







	
DOC NUMBER: E-569-B7B-PRO-400-006		CLIENT NUMBER: PRD-MEC-CLC-006	
CLIENT: TAKEDA			
PROJECT BURITI EPCMV			

HEATING HOT WATER SYSTEM (HVAC) – CALCULATION REPORT

0	30JUL2021	ISSUED FOR CONSTRUCTION	MPA	LFF	MSS
C	07JUN2021	90 % DD ISSUE	MSN	CCO	MSS
B	16OCT2020	FINAL BD ISSUE	LID	LFF	MSS
A	27AUG2020	90% BD ISSUE	LID	LFF	MSS
RE	DATE	DESCRIPTION	EXEC	CHECK	APPROV

 		 	
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1. REVISION HISTORY

Rev	Reason For Change
A	90% BD ISSUE
B	FINAL BD ISSUE
C	REHEAT COIL UNIT'S FLOW RATES AND DIAMETERS HAVE BEEN UPDATED. AS WELL AS CALCULATIONS AND EQUIPMENT, ALL DATA WERE UPDATED ACCORDING TO HVAC EQUIPMENT LIST
0	REHEAT COIL UNIT'S FLOW RATES AND DIAMETERS HAVE BEEN UPDATED. AS WELL AS CALCULATIONS AND EQUIPMENT, ALL DATA WERE UPDATED ACCORDING TO HVAC EQUIPMENT LIST

2. PURPOSE

This document aims to establish the main characteristics for sizing the Heating Hot Water Distribution System for HVAC, Building 7B - Bulk Drug Substance – BDS, intended to Takeda unit - Buriti Project, located at Hemobrás' site in Goiana - Pernambuco state, Brazil.

3. REFERENCE

The following documents were used as reference:

Item	Number	Title
01	PRD-HVC-LIS-004	HVAC – LIST OF EQUIPMENTS

4. BASIC DATA AND PREMISES

The Heating Hot Water Distribution System for HVAC supply the Building 7B and this system includes centrifugal pumps (one in operation and one stand by) and Heat Exchanger.

For system sizing, the following conditions were considered:





- DESIGN CONDITION – Sizing Criterion for heating hot water skid, lines, valves and pumps - 100% of the capacity of all HVAC's equipment and an oversizing of 20%, where the excess of flowrate is diverted to a future expansion (tie-in).
- MAXIMUM OPERATING CONDITION –100% of the capacity of all HVAC's equipment operating at the same time.
- MINIMUM OPERATING CONDITION FOR THE HEATING HOT WATER SKID – 50% of the Reheat Coil Units capacities operating at the same time.
- MINIMUM OPERATING CONDITION FOR VALVES – 10% of the Reheat Coil Units capacities operating at the same time.

It was considered the installation of 1 Heat Exchanger with nominal capacity of 222 TR and an available pressure drop of 1.0 bar (side water).

It was estimated an available pressure drop of 0.5 bar for each HVAC equipment.

To guarantee a balancing and a good distribution, static balancing valves were considered throughout the system as indicated in the PID's.

Motorized pressure independent balancing and temperature control valves with on off control were used for diameters of $\frac{3}{4}$ ". For diameters from 1", were used the same valves with modulating control.

 		 	
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5. CALCULATION

5.1 FLOW RATES REQUIRED

The Heating Hot Water Distribution System for HVAC has the following consumers in the Building 7B:

- Design Condition

EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOWRATE (m³/h)	SIMULT. FLOWRATE (lpm)	SIMULT. FLOWRATE (kg/h)	NOTES
Reheat Coil	RH-B2056-1	Y	1.97	32.76	1,931.76	
Reheat Coil	RH-B2056-2	Y	1.97	32.76	1,931.76	
Reheat Coil	RH-B2029-1	Y	0.19	3.09	181.98	
Reheat Coil	RH-B2051-1	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2052-1	Y	0.06	0.95	55.99	
Reheat Coil	RH-B1023-1	Y	1.92	32.05	1,889.76	
Reheat Coil	RH-B2015-1	Y	0.26	4.27	251.97	
Reheat Coil	RH-B2021-1	Y	1.05	17.57	1,035.87	
Reheat Coil	RH-B2027-1	Y	0.31	5.22	307.96	
Reheat Coil	RH-B2028-1	Y	2.42	40.36	2,379.70	
Reheat Coil	RH-B2028-2	Y	2.42	40.36	2,379.70	
Reheat Coil	RH-B2030-1	Y	0.30	4.99	293.96	
Reheat Coil	RH-B2031-1	Y	0.30	4.99	293.96	
Reheat Coil	RH-B2037-1	Y	1.57	26.12	1,539.81	
Reheat Coil	RH-B2037-2	Y	1.57	26.12	1,539.81	
Reheat Coil	RH-B2050-1	Y	0.26	4.27	251.97	
Reheat Coil	RH-B2053-1	Y	0.68	11.40	671.92	
Reheat Coil	RH-B2057-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B1024-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B1025-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B2032-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2033-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2034-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2035-1	Y	0.34	5.70	335.96	
Reheat Coil	RH-B2036-1	Y	0.34	5.70	335.96	
Reheat Coil	RH-B2048-1	Y	3.14	52.41	3,089.75	
Reheat Coil	RH-B2048-2	Y	1.97	32.75	1,931.09	
Reheat Coil	RH-B2048-3	Y	1.47	24.57	1,448.32	
Reheat Coil	RH-B2048-4	Y	1.47	24.57	1,448.32	
Reheat Coil	RH-B2048-5	Y	0.88	14.74	868.99	
Reheat Coil	RH-B2054-1	Y	0.37	6.17	363.95	
Reheat Coil	RH-B2038-1	Y	0.17	2.87	168.97	
Reheat Coil	RH-B2039-1	Y	1.78	29.68	1,750.05	
Reheat Coil	RH-B2039-2	Y	1.60	26.71	1,575.05	
Reheat Coil	RH-B2039-3	Y	1.60	26.71	1,575.05	
Reheat Coil	RH-B2039-4	Y	2.14	35.62	2,100.06	

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EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOWRATE (m³/h)	SIMULT. FLOWRATE (lpm)	SIMULT. FLOWRATE (kg/h)	NOTES
Reheat Coil	RH-B2045-1	Y	0.57	9.50	559.93	
Reheat Coil	RH-B2040-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2041-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2042-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2043-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2044-1	Y	1.34	22.38	1,319.66	
Reheat Coil	RH-B2044-2	Y	0.67	11.19	659.71	
Reheat Coil	RH-B2047-1	Y	0.37	6.17	363.95	
Reheat Coil	RH-B2046-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B2008-1	Y	0.17	2.87	168.97	
Reheat Coil	RH-B2010-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2011-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2012-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2013-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2014-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2003-1	Y	0.14	2.37	139.98	
Reheat Coil	RH-B2004-1	Y	0.34	5.70	335.96	
Reheat Coil	RH-B2023-1	Y	0.19	3.09	181.98	
Reheat Coil	RH-B2024-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2025-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2026-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2001-1	Y	1.25	20.89	1,231.85	
Reheat Coil	RH-B2001-2	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2002-1	Y	0.46	7.60	447.94	
Reheat Coil	RH-B2016-1	Y	2.19	36.56	2,155.73	
Reheat Coil	RH-B2016-2	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2017-1	Y	0.28	4.75	279.97	
Reheat Coil	RH-B2018-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B2019-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B2020-1	Y	0.20	3.28	193.11	
Reheat Coil	RH-B1019-1	Y	0.27	4.42	260.70	
Reheat Coil	RH-B1021-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B1026-1	Y	0.17	2.85	167.98	
TOTAL		-	47.90	798.40	47,072.23	
Recirculation (BV)		Y	19.85	330.84	19,505.69	1
Tie-in		Y	13.23	220.42	12,995.78	2
TOTAL		Y	81.0	1,349.66	79,573.71	3





Notes:

- Flow rate through bypasses.
- Oversizing of 27%
- Total flow rate after the Heat Exchanger at 61.1°C – Due to the recirculation flow rate, software FATHOM calculated a return temperature of 52.7°C, resulting in a total volumetric flow rate for the pump of 80.66 m³/h. - Design Condition.

 		 	
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- Maximum Operating Condition





EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOWRATE (m³/h)	SIMULT. FLOWRATE (lpm)	SIMULT. FLOWRATE (kg/h)	NOTES
Reheat Coil	RH-B2056-1	Y	1.97	32.76	1,931.76	
Reheat Coil	RH-B2056-2	Y	1.97	32.76	1,931.76	
Reheat Coil	RH-B2029-1	Y	0.19	3.09	181.98	
Reheat Coil	RH-B2051-1	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2052-1	Y	0.06	0.95	55.99	
Reheat Coil	RH-B1023-1	Y	1.92	32.05	1,889.76	
Reheat Coil	RH-B2015-1	Y	0.26	4.27	251.97	
Reheat Coil	RH-B2021-1	Y	1.05	17.57	1,035.87	
Reheat Coil	RH-B2027-1	Y	0.31	5.22	307.96	
Reheat Coil	RH-B2028-1	Y	2.42	40.36	2,379.70	
Reheat Coil	RH-B2028-2	Y	2.42	40.36	2,379.70	
Reheat Coil	RH-B2030-1	Y	0.30	4.99	293.96	
Reheat Coil	RH-B2031-1	Y	0.30	4.99	293.96	
Reheat Coil	RH-B2037-1	Y	1.57	26.12	1,539.81	
Reheat Coil	RH-B2037-2	Y	1.57	26.12	1,539.81	
Reheat Coil	RH-B2050-1	Y	0.26	4.27	251.97	
Reheat Coil	RH-B2053-1	Y	0.68	11.40	671.92	
Reheat Coil	RH-B2057-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B1024-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B1025-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B2032-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2033-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2034-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2035-1	Y	0.34	5.70	335.96	
Reheat Coil	RH-B2036-1	Y	0.34	5.70	335.96	
Reheat Coil	RH-B2048-1	Y	3.14	52.41	3,089.75	
Reheat Coil	RH-B2048-2	Y	1.97	32.75	1,931.09	
Reheat Coil	RH-B2048-3	Y	1.47	24.57	1,448.32	
Reheat Coil	RH-B2048-4	Y	1.47	24.57	1,448.32	
Reheat Coil	RH-B2048-5	Y	0.88	14.74	868.99	
Reheat Coil	RH-B2054-1	Y	0.37	6.17	363.95	
Reheat Coil	RH-B2038-1	Y	0.17	2.87	168.97	
Reheat Coil	RH-B2039-1	Y	1.78	29.68	1,750.05	
Reheat Coil	RH-B2039-2	Y	1.60	26.71	1,575.05	
Reheat Coil	RH-B2039-3	Y	1.60	26.71	1,575.05	
Reheat Coil	RH-B2039-4	Y	2.14	35.62	2,100.06	
Reheat Coil	RH-B2045-1	Y	0.57	9.50	559.93	
Reheat Coil	RH-B2040-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2041-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2042-1	Y	0.23	3.80	223.97	

 		 	
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EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOWRATE (m³/h)	SIMULT. FLOWRATE (lpm)	SIMULT. FLOWRATE (kg/h)	NOTES
Reheat Coil	RH-B2043-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2044-1	Y	1.34	22.38	1,319.66	
Reheat Coil	RH-B2044-2	Y	0.67	11.19	659.71	
Reheat Coil	RH-B2047-1	Y	0.37	6.17	363.95	
Reheat Coil	RH-B2046-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B2008-1	Y	0.17	2.87	168.97	
Reheat Coil	RH-B2010-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2011-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2012-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2013-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2014-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2003-1	Y	0.14	2.37	139.98	
Reheat Coil	RH-B2004-1	Y	0.34	5.70	335.96	
Reheat Coil	RH-B2023-1	Y	0.19	3.09	181.98	
Reheat Coil	RH-B2024-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2025-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2026-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2001-1	Y	1.25	20.89	1,231.85	
Reheat Coil	RH-B2001-2	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2002-1	Y	0.46	7.60	447.94	
Reheat Coil	RH-B2016-1	Y	2.19	36.56	2,155.73	
Reheat Coil	RH-B2016-2	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2017-1	Y	0.28	4.75	279.97	
Reheat Coil	RH-B2018-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B2019-1	Y	0.20	3.32	195.98	
Reheat Coil	RH-B2020-1	Y	0.20	3.28	193.11	
Reheat Coil	RH-B1019-1	Y	0.27	4.42	260.70	
Reheat Coil	RH-B1021-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B1026-1	Y	0.17	2.85	167.98	
TOTAL		-	47.90	798.40	47,072.23	
Recirculation (BV)		Y	19.71	328.46	19,365.77	1
Tie-in		N	-	-	-	
TOTAL		-	67.61	1,126.86	66,438.00	2





Notes:

- Flow rate through bypasses.
- Total flow rate after the Heat Exchanger at 61,1°C – Due to the recirculation flow rate, software FATHOM calculated a return temperature of 53.23°C, resulting in a total volumetric flow rate for the pump of 67.36 m³/h. - Maximum Operating Condition

 		 	
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- Minimum Operating Condition for Valves (10% diversity)

EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOWRATE (m³/h)	SIMULT. FLOWRATE (lpm)	SIMULT. FLOWRATE (kg/h)	NOTES
Reheat Coil	RH-B2056-1	Y	0.20	3.28	193.18	
Reheat Coil	RH-B2056-2	Y	0.20	3.28	193.18	
Reheat Coil	RH-B2029-1	Y	0.02	0.31	18.20	
Reheat Coil	RH-B2051-1	Y	0.01	0.14	8.40	
Reheat Coil	RH-B2052-1	Y	0.01	0.09	5.60	
Reheat Coil	RH-B1023-1	Y	0.19	3.21	188.98	
Reheat Coil	RH-B2015-1	Y	0.03	0.43	25.20	
Reheat Coil	RH-B2021-1	Y	0.11	1.76	103.59	
Reheat Coil	RH-B2027-1	Y	0.03	0.52	30.80	
Reheat Coil	RH-B2028-1	Y	0.24	4.04	237.97	
Reheat Coil	RH-B2028-2	Y	0.24	4.04	237.97	
Reheat Coil	RH-B2030-1	Y	0.03	0.50	29.40	
Reheat Coil	RH-B2031-1	Y	0.03	0.50	29.40	
Reheat Coil	RH-B2037-1	Y	0.16	2.61	153.98	
Reheat Coil	RH-B2037-2	Y	0.16	2.61	153.98	
Reheat Coil	RH-B2050-1	Y	0.03	0.43	25.20	
Reheat Coil	RH-B2053-1	Y	0.07	1.14	67.19	
Reheat Coil	RH-B2057-1	Y	0.02	0.33	19.60	
Reheat Coil	RH-B1024-1	Y	0.02	0.33	19.60	
Reheat Coil	RH-B1025-1	Y	0.02	0.33	19.60	
Reheat Coil	RH-B2032-1	Y	0.02	0.38	22.40	
Reheat Coil	RH-B2033-1	Y	0.02	0.28	16.80	
Reheat Coil	RH-B2034-1	Y	0.02	0.28	16.80	
Reheat Coil	RH-B2035-1	Y	0.03	0.57	33.60	
Reheat Coil	RH-B2036-1	Y	0.03	0.57	33.60	
Reheat Coil	RH-B2048-1	Y	0.31	5.24	308.97	
Reheat Coil	RH-B2048-2	Y	0.20	3.28	193.11	
Reheat Coil	RH-B2048-3	Y	0.15	2.46	144.83	
Reheat Coil	RH-B2048-4	Y	0.15	2.46	144.83	
Reheat Coil	RH-B2048-5	Y	0.09	1.47	86.90	
Reheat Coil	RH-B2054-1	Y	0.04	0.62	36.40	
Reheat Coil	RH-B2038-1	Y	0.02	0.29	16.90	
Reheat Coil	RH-B2039-1	Y	0.18	2.97	175.01	
Reheat Coil	RH-B2039-2	Y	0.16	2.67	157.50	
Reheat Coil	RH-B2039-3	Y	0.16	2.67	157.50	
Reheat Coil	RH-B2039-4	Y	0.21	3.56	210.01	
Reheat Coil	RH-B2045-1	Y	0.06	0.95	55.99	
Reheat Coil	RH-B2040-1	Y	0.02	0.38	22.40	
Reheat Coil	RH-B2041-1	Y	0.02	0.28	16.80	
Reheat Coil	RH-B2042-1	Y	0.02	0.38	22.40	

 		 	
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EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOWRATE (m³/h)	SIMULT. FLOWRATE (lpm)	SIMULT. FLOWRATE (kg/h)	NOTES
Reheat Coil	RH-B2043-1	Y	0.02	0.28	16.80	
Reheat Coil	RH-B2044-1	Y	0.13	2.24	131.97	
Reheat Coil	RH-B2044-2	Y	0.07	1.12	65.97	
Reheat Coil	RH-B2047-1	Y	0.04	0.62	36.40	
Reheat Coil	RH-B2046-1	Y	0.02	0.33	19.60	
Reheat Coil	RH-B2008-1	Y	0.02	0.29	16.90	
Reheat Coil	RH-B2010-1	Y	0.02	0.28	16.80	
Reheat Coil	RH-B2011-1	Y	0.02	0.28	16.80	
Reheat Coil	RH-B2012-1	Y	0.02	0.38	22.40	
Reheat Coil	RH-B2013-1	Y	0.02	0.38	22.40	
Reheat Coil	RH-B2014-1	Y	0.02	0.28	16.80	
Reheat Coil	RH-B2003-1	Y	0.01	0.24	14.00	
Reheat Coil	RH-B2004-1	Y	0.03	0.57	33.60	
Reheat Coil	RH-B2023-1	Y	0.02	0.31	18.20	
Reheat Coil	RH-B2024-1	Y	0.02	0.38	22.40	
Reheat Coil	RH-B2025-1	Y	0.02	0.38	22.40	
Reheat Coil	RH-B2026-1	Y	0.02	0.28	16.80	
Reheat Coil	RH-B2001-1	Y	0.13	2.09	123.18	
Reheat Coil	RH-B2001-2	Y	0.02	0.28	16.80	
Reheat Coil	RH-B2002-1	Y	0.05	0.76	44.79	
Reheat Coil	RH-B2016-1	Y	0.22	3.66	215.57	
Reheat Coil	RH-B2016-2	Y	0.02	0.28	16.80	
Reheat Coil	RH-B2017-1	Y	0.03	0.47	28.00	
Reheat Coil	RH-B2018-1	Y	0.02	0.33	19.60	
Reheat Coil	RH-B2019-1	Y	0.02	0.33	19.60	
Reheat Coil	RH-B2020-1	Y	0.02	0.33	19.31	
Reheat Coil	RH-B1019-1	Y	0.03	0.44	26.07	
Reheat Coil	RH-B1021-1	Y	0.02	0.28	16.80	
Reheat Coil	RH-B1026-1	Y	0.02	0.28	16.80	
TOTAL		-	4.79	79.84	4,707.22	
Recirculation (BV)		Y	20.67	344.48	20,309.93	1
Tie-in		N	-	-	-	
TOTAL		-	25.46	424.32	25,017.16	2

Notes:

- Flow rate through bypasses.
- Total flow rate after the Heat Exchanger at 61,1°C – Due to the recirculation flow rate, software FATHOM calculated a return temperature of 59.02°C, resulting in a total volumetric flow rate for the pump of 25.43 m³/h. - Minimum Operating Condition.

- Minimum Operating Condition for Heating Hot Water Skid (50% diversity)

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EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOWRATE (m³/h)	SIMULT. FLOWRATE (lpm)	SIMULT. FLOWRATE (kg/h)	NOTES
Reheat Coil	RH-B2056-1	Y	0.98	16.38	965.88	
Reheat Coil	RH-B2056-2	Y	0.98	16.38	965.88	
Reheat Coil	RH-B2029-1	Y	0.09	1.54	90.99	
Reheat Coil	RH-B2051-1	Y	0.04	0.71	41.99	
Reheat Coil	RH-B2052-1	Y	0.03	0.47	28.00	
Reheat Coil	RH-B1023-1	Y	0.96	16.03	944.88	
Reheat Coil	RH-B2015-1	Y	0.13	2.14	125.98	
Reheat Coil	RH-B2021-1	Y	0.53	8.78	517.94	
Reheat Coil	RH-B2027-1	Y	0.16	2.61	153.98	
Reheat Coil	RH-B2028-1	Y	1.21	20.18	1,189.85	
Reheat Coil	RH-B2028-2	Y	1.21	20.18	1,189.85	
Reheat Coil	RH-B2030-1	Y	0.15	2.49	146.98	
Reheat Coil	RH-B2031-1	Y	0.15	2.49	146.98	
Reheat Coil	RH-B2037-1	Y	0.78	13.06	769.90	
Reheat Coil	RH-B2037-2	Y	0.78	13.06	769.90	
Reheat Coil	RH-B2050-1	Y	0.13	2.14	125.98	
Reheat Coil	RH-B2053-1	Y	0.34	5.70	335.96	
Reheat Coil	RH-B2057-1	Y	0.10	1.66	97.99	
Reheat Coil	RH-B1024-1	Y	0.10	1.66	97.99	
Reheat Coil	RH-B1025-1	Y	0.10	1.66	97.99	
Reheat Coil	RH-B2032-1	Y	0.11	1.90	111.99	
Reheat Coil	RH-B2033-1	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2034-1	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2035-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2036-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2048-1	Y	1.57	26.20	1,544.87	
Reheat Coil	RH-B2048-2	Y	0.98	16.38	965.55	
Reheat Coil	RH-B2048-3	Y	0.74	12.28	724.16	
Reheat Coil	RH-B2048-4	Y	0.74	12.28	724.16	
Reheat Coil	RH-B2048-5	Y	0.44	7.37	434.50	
Reheat Coil	RH-B2054-1	Y	0.19	3.09	181.98	
Reheat Coil	RH-B2038-1	Y	0.09	1.43	84.49	
Reheat Coil	RH-B2039-1	Y	0.89	14.84	875.03	
Reheat Coil	RH-B2039-2	Y	0.80	13.36	787.52	
Reheat Coil	RH-B2039-3	Y	0.80	13.36	787.52	
Reheat Coil	RH-B2039-4	Y	1.07	17.81	1,050.03	
Reheat Coil	RH-B2045-1	Y	0.28	4.75	279.97	
Reheat Coil	RH-B2040-1	Y	0.11	1.90	111.99	
Reheat Coil	RH-B2041-1	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2042-1	Y	0.11	1.90	111.99	
Reheat Coil	RH-B2043-1	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2044-1	Y	0.67	11.19	659.83	

 		 	
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EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOWRATE (m³/h)	SIMULT. FLOWRATE (lpm)	SIMULT. FLOWRATE (kg/h)	NOTES
Reheat Coil	RH-B2044-2	Y	0.34	5.59	329.85	
Reheat Coil	RH-B2047-1	Y	0.19	3.09	181.98	
Reheat Coil	RH-B2046-1	Y	0.10	1.66	97.99	
Reheat Coil	RH-B2008-1	Y	0.09	1.43	84.49	
Reheat Coil	RH-B2010-1	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2011-1	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2012-1	Y	0.11	1.90	111.99	
Reheat Coil	RH-B2013-1	Y	0.11	1.90	111.99	
Reheat Coil	RH-B2014-1	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2003-1	Y	0.07	1.19	69.99	
Reheat Coil	RH-B2004-1	Y	0.17	2.85	167.98	
Reheat Coil	RH-B2023-1	Y	0.09	1.54	90.99	
Reheat Coil	RH-B2024-1	Y	0.11	1.90	111.99	
Reheat Coil	RH-B2025-1	Y	0.11	1.90	111.99	
Reheat Coil	RH-B2026-1	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2001-1	Y	0.63	10.45	615.92	
Reheat Coil	RH-B2001-2	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2002-1	Y	0.23	3.80	223.97	
Reheat Coil	RH-B2016-1	Y	1.10	18.28	1,077.87	
Reheat Coil	RH-B2016-2	Y	0.09	1.42	83.99	
Reheat Coil	RH-B2017-1	Y	0.14	2.37	139.98	
Reheat Coil	RH-B2018-1	Y	0.10	1.66	97.99	
Reheat Coil	RH-B2019-1	Y	0.10	1.66	97.99	
Reheat Coil	RH-B2020-1	Y	0.10	1.64	96.55	
Reheat Coil	RH-B1019-1	Y	0.13	2.21	130.35	
Reheat Coil	RH-B1021-1	Y	0.09	1.42	83.99	
Reheat Coil	RH-B1026-1	Y	0.09	1.42	83.99	
TOTAL		-	23.95	399.20	23,536.12	
Recirculation (BV)		Y	20.34	338.96	19,984.31	1
Tie-in		N	-	-	-	
TOTAL		-	44.29	738.15	43,520.42	2

Notes:

- Flow rate through bypasses.
- Total flow rate after the Heat Exchanger at 61,1°C – Due to the recirculation flow rate, software FATHOM calculated a return temperature of 55.11°C, resulting in a total volumetric flow rate for the pump of 44.15 m³/h. - Minimum Operating Condition.

 		 	
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5.2 PUMPS

Based on the conditions above, the pumps for Heating Hot Water Skid to Building 7B (HX-7B-1) were sized for the following conditions:

Design Condition – Flowrate = 80.66 m³/h

Maximum Operating Condition = 67.36 m³/h

Minimum Operating Condition for Heating Hot Water Skid (50% diversity) = 44.15 m³/h

Minimum Operating Condition for Valves (10% diversity) = 25.43 m³/h

There are 2 pumps, where one is operating and the other in stand-by. They are controlled by the differential pressure transmitter PDIT-970001 maintaining constant the pressure drop of 1.596 bar at the main distribution header.

This instrument is installed at a distance of 2/3 of the main distribution pipe total length, to guarantee a good control.

The results of the pumps calculated are indicated in Item 6.3 of this document.





5.3 FLOW RATES REQUIRED FOR BALANCING VALVES

To ensure the correct flow distribution in the installation, the following balancing valves were installed.

5.3.1 By-pass at the end of the header distribution

It was considered 19.9 m³/h for hot water recirculation. This flow rate will be guaranteed by using 19 manual static balancing valves in the by-pass as below:

Item	Descrição	Vazão Volum.		Pressão Entrada	Pressão Saída	ΔP	Cv	KV
		(m ³ /h)	(LPM)	(barG)	(barG)	(bar)	(Calculated)	(Calculated)
500	BV-970005	1.00	16.67	1.48	0.93	15.67	310.03	0.81
501	BV-9700111	1.00	16.67	1.57	0.99	14.03	277.49	0.85
502	BV-970099	1.00	16.67	1.52	0.95	14.98	296.37	0.83
503	BV-970087	1.00	16.67	1.57	0.99	14.02	277.43	0.85
504	BV-9700473	1.00	16.67	1.54	0.96	14.91	294.96	0.83
505	BV-9700441	1.00	16.67	1.51	0.92	15.95	873.05	0.80
506	BV-9700443	1.00	16.67	1.48	0.92	16.04	317.24	0.80
507	BV-9700445	1.00	16.67	1.52	0.95	15.01	296.83	0.82
508	BV-970009	1.00	16.67	1.48	0.94	15.48	306.30	0.81
509	BV-9700447	1.00	16.67	1.55	0.99	14.01	277.16	0.85
510	BV-9700455	1.00	16.67	1.49	0.94	15.44	305.39	0.81
511	BV-970057	1.00	16.67	1.71	1.10	11.28	223.06	0.95
512	BV-9700467	1.00	16.67	1.70	1.09	11.46	226.68	0.94
513	BV-9700457	1.00	16.67	1.64	1.03	12.84	253.98	0.89
514	BV-9700551	1.00	16.67	1.76	1.13	10.74	212.46	0.97

 		 	
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Item	Descrição	Vazão Volum.		Pressão Entrada	Pressão Saída	ΔP	Cv	KV
		(m³/h)	(LPM)	(barG)	(barG)	(bar)	(Calculated)	(Calculated)
515	BV-970037	1.00	16.67	1.67	1.06	12.14	240.24	0.92
516	BV-970003	1.00	16.67	2.21	0.90	16.72	330.85	0.78
517	BV-9700123	1.00	16.67	2.28	0.94	15.44	305.52	0.81
518	BV-970001	1.85	30.83	1.55	1.81	14.27	228.20	1.56
TOTAL		19.9	330.8	-	-	-	-	-

5.3.2 Balancing valves installed at the beginning of the distribution headers

Throughout the system, 13 static balancing valves in the distribution headers was considered to guarantee the correct water distribution. as shown in the table below:

Item	Descrição	Vazão Volum.		Pressão Entrada	Pressão Saída	ΔP	Cv	KV
		(m³/h)	(LPM)	(barG)	(barG)	(bar)	(Calculated)	(Calculated)
384	BV-9700533	6.76	112.72	2.87	37.34	0.45	3.23	32.30
400	BV-9700543	4.38	73.07	2.88	22.31	0.53	9.05	19.30
445	BV-9700541	6.04	100.62	2.81	37.34	0.36	3.23	32.30
494	BV-9700544	8.26	137.63	2.86	60.12	0.26	3.48	52.00
547	BV-9700536	3.18	52.99	2.89	22.20	0.28	9.15	19.20
581	BV-9700532	3.93	65.49	3.73	22.20	0.43	9.15	19.20
600	BV-9700534	4.30	71.61	2.97	22.20	0.51	9.15	19.20
603	BV-9700535	2.68	44.68	2.94	16.42	0.36	2.77	14.20
620	BV-9700538	13.19	219.88	2.99	85.00	0.33	2.25	73.52
621	BV-9700537	5.60	93.36	2.92	37.34	0.31	3.23	32.30
624	BV-9700540	1.63	27.11	2.83	9.93	0.37	7.57	8.59
625	BV-9700542	1.57	26.16	2.76	9.93	0.34	7.57	8.59
626	BV-9700539	1.56	25.93	2.86	9.93	0.33	7.57	8.59

5.3.3 Temperature Control Valves

Motorized pressure independent balancing and temperature control valves with on off control were used for diameters of ¾". For diameters starting in 1". were used the same valves with modulating control.

Based on the simulations attached (Item 6) these valves will have the following conditions:

a) Design Condition

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Item	Descrição	Vazão Volum.		Pressão Entrada (barG)	Pressão Saída (barG)	ΔP (bar)	Cv (Calculated)	KV (Calculated)
		(m³/h)	(LPM)					
13	TV-9700547	2.41	40.14	1.38	2.48	12.90	735.02	2.14
15	TV-970016	0.17	2.83	1.49	0.19	11.29	7731.45	0.16
17	TV-970012	0.23	3.78	1.48	0.25	11.46	4414.51	0.21
19	TV-970018	0.23	3.78	1.50	0.26	10.66	4103.38	0.22
21	TV-970014	0.18	3.07	1.51	0.21	10.44	6090.41	0.18
23	TV-970026	0.14	2.36	1.53	0.16	10.29	10138.13	0.14
25	TV-970024	0.34	5.67	1.50	0.39	10.52	1800.43	0.33
27	TV-970042	0.17	2.83	1.60	0.21	8.98	6147.42	0.18
29	TV-970046	0.23	3.78	1.63	0.29	8.42	3243.50	0.25
31	TV-970040	0.23	3.78	1.64	0.29	8.23	3170.18	0.25
33	TV-970044	0.17	2.83	1.65	0.22	8.05	5508.73	0.19
34	TV-9700460	0.18	3.07	1.61	0.23	8.44	4924.64	0.20
37	TV-970054	0.17	2.85	1.66	0.23	7.62	5154.65	0.20
39	TV-970052	0.17	2.83	1.68	0.23	7.37	5046.22	0.20
41	TV-9700464	1.96	32.58	1.87	3.33	4.69	67.23	2.88
43	TV-9700530	1.96	32.58	1.88	3.74	3.73	53.45	3.23
44	TV-970025	0.17	2.83	1.71	0.24	6.75	4623.28	0.21
46	TV-970066	0.23	3.78	1.70	0.32	6.93	2668.36	0.28
48	TV-970064	0.17	2.83	1.68	0.23	7.25	4959.69	0.20
51	TV-970060	0.23	3.78	1.63	0.29	8.05	3101.01	0.26
53	TV-970068	1.34	22.26	1.68	1.84	7.19	220.51	1.59
55	TV-9700470	0.67	11.13	1.68	0.92	7.15	317.13	0.80
57	TV-970074	0.20	3.31	1.70	0.28	6.80	3419.52	0.24
59	TV-970072	0.37	6.14	1.73	0.54	6.35	926.19	0.47
61	TV-9700472	0.09	1.42	1.72	0.12	6.51	17825.97	0.11
63	TV-970070	0.57	9.44	1.72	0.83	6.29	387.46	0.72
65	TV-970036	1.77	29.52	1.49	2.00	10.69	1126.16	1.73
67	TV-9700454	1.59	26.57	1.50	1.81	10.61	1379.34	1.56
69	TV-970048	0.26	4.25	1.48	0.29	10.47	3184.64	0.25
71	TV-970032	0.20	3.31	1.54	0.24	9.59	4823.15	0.20
73	TV-9700452	2.13	35.42	1.57	2.60	9.11	666.03	2.25
75	TV-9700450	1.59	26.57	1.56	1.92	9.36	1217.11	1.66
77	TV-970030	1.56	25.97	1.52	1.84	9.84	1338.11	1.59
79	TV-970028	0.34	5.67	1.44	0.36	11.87	2032.04	0.32
81	TV-9700438	1.95	32.57	1.53	2.20	10.79	933.45	1.90
83	TV-970008	0.34	5.67	1.43	0.36	12.00	2054.06	0.31
85	TV-970084	3.13	52.12	1.48	3.45	11.18	377.79	2.99

 		 	
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Item	Descrição	Vazão Volum.		Pressão Entrada (barG)	Pressão Saída (barG)	ΔP (bar)	Cv (Calculated)	KV (Calculated)
		(m³/h)	(LPM)					
87	TV-9700432	0.88	14.66	1.52	1.01	10.42	266.42	0.87
89	TV-9700436	1.47	24.43	1.56	1.75	9.62	245.00	1.51
91	TV-970082	0.17	2.83	1.36	0.17	13.04	8925.04	0.15
93	TV-970080	0.17	2.83	1.40	0.18	12.64	8651.39	0.15
95	TV-970078	0.23	3.78	1.42	0.24	12.21	4702.45	0.21
97	TV-9700104	0.30	4.96	1.51	0.34	10.56	2360.98	0.29
99	TV-9700478	0.20	3.31	1.52	0.23	10.36	5211.95	0.20
101	TV-970086	0.37	6.14	1.53	0.43	10.12	1476.13	0.37
103	TV-9700109	0.68	11.33	1.54	0.81	9.73	416.22	0.70
105	TV-9700462	0.06	0.94	1.52	0.07	10.36	63819.67	0.06
107	TV-9700106	0.26	4.25	1.52	0.29	10.32	3140.18	0.25
109	TV-9700114	0.31	5.19	1.52	0.36	10.40	2118.44	0.31
111	TV-970034	2.41	40.14	1.49	2.69	10.96	624.54	2.32
113	TV-9700102	0.30	4.96	1.52	0.34	10.33	2309.42	0.30
115	TV-9700116	0.28	4.72	1.54	0.33	10.18	2507.95	0.28
117	TV-9700120	0.20	3.31	1.54	0.23	10.01	5032.52	0.20
119	TV-9700118	0.20	3.31	1.54	0.23	10.02	5036.62	0.20
121	TV-970098	1.25	20.78	1.58	1.52	9.14	321.98	1.32
123	TV-970094	1.05	17.47	1.54	1.24	9.73	484.54	1.07
125	TV-9700476	0.17	2.83	1.57	0.20	9.42	6446.64	0.18
127	TV-970096	0.45	7.56	1.58	0.55	9.20	2450.61	0.48
129	TV-9700466	0.26	4.40	2.26	0.29	11.09	3151.22	0.25
131	TV-9700126	0.17	2.83	2.27	0.19	11.01	7534.28	0.16
133	TV-9700130	0.20	3.31	2.28	0.22	10.81	5438.18	0.19
135	TV-9700134	0.17	2.83	2.29	0.19	10.66	7295.29	0.17
137	TV-9700132	0.20	3.31	2.29	0.22	10.62	5339.03	0.19
139	TV-9700128	1.91	31.88	2.29	2.16	10.65	962.31	1.87
141	TV-9700424	1.47	24.43	1.52	1.67	10.48	266.93	1.45
143	TV-970092	0.20	3.26	1.35	0.21	11.68	6049.99	0.18
145	TV-9700440	1.56	25.97	1.54	1.75	10.77	1465.76	1.52
147	TV-9700122	2.18	36.36	1.57	2.61	9.53	661.78	2.26
149	TV-9700464	0.17	2.83	1.57	0.20	9.55	6533.99	0.18

b) Maximum Operating Condition

Item	Descrição	Vazão Volum.		Pressão Entrada (barG)	Pressão Saída (barG)	ΔP (bar)	Cv (Calculated)	KV (Calculated)
		(m³/h)	(LPM)					
13	TV-9700547	2.41	40.14	2.62	1.36	1.25	2.47	2.14

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Item	Descrição	Vazão Volum.		Pressão Entrada (barG)	Pressão Saída (barG)	ΔP (bar)	Cv (Calculated)	KV (Calculated)
		(m ³ /h)	(LPM)					
15	TV-970016	0.17	2.83	2.57	1.47	1.10	0.19	0.16
17	TV-970012	0.23	3.78	2.57	1.46	1.11	0.25	0.21
19	TV-970018	0.23	3.78	2.52	1.49	1.04	0.26	0.22
21	TV-970014	0.18	3.07	2.51	1.50	1.02	0.21	0.18
23	TV-970026	0.14	2.36	2.51	1.51	1.00	0.16	0.14
25	TV-970024	0.34	5.67	2.50	1.48	1.02	0.39	0.33
27	TV-970042	0.17	2.83	2.46	1.58	0.87	0.21	0.18
29	TV-970046	0.23	3.78	2.43	1.61	0.82	0.29	0.25
31	TV-970040	0.23	3.78	2.43	1.62	0.80	0.29	0.25
33	TV-970044	0.17	2.83	2.42	1.63	0.78	0.22	0.19
34	TV-9700460	0.18	3.07	2.42	1.60	0.82	0.23	0.20
37	TV-970054	0.17	2.85	2.38	1.64	0.74	0.23	0.20
39	TV-970052	0.17	2.83	2.38	1.67	0.72	0.23	0.20
41	TV-9700464	1.96	32.58	2.31	1.85	0.46	3.32	2.87
43	TV-9700530	1.96	32.58	2.23	1.86	0.37	3.72	3.21
44	TV-970025	0.17	2.83	2.35	1.69	0.66	0.24	0.21
46	TV-970066	0.23	3.78	2.36	1.68	0.67	0.32	0.27
48	TV-970064	0.17	2.83	2.37	1.67	0.71	0.23	0.20
51	TV-970060	0.23	3.78	2.39	1.61	0.78	0.29	0.25
53	TV-970068	1.34	22.26	2.36	1.66	0.70	1.84	1.59
55	TV-9700470	0.67	11.13	2.36	1.67	0.70	0.92	0.80
57	TV-970074	0.20	3.31	2.34	1.68	0.66	0.28	0.24
59	TV-970072	0.37	6.14	2.33	1.71	0.62	0.54	0.47
61	TV-9700472	0.09	1.42	2.34	1.70	0.63	0.12	0.11
63	TV-970070	0.57	9.44	2.32	1.71	0.61	0.83	0.72
65	TV-970036	1.77	29.52	2.51	1.47	1.04	2.00	1.73
67	TV-9700454	1.59	26.57	2.51	1.48	1.03	1.80	1.56
69	TV-970048	0.26	4.25	2.49	1.47	1.02	0.29	0.25
71	TV-970032	0.20	3.31	2.46	1.53	0.93	0.24	0.20
73	TV-9700452	2.13	35.42	2.44	1.55	0.89	2.60	2.25
75	TV-9700450	1.59	26.57	2.45	1.54	0.91	1.92	1.66
77	TV-970030	1.56	25.97	2.46	1.51	0.96	1.83	1.58
79	TV-970028	0.34	5.67	2.58	1.43	1.15	0.36	0.31
81	TV-9700438	1.95	32.57	2.57	1.52	1.05	2.19	1.90
83	TV-970008	0.34	5.67	2.58	1.42	1.17	0.36	0.31
85	TV-970084	3.13	52.12	2.55	1.46	1.09	3.45	2.98
87	TV-9700432	0.88	14.66	2.52	1.50	1.01	1.00	0.87
89	TV-9700436	1.47	24.43	2.48	1.55	0.94	1.74	1.51
91	TV-970082	0.17	2.83	2.61	1.35	1.27	0.17	0.15
93	TV-970080	0.17	2.83	2.61	1.39	1.23	0.18	0.15

 		 	
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Item	Descrição	Vazão Volum.		Pressão Entrada (barG)	Pressão Saída (barG)	ΔP (bar)	Cv (Calculated)	KV (Calculated)
		(m³/h)	(LPM)					
95	TV-970078	0.23	3.78	2.59	1.41	1.19	0.24	0.21
97	TV-9700104	0.30	4.96	2.52	1.50	1.03	0.34	0.29
99	TV-9700478	0.20	3.31	2.51	1.50	1.01	0.23	0.20
101	TV-970086	0.37	6.14	2.50	1.51	0.98	0.43	0.37
103	TV-9700109	0.68	11.33	2.47	1.53	0.95	0.80	0.69
105	TV-9700462	0.06	0.94	2.51	1.50	1.01	0.06	0.06
107	TV-9700106	0.26	4.25	2.51	1.50	1.00	0.29	0.25
109	TV-9700114	0.31	5.19	2.51	1.50	1.01	0.36	0.31
111	TV-970034	2.41	40.14	2.54	1.47	1.07	2.68	2.32
113	TV-9700102	0.30	4.96	2.51	1.51	1.00	0.34	0.30
115	TV-9700116	0.28	4.72	2.51	1.52	0.99	0.33	0.28
117	TV-9700120	0.20	3.31	2.50	1.52	0.97	0.23	0.20
119	TV-9700118	0.20	3.31	2.50	1.53	0.97	0.23	0.20
121	TV-970098	1.25	20.78	2.45	1.56	0.89	1.52	1.31
123	TV-970094	1.05	17.47	2.47	1.53	0.95	1.24	1.07
125	TV-9700476	0.17	2.83	2.47	1.55	0.92	0.20	0.18
127	TV-970096	0.45	7.56	2.46	1.56	0.90	0.55	0.48
129	TV-9700466	0.26	4.40	3.32	2.24	1.08	0.29	0.25
131	TV-9700126	0.17	2.83	3.32	2.25	1.07	0.19	0.16
133	TV-9700130	0.20	3.31	3.31	2.26	1.05	0.22	0.19
135	TV-9700134	0.17	2.83	3.31	2.27	1.04	0.19	0.17
137	TV-9700132	0.20	3.31	3.30	2.27	1.03	0.22	0.19
139	TV-9700128	1.91	31.88	3.31	2.27	1.04	2.16	1.87
141	TV-9700424	1.47	24.43	2.52	1.50	1.02	1.67	1.44
143	TV-970092	0.20	3.26	2.47	1.34	1.14	0.21	0.18
145	TV-9700440	1.56	25.97	2.57	1.52	1.05	1.75	1.51
147	TV-9700122	2.18	36.36	2.48	1.55	0.93	2.60	2.25
149	TV-9700464	0.17	2.83	2.48	1.55	0.93	0.20	0.18

a) Minimum Operating Condition For Valves (10% diversity)

Item	Descrição	Vazão Volum.		Pressão Entrada (barG)	Pressão Saída (barG)	ΔP (bar)	Cv (Calculated)	KV (Calculated)
		(m³/h)	(LPM)					
13	TV-9700547	0.24	4.01	2.37	1.24	1.13	0.26	0.22
15	TV-970016	0.02	0.28	2.37	1.31	1.06	0.02	0.02
17	TV-970012	0.02	0.38	2.37	1.31	1.07	0.03	0.02
19	TV-970018	0.02	0.38	2.35	1.32	1.03	0.03	0.02
21	TV-970014	0.02	0.31	2.34	1.32	1.02	0.02	0.02

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Item	Descrição	Vazão Volum.		Pressão Entrada (barG)	Pressão Saída (barG)	ΔP (bar)	Cv (Calculated)	KV (Calculated)
		(m ³ /h)	(LPM)					
23	TV-970026	0.01	0.24	2.34	1.34	1.00	0.02	0.01
25	TV-970024	0.03	0.57	2.32	1.31	1.02	0.04	0.03
27	TV-970042	0.02	0.28	2.35	1.31	1.04	0.02	0.02
29	TV-970046	0.02	0.38	2.35	1.34	1.01	0.03	0.02
31	TV-970040	0.02	0.38	2.34	1.35	1.00	0.03	0.02
33	TV-970044	0.02	0.28	2.33	1.35	0.98	0.02	0.02
34	TV-9700460	0.02	0.31	2.34	1.31	1.03	0.02	0.02
37	TV-970054	0.02	0.29	2.33	1.32	1.01	0.02	0.02
39	TV-970052	0.02	0.28	2.33	1.33	1.00	0.02	0.02
41	TV-9700464	0.20	3.26	2.36	1.36	0.99	0.23	0.20
43	TV-9700530	0.20	3.26	2.36	1.37	0.99	0.23	0.20
44	TV-970025	0.02	0.28	2.32	1.38	0.93	0.02	0.02
46	TV-970066	0.02	0.38	2.32	1.37	0.95	0.03	0.02
48	TV-970064	0.02	0.28	2.33	1.36	0.97	0.02	0.02
51	TV-970060	0.02	0.38	2.33	1.32	1.02	0.03	0.02
53	TV-970068	0.13	2.23	2.33	1.33	1.01	0.15	0.13
55	TV-9700470	0.07	1.11	2.33	1.33	1.01	0.08	0.07
57	TV-970074	0.02	0.33	2.31	1.33	0.98	0.02	0.02
59	TV-970072	0.04	0.61	2.31	1.34	0.97	0.04	0.04
61	TV-9700472	0.01	0.14	2.30	1.33	0.97	0.01	0.01
63	TV-970070	0.06	0.94	2.32	1.34	0.97	0.07	0.06
65	TV-970036	0.18	2.95	2.38	1.28	1.10	0.19	0.17
67	TV-9700454	0.16	2.66	2.38	1.28	1.10	0.17	0.15
69	TV-970048	0.03	0.43	2.38	1.27	1.11	0.03	0.02
71	TV-970032	0.02	0.33	2.38	1.28	1.10	0.02	0.02
73	TV-9700452	0.21	3.54	2.38	1.28	1.09	0.23	0.20
75	TV-9700450	0.16	2.66	2.38	1.28	1.10	0.17	0.15
77	TV-970030	0.16	2.60	2.38	1.28	1.10	0.17	0.15
79	TV-970028	0.03	0.57	2.40	1.27	1.13	0.04	0.03
81	TV-9700438	0.20	3.26	2.42	1.30	1.12	0.21	0.18
83	TV-970008	0.03	0.57	2.40	1.27	1.13	0.04	0.03
85	TV-970084	0.31	5.21	2.39	1.27	1.12	0.34	0.29
87	TV-9700432	0.09	1.47	2.39	1.27	1.12	0.10	0.08
89	TV-9700436	0.15	2.44	2.38	1.28	1.10	0.16	0.14
91	TV-970082	0.02	0.28	2.36	1.23	1.14	0.02	0.02
93	TV-970080	0.02	0.28	2.37	1.24	1.13	0.02	0.02
95	TV-970078	0.02	0.38	2.37	1.24	1.13	0.02	0.02
97	TV-9700104	0.03	0.50	2.38	1.28	1.10	0.03	0.03
99	TV-9700478	0.02	0.33	2.38	1.28	1.10	0.02	0.02
101	TV-970086	0.04	0.61	2.38	1.28	1.10	0.04	0.03

 		 	
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Item	Descrição	Vazão Volum.		Pressão Entrada (barG)	Pressão Saída (barG)	ΔP (bar)	Cv (Calculated)	KV (Calculated)
		(m³/h)	(LPM)					
103	TV-9700109	0.07	1.13	2.37	1.28	1.09	0.07	0.06
105	TV-9700462	0.01	0.09	2.38	1.28	1.10	0.01	0.01
107	TV-9700106	0.03	0.43	2.38	1.28	1.10	0.03	0.02
109	TV-9700114	0.03	0.52	2.38	1.28	1.10	0.03	0.03
111	TV-970034	0.24	4.01	2.36	1.25	1.11	0.26	0.23
113	TV-9700102	0.03	0.50	2.39	1.28	1.11	0.03	0.03
115	TV-9700116	0.03	0.47	2.39	1.28	1.11	0.03	0.03
117	TV-9700120	0.02	0.33	2.38	1.28	1.10	0.02	0.02
119	TV-9700118	0.02	0.33	2.38	1.28	1.10	0.02	0.02
121	TV-970098	0.12	2.08	2.38	1.28	1.10	0.14	0.12
123	TV-970094	0.10	1.75	2.37	1.29	1.08	0.12	0.10
125	TV-9700476	0.02	0.28	2.35	1.29	1.05	0.02	0.02
127	TV-970096	0.05	0.76	2.35	1.31	1.04	0.05	0.04
129	TV-9700466	0.03	0.44	3.15	2.07	1.09	0.03	0.03
131	TV-9700126	0.02	0.28	3.15	2.07	1.09	0.02	0.02
133	TV-9700130	0.02	0.33	3.15	2.07	1.08	0.02	0.02
135	TV-9700134	0.02	0.28	3.14	2.06	1.08	0.02	0.02
137	TV-9700132	0.02	0.33	3.14	2.07	1.08	0.02	0.02
139	TV-9700128	0.19	3.19	3.15	2.07	1.08	0.21	0.18
141	TV-9700424	0.15	2.44	2.39	1.27	1.12	0.16	0.14
143	TV-970092	0.02	0.33	2.27	1.15	1.12	0.02	0.02
145	TV-9700440	0.16	2.60	2.42	1.30	1.12	0.17	0.15
147	TV-9700122	0.22	3.64	2.38	1.28	1.10	0.24	0.21
149	TV-9700464	0.02	0.28	2.38	1.28	1.10	0.02	0.02





5.4 HEATING HOT WATER SKID

The utility used to heat the water is steam saturated at 2.0 bar(g) at the steam nozzle – inlet skid.

The skid needs to have a temperature control valve to be controlled by the TIC-970001. keeping the water temperature outlet of 61.1°C. For this temperature control valve (TV-970001) was considered a pressure drop of 0.5 bar(g) for the design condition. The heat exchanger shall be sized to operate with 1.5 bar(g) at the inlet nozzle.

Therefore. for the heat exchanger sizing. the following characteristics of industrial steam were considered:

Fluid: Plant Steam
Operating Pressure: 1.5 bar(g)
Enthalpy of Vaporization: 520.70 kcal/kg
Temperature: 166°C
Enthalpy: 668.31 kcal/kg

 		 	
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According to calculations carried out. the heat exchanger of heating hot water skid shall be sized for following conditions indicated below.

5.4.1 Design Condition

HEAT EXCHANGER - HX-7B-1		
SIDE - WATER		
Thermal Load	666,541.52	kcal/h
Flow rate	79,598.45	kg/h
Temperature Inlet	52.73	°C
Temperature Outlet	61.1	°C
SIDE - PLANT STEAM		
Operating Pressure	1.5	barG
Enthalpy of Vaporization	520.7	kcal/kg
Flow rate	1,280.09	kg/h





5.4.2 Maximum Operating Condition

HEAT EXCHANGER - HX-7B-1		
SIDE - WATER		
Thermal Load	522,661.55	kcal/h
Flow rate	66,458.33	kg/h
Temperature Inlet	53.24	°C
Temperature Outlet	61.1	°C
SIDE - PLANT STEAM		
Operating Pressure	1.5	barG
Enthalpy of Vaporization	520.7	kcal/kg
Flow rate	1,003.77	kg/h

5.4.1 Minimum Operating Condition For Heating Hot Water Skid (50% diversity)





HEAT EXCHANGER - HX-7B-1		
SIDE - WATER		
Thermal Load	260,818.21	kcal/h
Flow rate	43,518.30	kg/h
Temperature Inlet	55.11	°C
Temperature Outlet	61.1	°C
SIDE - PLANT STEAM		
Operating Pressure	1.5	barG
Enthalpy of Vaporization	520.7	kcal/kg
Flow rate	500.90	kg/h

The Heating Hot Water Distribution System was sized based on the flow rates and diversity indicated above. using the software FATHOM version 10.0 and the PIDs 7B-M-0-5-46. 7B-M-0-5-47. 7B-M-0-5-48 and 7B-M-0-5-49 for this system were elaborated based on these calculations.





 		 	
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6. RESULTS

6.1 VISUAL REPORT


 VR MIN 10%.pdf
  VR MAX.pdf
  VR DESIGN.pdf
  VR MIN 50%.pdf

6.2 OUTPUT


 OUTPUT MIN 10%.pdf
  OUTPUT MAX.pdf
  OUTPUT DESIGN.pdf
  OUTPUT MIN 50%.pdf

6.3 PUMPS SELECTED:


6.3.1 Design Condition

Jct	Results Diagram	Name	Vol. Flow (m ³ /hr)	Mass Flow (kg/hr)	dP (bar)	dH (meters)	Ideal Power (kW)	Overall Efficiency (Percent)	Overall Power (kW)	Speed (Percent)	NPSHA (meters)	NPSHR (meters)	P Static Suction (barG)	P Static Disc. (barG)
3	Show 	P-7B-X (A/B)	80,6642	79.598,5	3,27586	33,8517	7,33522	73,9509	9,91905	100,000	16,2873	N/A	0,667089	3,94295


6.3.2 Maximum Condition

Jct	Results Diagram	Name	Vol. Flow (m ³ /hr)	Mass Flow (kg/hr)	dP (bar)	dH (meters)	Ideal Power (kW)	Overall Efficiency (Percent)	Overall Power (kW)	Speed (Percent)	NPSHA (meters)	NPSHR (meters)	P Static Suction (barG)	P Static Disc. (barG)
3	Show 	P-7B-X (A/B)	67,3648	66.458,3	3,19085	32,9813	5,96685	70,9375	8,41142	97,8000	16,5552	N/A	0,707243	3,89809

6.3.3 Minimum Condition For Heating Hot Water Skid (50% diversity)

Jct	Results Diagram	Name	Vol. Flow (m ³ /hr)	Mass Flow (kg/hr)	dP (bar)	dH (meters)	Ideal Power (kW)	Overall Efficiency (Percent)	Overall Power (kW)	Speed (Percent)	NPSHA (meters)	NPSHR (meters)	P Static Suction (barG)	P Static Disc. (barG)
3	Show 	P-7B-X (A/B)	44,1526	43.518,3	2,86589	29,6498	3,51254	63,5343	5,52857	91,8000	16,8254	N/A	0,760088	3,62597

6.3.4 Minimum Condition For Valves (10% diversity)

Jct	Results Diagram	Name	Vol. Flow (m ³ /hr)	Mass Flow (kg/hr)	dP (bar)	dH (meters)	Ideal Power (kW)	Overall Efficiency (Percent)	Overall Power (kW)	Speed (Percent)	NPSHA (meters)	NPSHR (meters)	P Static Suction (barG)	P Static Disc. (barG)
3	Show 	P-7B-X (A/B)	25,4345	25.019,1	2,69623	27,9503	1,90365	54,1720	3,51408	88,9000	16,7277	N/A	0,786724	3,48295

Based on this calculation. the pumps were selected with a design condition of 80.66 m³/h and a HEAD of 35 mcl (the values calculated were rounded).

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6.3.5 Selected Pump

Model selected – MEGANORM 1750 RPM – 125-80-250

