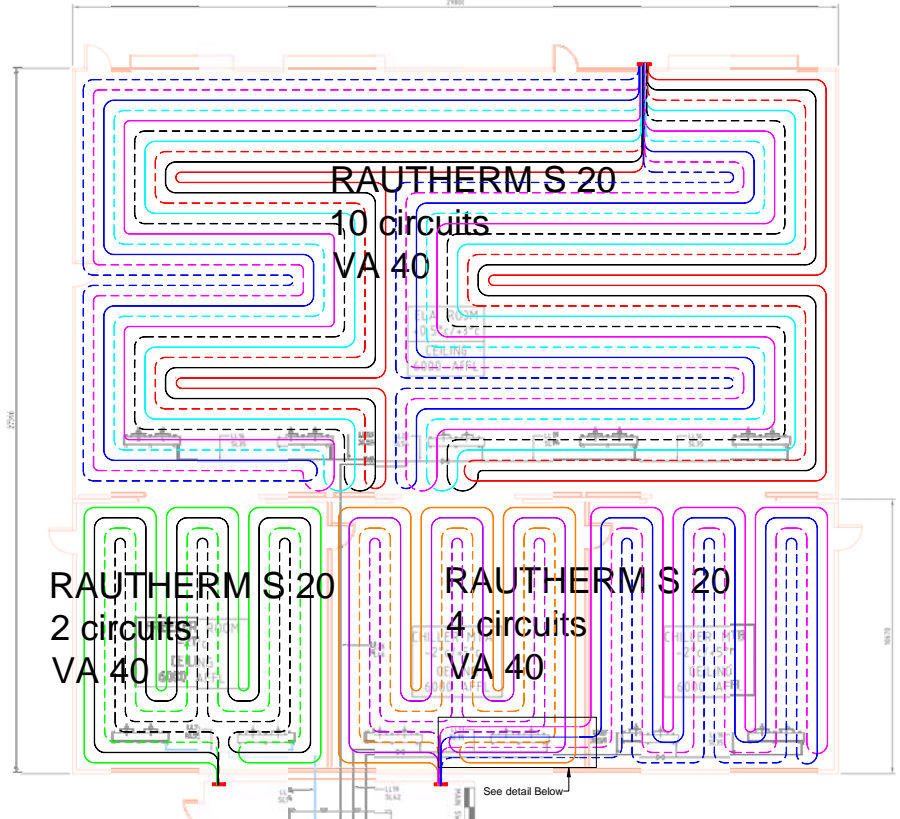
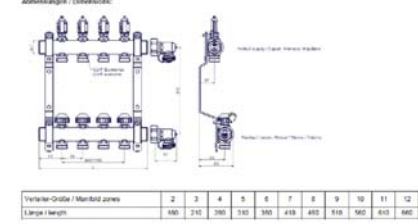
Stainless	Circuits pipe: RAUTHERM S 16x2.0	Total Flow Rate: 25.0 L/min	Pressure Loss: 11.6 KPa
Circuit No.:	Pipe Spacing: (mm)	Total Length: (m)	Flow Rate: (L/min)
M.1.1	400 mm	124	2.5
M.1.2	400 mm	125	2.6
M.1.3	400 mm	122	2.5
M.1.4	400 mm	120	2.5
M.1.5	400 mm	119	2.4
M.1.6	400 mm	120	2.5
M.1.7	400 mm	121	2.5
M.1.8	400 mm	122	2.5
M.1.9	400 mm	124	2.5
M.1.10	400 mm	125	2.6

Manifold No.: M.2

Stainless	Circuits pipe: RAUTHERM S 16x2.0	Total Flow Rate: 5.3 L/min	Pressure Loss: 12.9 KPa
Circuit No.:	Pipe Spacing: (mm)	Total Length: (m)	Flow Rate: (L/min)
M.2.1	400 mm	126	2.7
M.2.2	400 mm	122	2.6

Manifold No.: M.3

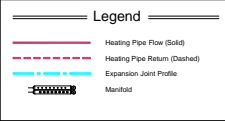
Stainless	Circuits pipe: RAUTHERM S 16x2.0	Total Flow Rate: 11.1 L/min	Pressure Loss: 15.9 KPa
Circuit No.:	Pipe Spacing: (mm)	Total Length: (m)	Flow Rate: (L/min)
M.3.1	400 mm	126	2.7
M.3.2	400 mm	122	2.6
M.3.3	400 mm	137	2.9
M.3.4	400 mm	134	2.9



IMPORTANT

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PROJECT TITLE

Mainfreight Freezer, Christchurch

DRAWING TITLE

UFH CIRCUIT LAYOUT

No.	DESCRIPTION	DATE
B	Manifold change	27/09/16
A	First Issue	21/09/16

ISSUES & REVISIONS

DRAWN BY	SCALE
D.P	A1 1:100
CHECKED BY	SHEET NO.
D.P	A13 1:300
APPROVED BY	DRAWING NO.
D.P	P1
DATE	21/09/16

DRAWING No:

RDC-ANZ-15-145