DOC NUMBER: **569-DB7A-PRO-400-006**	CLIENT NUMBER: **PRD-MEC-CLC-005**
CLIENT: **TAKEDA/BAXALTA**	
PROJECT **BURITI EPCMV**	

HEATING HOT WATER SYSTEM (HVAC)
CALCULATION REPORT

0	30JUL2021	ISSUED FOR CONSTRUCTION	JRM	LFF	MSS
C	10JUN2021	90 % DD ISSUE	JRM	CCO	MSS
B	16OCT2020	FINAL BD ISSUE	LID	LFF	MSS
A	28AUG2020	90% BD ISSUE	LID	LFF	MSS
RE	DATE	DESCRIPTION	EXEC	CHECK	APPROV

1. REVISION HISTORY 3
2. PURPOSE 3
3. REFERENCE 3
4. BASIC DATA AND PREMISES 3
5. CALCULATION 4
6. RESULTS 20
6.1 VISUAL REPORT 20
6.2 OUTPUT 20
7. PUMPS SELECTED 20

1. REVISION HISTORY

Rev	Reason For Change
A	90% BD ISSUE
B	FINAL BD ISSUE
C	REHEAT COIL UNIT'S FLOWRATES 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 (RH-A2001-1 AND RH-A2036-2) HAVE BEEN UPDATED AND INCLUDE REHEAT COIL RH-A1005-1.

2. PURPOSE

This document aims to establish the main characteristics for sizing the Heating Hot Water Distribution System for HVAC, building 7A – Final Drug Product, intended to 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	LIST OF EQUIPMENT

4. BASIC DATA AND PREMISES

The Heating Hot Water Distribution System supplies the Building 7A for HVAC 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 21%, 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

  - 50%: Sizing Criterion for the Heat hot water skid (Heat Exchanger).

  - 10%: Sizing Criterion for valves and pumps – 10% of the capacity off all Reheat Coil Units capacities operating at the same time.

It was considered the installation of 1 Heat Exchanger with nominal capacity of 574,615 kcal/h (190 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 ¾". For diameters from 1", were used the same valves with modulating control.

5. CALCULATION

5.1 FLOW RATES REQUIRED

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

- Design Condition

EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOW RATE (m^3/h)	SIMULT. FLOW RATE (lpm)	SIUMLT. FLOW RATE (kg/h)	NOTES
Reheat Coil	RH-A2001-1	Y	1.30	21.7	1,279.3	
Reheat Coil	RH-A2004-1	Y	0.97	16.1	951.8	
Reheat Coil	RH-A2005-1	Y	0.26	4.3	252.0	
Reheat Coil	RH-A2007-1	Y	0.36	5.9	349.9	
Reheat Coil	RH-A2017-1	Y	0.38	6.4	377.9	
Reheat Coil	RH-A2023-1	Y	0.63	10.4	615.9	
Reheat Coil	RH-A2030-1	Y	0.23	3.8	224.0	
Reheat Coil	RH-A2040-1	Y	0.17	2.8	168.0	
Reheat Coil	RH-A2041-1	Y	1.77	29.4	1,735.7	
Reheat Coil	RH-A2044-1	Y	1.42	23.7	1,399.7	
Reheat Coil	RH-A2044-2	Y	1.42	23.7	1,399.7	
Reheat Coil	RH-A2044-3	Y	1.42	23.7	1,399.7	
Reheat Coil	RH-A2046-1	Y	0.43	7.1	419.9	
Reheat Coil	RH-A2006-1	Y	0.11	1.9	112.0	
Reheat Coil	RH-A2008-1	Y	0.13	2.1	126.0	
Reheat Coil	RH-A2010-1	Y	0.10	1.7	98.0	
Reheat Coil	RH-A2011-1	Y	0.23	3.8	224.0	
Reheat Coil	RH-A2012-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2013-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2014-1	Y	0.46	7.6	447.9	
Reheat Coil	RH-A2015-1	Y	0.21	3.6	210.0	
Reheat Coil	RH-A2016-1	Y	0.09	1.4	84.0	
Reheat Coil	RH-A2018-1	Y	0.09	1.4	84.0	
Reheat Coil	RH-A2019-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2020-1	Y	0.09	1.4	84.0	
Reheat Coil	RH-A2021-1	Y	1.48	24.7	1,455.7	
Reheat Coil	RH-A2021-2	Y	1.48	24.7	1,455.7	
Reheat Coil	RH-A2022-1	Y	0.06	0.9	56.0	
Reheat Coil	RH-A2042-1	Y	0.34	5.7	335.9	
Reheat Coil	RH-A2049-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2003-1	Y	1.28	21.4	1,259.8	
Reheat Coil	RH-A2003-2	Y	0.28	4.7	279.9	
Reheat Coil	RH-A2009-1	Y	0.28	4.7	279.9	
Reheat Coil	RH-A2028-1	Y	0.20	3.3	196.0	
Reheat Coil	RH-A2029-1	Y	0.85	14.2	839.8	
Reheat Coil	RH-A2033-1	Y	1.07	17.8	1,049.8	

EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOW RATE (m³/h)	SIMULT. FLOW RATE (lpm)	SIUMLT. FLOW RATE (kg/h)	NOTES
Reheat Coil	RH-A2033-2	Y	1.07	17.8	1,049.8	
Reheat Coil	RH-A2034-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2035-1	Y	0.23	3.8	224.0	
Reheat Coil	RH-A2036-1	Y	1.82	30.4	1,791.7	
Reheat Coil	RH-A2036-2	Y	0.17	2.9	169.0	
Reheat Coil	RH-A2037-1	Y	0.77	12.8	755.9	
Reheat Coil	RH-A2037-2	Y	0.28	4.7	279.9	
Reheat Coil	RH-A2038-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2039-1	Y	0.23	3.8	224.0	
Reheat Coil	RH-A2002-1	Y	0.97	16.1	951.8	
Reheat Coil	RH-A2002-2	Y	0.97	16.1	951.8	
Reheat Coil	RH-A2002-3	Y	0.26	4.3	252.0	
Reheat Coil	RH-A2025-1	Y	0.77	12.8	755.9	
Reheat Coil	RH-A2025-2	Y	0.77	12.8	755.9	
Reheat Coil	RH-A2025-3	Y	0.77	12.8	755.9	
Reheat Coil	RH-A2025-4	Y	0.77	12.8	755.9	
Reheat Coil	RH-A2026-1	Y	0.46	7.6	447.9	
Reheat Coil	RH-A2027-1	Y	0.46	7.6	447.9	
Reheat Coil	RH-A2031-1	Y	0.36	5.9	349.9	
Reheat Coil	RH-A2032-1	Y	0.38	6.4	377.9	
Reheat Coil	RH-A1001-1	Y	1.58	26.4	1,553.7	
Reheat Coil	RH-A1002-1	Y	0.28	4.7	279.9	
Reheat Coil	RH-A1003-1	Y	0.27	4.5	266.0	
Reheat Coil	RH-A1004-1	Y	0.51	8.5	503.9	
Reheat Coil	RH-A1005-1	Y	0.25	4.1	241.4	
Reheat Coil	RH-A1019-1	Y	1.67	27.8	1,637.7	
Reheat Coil	RH-A1029-1	Y	1.28	21.4	1,259.8	
Reheat Coil	RH-A1029-2	Y	1.28	21.4	1,259.8	
Reheat Coil	RH-A1040-1	Y	2.04	34.0	2,001.6	
Reheat Coil	RH-A1040-2	Y	2.04	34.0	2,001.6	
TOTAL		**-**	**43.4**	**723.4**	**42,646.2**	
Recirculation (BV)		**Y**	**15.5**	**259.0**	**15,271.5**	*1*
Tie-in		**Y**	**9.1**	**150.9**	**8,898.1**	*2*
TOTAL		**Y**	**68.0**	**1,133.3**	**66,815.7**	*3*

Notes:

1. Flow rate through bypasses.
2. Oversizing of 21%
3. Total flow rate after the Heat Exchanger, due to the recirculation flow rate, software FATHOM calculated a return temperature of 52.5°C, resulting in a total volumetric for the pump of 67.7 m³/h – Design Condition.

- Maximum Operating Condition

EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOW RATE (m³/h)	SIMULT. FLOW RATE (lpm)	SIMULT. FLOW RATE (kg/h)	NOTES
Reheat Coil	RH-A2001-1	Y	1.30	21.7	1,279.3	
Reheat Coil	RH-A2004-1	Y	0.97	16.1	951.8	
Reheat Coil	RH-A2005-1	Y	0.26	4.3	252.0	
Reheat Coil	RH-A2007-1	Y	0.36	5.9	349.9	
Reheat Coil	RH-A2017-1	Y	0.38	6.4	377.9	
Reheat Coil	RH-A2023-1	Y	0.63	10.4	615.9	
Reheat Coil	RH-A2030-1	Y	0.23	3.8	224.0	
Reheat Coil	RH-A2040-1	Y	0.17	2.8	168.0	
Reheat Coil	RH-A2041-1	Y	1.77	29.4	1,735.7	
Reheat Coil	RH-A2044-1	Y	1.42	23.7	1,399.7	
Reheat Coil	RH-A2044-2	Y	1.42	23.7	1,399.7	
Reheat Coil	RH-A2044-3	Y	1.42	23.7	1,399.7	
Reheat Coil	RH-A2046-1	Y	0.43	7.1	419.9	
Reheat Coil	RH-A2006-1	Y	0.11	1.9	112.0	
Reheat Coil	RH-A2008-1	Y	0.13	2.1	126.0	
Reheat Coil	RH-A2010-1	Y	0.10	1.7	98.0	
Reheat Coil	RH-A2011-1	Y	0.23	3.8	224.0	
Reheat Coil	RH-A2012-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2013-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2014-1	Y	0.46	7.6	447.9	
Reheat Coil	RH-A2015-1	Y	0.21	3.6	210.0	
Reheat Coil	RH-A2016-1	Y	0.09	1.4	84.0	
Reheat Coil	RH-A2018-1	Y	0.09	1.4	84.0	
Reheat Coil	RH-A2019-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2020-1	Y	0.09	1.4	84.0	
Reheat Coil	RH-A2021-1	Y	1.48	24.7	1,455.7	
Reheat Coil	RH-A2021-2	Y	1.48	24.7	1,455.7	
Reheat Coil	RH-A2022-1	Y	0.06	0.9	56.0	
Reheat Coil	RH-A2042-1	Y	0.34	5.7	335.9	
Reheat Coil	RH-A2049-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2003-1	Y	1.28	21.4	1,259.8	
Reheat Coil	RH-A2003-2	Y	0.28	4.7	279.9	
Reheat Coil	RH-A2009-1	Y	0.28	4.7	279.9	
Reheat Coil	RH-A2028-1	Y	0.20	3.3	196.0	
Reheat Coil	RH-A2029-1	Y	0.85	14.2	839.8	
Reheat Coil	RH-A2033-1	Y	1.07	17.8	1,049.8	
Reheat Coil	RH-A2033-2	Y	1.07	17.8	1,049.8	
Reheat Coil	RH-A2034-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2035-1	Y	0.23	3.8	224.0	
Reheat Coil	RH-A2036-1	Y	1.82	30.4	1,791.7	
Reheat Coil	RH-A2036-2	Y	0.17	2.9	169.0	
Reheat Coil	RH-A2037-1	Y	0.77	12.8	755.9	
Reheat Coil	RH-A2037-2	Y	0.28	4.7	279.9	
Reheat Coil	RH-A2038-1	Y	0.19	3.1	182.0	
Reheat Coil	RH-A2039-1	Y	0.23	3.8	224.0	

EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOW RATE (m³/h)	SIMULT. FLOW RATE (lpm)	SIMULT. FLOW RATE (kg/h)	NOTES
Reheat Coil	RH-A2002-1	Y	0.97	16.1	951.8	
Reheat Coil	RH-A2002-2	Y	0.97	16.1	951.8	
Reheat Coil	RH-A2002-3	Y	0.26	4.3	252.0	
Reheat Coil	RH-A2025-1	Y	0.77	12.8	755.9	
Reheat Coil	RH-A2025-2	Y	0.77	12.8	755.9	
Reheat Coil	RH-A2025-3	Y	0.77	12.8	755.9	
Reheat Coil	RH-A2025-4	Y	0.77	12.8	755.9	
Reheat Coil	RH-A2026-1	Y	0.46	7.6	447.9	
Reheat Coil	RH-A2027-1	Y	0.46	7.6	447.9	
Reheat Coil	RH-A2031-1	Y	0.36	5.9	349.9	
Reheat Coil	RH-A2032-1	Y	0.38	6.4	377.9	
Reheat Coil	RH-A1001-1	Y	1.58	26.4	1,553.7	
Reheat Coil	RH-A1002-1	Y	0.28	4.7	279.9	
Reheat Coil	RH-A1003-1	Y	0.27	4.5	266.0	
Reheat Coil	RH-A1004-1	Y	0.51	8.5	503.9	
Reheat Coil	RH-A1005-1	Y	0.25	4.1	241.4	
Reheat Coil	RH-A1019-1	Y	1.67	27.8	1,637.7	
Reheat Coil	RH-A1029-1	Y	1.28	21.4	1,259.8	
Reheat Coil	RH-A1029-2	Y	1.28	21.4	1,259.8	
Reheat Coil	RH-A1040-1	Y	2.04	34.0	2,001.6	
Reheat Coil	RH-A1040-2	Y	2.04	34.0	2,001.6	
TOTAL		**-**	**43.4**	**723.4**	**42,646.2**	
Recirculation (BV)		**Y**	**15.7**	**261.4**	**15,412.2**	*1*
Tie-in		**N**	**-**	**-**	**-**	
TOTAL		**-**	**59.1**	**984.8**	**58,058.4**	*2*

Notes:

1. Flow rate through bypasses.
2. Total flow rate after the Heat Exchanger, due to the recirculation flow rate, software FATHOM calculated a return temperature of 53°C, resulting in a total volumetric for the pump of 58.8 m³/h – Maximum Operating Condition.

- Minimum Operating Condition – 10 %

EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOW RATE (m³/h)	SIMULT. FLOW RATE (lpm)	SIMULT. FLOW RATE (kg/h)	NOTES
Reheat Coil	RH-A2001-1	Y	0.13	2.2	127.9	
Reheat Coil	RH-A2004-1	Y	0.10	1.6	95.2	
Reheat Coil	RH-A2005-1	Y	0.03	0.4	25.2	
Reheat Coil	RH-A2007-1	Y	0.04	0.6	35.0	
Reheat Coil	RH-A2017-1	Y	0.04	0.6	37.8	
Reheat Coil	RH-A2023-1	Y	0.06	1.0	61.6	
Reheat Coil	RH-A2030-1	Y	0.02	0.4	22.4	
Reheat Coil	RH-A2040-1	Y	0.02	0.3	16.8	
Reheat Coil	RH-A2041-1	Y	0.18	2.9	173.6	
Reheat Coil	RH-A2044-1	Y	0.14	2.4	140.0	
Reheat Coil	RH-A2044-2	Y	0.14	2.4	140.0	

EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOW RATE (m³/h)	SIMULT. FLOW RATE (lpm)	SIMULT. FLOW RATE (kg/h)	NOTES
Reheat Coil	RH-A2044-3	Y	0.14	2.4	140.0	
Reheat Coil	RH-A2046-1	Y	0.04	0.7	42.0	
Reheat Coil	RH-A2006-1	Y	0.01	0.2	11.2	
Reheat Coil	RH-A2008-1	Y	0.01	0.2	12.6	
Reheat Coil	RH-A2010-1	Y	0.01	0.2	9.8	
Reheat Coil	RH-A2011-1	Y	0.02	0.4	22.4	
Reheat Coil	RH-A2012-1	Y	0.02	0.3	18.2	
Reheat Coil	RH-A2013-1	Y	0.02	0.3	18.2	
Reheat Coil	RH-A2014-1	Y	0.05	0.8	44.8	
Reheat Coil	RH-A2015-1	Y	0.02	0.4	21.0	
Reheat Coil	RH-A2016-1	Y	0.01	0.1	8.4	
Reheat Coil	RH-A2018-1	Y	0.01	0.1	8.4	
Reheat Coil	RH-A2019-1	Y	0.02	0.3	18.2	
Reheat Coil	RH-A2020-1	Y	0.01	0.1	8.4	
Reheat Coil	RH-A2021-1	Y	0.15	2.5	145.6	
Reheat Coil	RH-A2021-2	Y	0.15	2.5	145.6	
Reheat Coil	RH-A2022-1	Y	0.01	0.1	5.6	
Reheat Coil	RH-A2042-1	Y	0.03	0.6	33.6	
Reheat Coil	RH-A2049-1	Y	0.02	0.3	18.2	
Reheat Coil	RH-A2003-1	Y	0.13	2.1	126.0	
Reheat Coil	RH-A2003-2	Y	0.03	0.5	28.0	
Reheat Coil	RH-A2009-1	Y	0.03	0.5	28.0	
Reheat Coil	RH-A2028-1	Y	0.02	0.3	19.6	
Reheat Coil	RH-A2029-1	Y	0.09	1.4	84.0	
Reheat Coil	RH-A2033-1	Y	0.11	1.8	105.0	
Reheat Coil	RH-A2033-2	Y	0.11	1.8	105.0	
Reheat Coil	RH-A2034-1	Y	0.02	0.3	18.2	
Reheat Coil	RH-A2035-1	Y	0.02	0.4	22.4	
Reheat Coil	RH-A2036-1	Y	0.18	3.0	179.2	
Reheat Coil	RH-A2036-2	Y	0.02	0.3	16.9	
Reheat Coil	RH-A2037-1	Y	0.08	1.3	75.6	
Reheat Coil	RH-A2037-2	Y	0.03	0.5	28.0	
Reheat Coil	RH-A2038-1	Y	0.02	0.3	18.2	
Reheat Coil	RH-A2039-1	Y	0.02	0.4	22.4	
Reheat Coil	RH-A2002-1	Y	0.10	1.6	95.2	
Reheat Coil	RH-A2002-2	Y	0.10	1.6	95.2	
Reheat Coil	RH-A2002-3	Y	0.03	0.4	25.2	
Reheat Coil	RH-A2025-1	Y	0.08	1.3	75.6	
Reheat Coil	RH-A2025-2	Y	0.08	1.3	75.6	
Reheat Coil	RH-A2025-3	Y	0.08	1.3	75.6	
Reheat Coil	RH-A2025-4	Y	0.08	1.3	75.6	
Reheat Coil	RH-A2026-1	Y	0.05	0.8	44.8	
Reheat Coil	RH-A2027-1	Y	0.05	0.8	44.8	
Reheat Coil	RH-A2031-1	Y	0.04	0.6	35.0	
Reheat Coil	RH-A2032-1	Y	0.04	0.6	37.8	
Reheat Coil	RH-A1001-1	Y	0.16	2.6	155.4	
Reheat Coil	RH-A1002-1	Y	0.03	0.5	28.0	

EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOW RATE (m³/h)	SIMULT. FLOW RATE (lpm)	SIMULT. FLOW RATE (kg/h)	NOTES
Reheat Coil	RH-A1003-1	Y	0.03	0.5	26.6	
Reheat Coil	RH-A1004-1	Y	0.05	0.9	50.4	
Reheat Coil	RH-A1005-1	Y	0.02	0.4	24.1	
Reheat Coil	RH-A1019-1	Y	0.17	2.8	163.8	
Reheat Coil	RH-A1029-1	Y	0.13	2.1	126.0	
Reheat Coil	RH-A1029-2	Y	0.13	2.1	126.0	
Reheat Coil	RH-A1040-1	Y	0.20	3.4	200.2	
Reheat Coil	RH-A1040-2	Y	0.20	3.4	200.2	
TOTAL		**-**	**4.3**	**72.3**	**4,264.6**	
Recirculation (BV)		**Y**	**15.9**	**264.6**	**15,596.6**	*1*
Tie-in		**N**	**-**	**-**	**-**	
TOTAL		**-**	**20.2**	**336.9**	**19,861.2**	*2*

Notes:

1. Flow rate through bypasses.
2. Total flow rate after the Heat Exchanger, due to the recirculation flow rate, software FATHOM calculated a return temperature of 58.7°C, resulting in a total volumetric for the pump of 20.2 m³/h – Minimum Operating Condition – 10%.

- Minimum Operating Condition – 50 %

EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOW RATE (m³/h)	SIMULT. FLOW RATE (lpm)	SIMULT. FLOW RATE (kg/h)	NOTES
Reheat Coil	RH-A2001-1	Y	0.65	10.8	639.6	
Reheat Coil	RH-A2004-1	Y	0.48	8.1	475.9	
Reheat Coil	RH-A2005-1	Y	0.13	2.1	126.0	
Reheat Coil	RH-A2007-1	Y	0.18	3.0	175.0	
Reheat Coil	RH-A2017-1	Y	0.19	3.2	189.0	
Reheat Coil	RH-A2023-1	Y	0.31	5.2	307.9	
Reheat Coil	RH-A2030-1	Y	0.11	1.9	112.0	
Reheat Coil	RH-A2040-1	Y	0.09	1.4	84.0	
Reheat Coil	RH-A2041-1	Y	0.88	14.7	867.8	
Reheat Coil	RH-A2044-1	Y	0.71	11.9	699.9	
Reheat Coil	RH-A2044-2	Y	0.71	11.9	699.9	
Reheat Coil	RH-A2044-3	Y	0.71	11.9	699.9	
Reheat Coil	RH-A2046-1	Y	0.21	3.6	210.0	
Reheat Coil	RH-A2006-1	Y	0.06	0.9	56.0	
Reheat Coil	RH-A2008-1	Y	0.06	1.1	63.0	
Reheat Coil	RH-A2010-1	Y	0.05	0.8	49.0	
Reheat Coil	RH-A2011-1	Y	0.11	1.9	112.0	
Reheat Coil	RH-A2012-1	Y	0.09	1.5	91.0	
Reheat Coil	RH-A2013-1	Y	0.09	1.5	91.0	
Reheat Coil	RH-A2014-1	Y	0.23	3.8	224.0	
Reheat Coil	RH-A2015-1	Y	0.11	1.8	105.0	
Reheat Coil	RH-A2016-1	Y	0.04	0.7	42.0	
Reheat Coil	RH-A2018-1	Y	0.04	0.7	42.0	
Reheat Coil	RH-A2019-1	Y	0.09	1.5	91.0	

EQUIPMENT	TAG	DIVERSITY (Y/N)	SIMULT. FLOW RATE (m³/h)	SIMULT. FLOW RATE (lpm)	SIMULT. FLOW RATE (kg/h)	NOTES
Reheat Coil	RH-A2020-1	Y	0.04	0.7	42.0	
Reheat Coil	RH-A2021-1	Y	0.74	12.3	727.9	
Reheat Coil	RH-A2021-2	Y	0.74	12.3	727.9	
Reheat Coil	RH-A2022-1	Y	0.03	0.5	28.0	
Reheat Coil	RH-A2042-1	Y	0.17	2.8	168.0	
Reheat Coil	RH-A2049-1	Y	0.09	1.5	91.0	
Reheat Coil	RH-A2003-1	Y	0.64	10.7	629.9	
Reheat Coil	RH-A2003-2	Y	0.14	2.4	140.0	
Reheat Coil	RH-A2009-1	Y	0.14	2.4	140.0	
Reheat Coil	RH-A2028-1	Y	0.10	1.7	98.0	
Reheat Coil	RH-A2029-1	Y	0.43	7.1	419.9	
Reheat Coil	RH-A2033-1	Y	0.53	8.9	524.9	
Reheat Coil	RH-A2033-2	Y	0.53	8.9	524.9	
Reheat Coil	RH-A2034-1	Y	0.09	1.5	91.0	
Reheat Coil	RH-A2035-1	Y	0.11	1.9	112.0	
Reheat Coil	RH-A2036-1	Y	0.91	15.2	895.8	
Reheat Coil	RH-A2036-2	Y	0.09	1.4	84.5	
Reheat Coil	RH-A2037-1	Y	0.38	6.4	377.9	
Reheat Coil	RH-A2037-2	Y	0.14	2.4	140.0	
Reheat Coil	RH-A2038-1	Y	0.09	1.5	91.0	
Reheat Coil	RH-A2039-1	Y	0.11	1.9	112.0	
Reheat Coil	RH-A2002-1	Y	0.48	8.1	475.9	
Reheat Coil	RH-A2002-2	Y	0.48	8.1	475.9	
Reheat Coil	RH-A2002-3	Y	0.13	2.1	126.0	
Reheat Coil	RH-A2025-1	Y	0.38	6.4	377.9	
Reheat Coil	RH-A2025-2	Y	0.38	6.4	377.9	
Reheat Coil	RH-A2025-3	Y	0.38	6.4	377.9	
Reheat Coil	RH-A2025-4	Y	0.38	6.4	377.9	
Reheat Coil	RH-A2026-1	Y	0.23	3.8	224.0	
Reheat Coil	RH-A2027-1	Y	0.23	3.8	224.0	
Reheat Coil	RH-A2031-1	Y	0.18	3.0	175.0	
Reheat Coil	RH-A2032-1	Y	0.19	3.2	189.0	
Reheat Coil	RH-A1001-1	Y	0.79	13.2	776.9	
Reheat Coil	RH-A1002-1	Y	0.14	2.4	140.0	
Reheat Coil	RH-A1003-1	Y	0.14	2.3	133.0	
Reheat Coil	RH-A1004-1	Y	0.26	4.3	252.0	
Reheat Coil	RH-A1005-1	Y	0.12	2.0	120.7	
Reheat Coil	RH-A1019-1	Y	0.83	13.9	818.9	
Reheat Coil	RH-A1029-1	Y	0.64	10.7	629.9	
Reheat Coil	RH-A1029-2	Y	0.64	10.7	629.9	
Reheat Coil	RH-A1040-1	Y	1.02	17.0	1,000.8	
Reheat Coil	RH-A1040-2	Y	1.02	17.0	1,000.8	
TOTAL		**-**	**21.7**	**361.7**	**21,323.1**	
Recirculation (BV)		**Y**	**15.7**	**262.3**	**15,464.3**	*1*
Tie-in		**N**	**-**	**-**	**-**	
TOTAL		**-**	**37.4**	**624.0**	**36,787.4**	*2*

Notes:

1. Flow rate through bypasses.
2. Total flow rate after the Heat Exchanger, due to the recirculation flow rate, software FATHOM calculated a return temperature of 54.7°C, resulting in a total volumetric for the pump of 37.3 m³/h – Minimum Operating Condition – 50%.

The Design Condition peak load for Building 7A is 572,140.8 kcal/h (189.2 TR).

5.2 PUMPS

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

Design Condition – Flowrate = 67.7 m³/h

Maximum Operating Condition = 58.8 m³/h

Minimum Operating Condition = 20.2 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-970005 maintaining constant the pressure drop of 1.27 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 7 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 15.5 m³/h for hot water recirculation. This flow rate will be guaranteed by using 16 manual static balancing valves in the by-pass as below:

ITEM	VALVE	VOLUMETRIC FLOW RATE		P in	P out	ΔP	CV
		(m³/h)	(LPM)	(bar)	(bar)	(bar)	(Calculated)
2000	BV-970028	0.97	16.19	3.2	1.5	1.7	0.9
2001	BV-970034	0.97	16.19	3.1	1.5	1.5	0.9
2002	BV-970042	0.97	16.19	3.0	1.5	1.5	0.9
2003	BV-970066	0.97	16.19	2.8	1.8	1.1	1.1
2004	BV-970059	0.97	16.19	2.8	1.7	1.1	1.1
2005	BV-9700294	0.97	16.19	2.6	1.7	1.0	1.1
2006	BV-970052	0.97	16.19	2.9	1.6	1.3	1.0
2007	BV-9700248	0.97	16.19	2.9	1.5	1.4	1.0
2008	BV-9700242	0.97	16.19	2.9	1.6	1.3	1.0
2009	BV-9700314	0.97	16.19	3.0	1.5	1.5	0.9
2010	BV-9700378	0.97	16.19	2.7	1.9	0.8	1.3
2011	BV-9700102	0.97	16.19	2.6	2.0	0.6	1.4
2012	BV-970010	0.97	16.19	2.7	2.0	0.8	1.3
2013	BV-9700396	0.97	16.19	3.8	3.0	0.7	1.3
2014	BV-9700120	0.97	16.19	4.0	2.9	1.1	1.1
2015	BV-970012	0.97	16.19	4.0	2.9	1.1	1.1
TOTAL		**15.5**	**259.0**	**-**	**-**	**-**	**-**

5.3.2 BALANCING VALVES INSTALLED AT THE BEGINNING OF THE DISTRIBUTION HEADERS

Throughout the system, 7 static balancing valves in the distribution headers were considered to guarantee the correct water distribution, as shown in the table below:

ITEM	VALVE	VOLUMETRIC FLOW RATE		P in	P out	ΔP	CV
		(m³/h)	(LPM)	(bar)	(bar)	(bar)	(Calculated)
101	BV-970005	33.69	33,103.41	3.3	3.3	0.03	223.0
160	BV-970019	11.14	10,945.45	3.3	3.3	0.03	73.7
201	BV-970011	5.05	4,957.74	4.3	4.2	0.03	33.4
208	BV-9700107	9.07	8,911.08	4.2	4.2	0.03	60.0
321	BV-970053	14.97	14,714.18	3.1	3.1	0.03	99.1
352	BV-9700245	4.02	3,950.92	3.0	2.9	0.03	26.6
390	BV-970054	3.44	3,378.67	2.9	2.9	0.03	22.8

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.

a) Design Condition

ITEM	VALVE	VOLUMETRIC FLOW RATE		P in	P out	ΔP	CV
		(m³/hr)	(lpm)	(barG)	(barG)	(bar)	(Calculated)
302	TV-970018	1.76	29.28	2.7	1.3	1.4	1.7
304	TV-9700216	0.09	1.42	2.7	1.3	1.3	0.1
308	TV-970027	0.34	5.67	2.7	1.4	1.3	0.3
320	TV-9700230	0.10	1.65	2.6	1.4	1.3	0.1
348	TV-970075	0.18	3.07	2.3	1.5	0.9	0.2
351	TV-970077	0.23	3.78	2.4	1.5	0.8	0.3
363	TV-970049	0.77	12.75	2.4	1.4	0.9	0.9
365	TV-9700254	0.28	4.72	2.4	1.4	0.9	0.3
367	TV-970025	1.81	30.22	2.4	1.4	0.9	2.2
369	TV-9700267	0.17	2.85	2.4	1.5	0.9	0.2
371	TV-9700281	1.06	17.71	2.5	1.5	1.0	1.2
378	TV-970045	0.20	3.31	2.3	1.5	0.9	0.2
380	TV-970047	1.06	17.71	2.4	1.6	0.8	1.4
399	TV-970056	0.85	14.17	2.2	1.6	0.7	1.2
406	TV-970069	0.18	3.07	2.1	1.6	0.5	0.3
408	TV-970073	0.23	3.78	2.2	1.7	0.5	0.4
410	TV-970058	0.23	3.78	2.3	1.7	0.6	0.3
412	TV-970061	0.28	4.72	2.4	1.6	0.8	0.4
414	TV-970063	1.27	21.25	2.3	1.7	0.6	1.9
416	TV-9700300	0.28	4.72	2.3	1.7	0.6	0.4
427	TV-970051	1.42	23.61	2.6	1.5	1.1	1.5
429	TV-970079	0.17	2.83	2.6	1.5	1.1	0.2
436	TV-970083	0.43	7.08	2.5	1.5	1.0	0.5
438	TV-970087	1.47	24.56	2.5	1.5	1.0	1.7
440	TV-970081	0.62	10.39	2.5	1.5	1.0	0.7
442	TV-970085	0.18	3.07	2.5	1.5	1.0	0.2
444	TV-9700320	0.06	0.94	2.5	1.5	1.0	0.1
446	TV-9700332	1.47	24.56	2.5	1.6	0.9	1.7
448	TV-9700106	0.21	3.54	2.5	1.6	0.9	0.3
450	TV-9700344	0.18	3.07	2.5	1.6	0.9	0.2
452	TV-9700104	0.45	7.56	2.5	1.6	0.9	0.6
454	TV-9700357	0.18	3.07	2.4	1.6	0.8	0.2
456	TV-9700369	0.09	1.42	2.4	1.6	0.8	0.1
463	TV-970091	0.09	1.42	2.2	1.8	0.4	0.2
465	TV-970071	0.38	6.38	2.1	1.8	0.3	0.8

ITEM	VALVE	VOLUMETRIC FLOW RATE		P in	P out	ΔP	CV
		(m³/hr)	(lpm)	(barG)	(barG)	(bar)	(Calculated)
467	TV-970093	0.18	3.07	2.3	1.7	0.6	0.3
469	TV-970095	0.23	3.78	2.3	1.8	0.6	0.3
476	TV-970097	0.13	2.13	2.1	1.8	0.3	0.3
478	TV-970099	0.35	5.90	2.1	2.0	0.2	1.0
480	TV-9700380	0.11	1.89	2.3	1.8	0.4	0.2
482	TV-9700101	0.26	4.25	2.2	1.9	0.4	0.5
484	TV-9700384	1.42	23.61	2.2	1.9	0.3	2.8
486	TV-9700388	1.42	23.61	2.2	1.9	0.3	2.8
488	TV-970065	0.96	16.06	2.2	1.9	0.3	2.2
490	TV-9700411	2.03	33.76	3.5	2.8	0.7	2.9
492	TV-9700415	2.03	33.76	3.5	2.8	0.6	2.9
494	TV-9700392	1.27	21.25	3.6	2.7	0.9	1.6
496	TV-9700115	1.27	21.25	3.5	2.8	0.7	1.7
503	TV-9700117	0.28	4.72	3.2	2.9	0.3	0.6
505	TV-9700398	0.27	4.49	3.2	3.0	0.3	0.6
507	TV-9700402	0.51	8.50	3.5	2.8	0.6	0.7
509	TV-9700119	1.57	26.21	3.5	2.8	0.6	2.3
511	TV-9700406	1.66	27.62	3.5	2.8	0.6	2.4
530	TV-970023	0.38	6.38	2.7	1.3	1.4	0.4
533	TV-970031	0.77	12.75	2.7	1.4	1.4	0.8
536	TV-970021	0.35	5.90	2.7	1.4	1.4	0.3
539	TV-970037	0.45	7.56	2.7	1.4	1.3	0.5
542	TV-9700155	0.77	12.75	2.7	1.4	1.3	0.8
550	TV-970041	0.96	16.06	2.5	1.5	1.0	1.1
553	TV-9700168	0.96	16.06	2.5	1.5	1.0	1.1
556	TV-9700180	0.77	12.75	2.7	1.4	1.2	0.8
559	TV-970039	0.45	7.56	2.7	1.4	1.2	0.5
568	TV-9700192	0.77	12.75	2.5	1.4	1.1	0.8
571	TV-9700204	0.26	4.25	2.6	1.5	1.0	0.3
609	TV-970033	1.29	21.58	2.7	1.5	1.2	1.3
610	TV-9700430	0.24	4.07	3.3	2.9	0.5	0.4

b) Maximum Condition

ITEM	VALVE	VOLUMETRIC FLOW RATE		P in	P out	ΔP	CV
		(m³/hr)	(lpm)	(barG)	(barG)	(bar)	(Calculated)
302	TV-970018	1.76	29.28	1.3	1.4	1.7	1.5
304	TV-9700216	0.09	1.42	1.3	1.4	0.1	0.1
308	TV-970027	0.34	5.67	1.3	1.3	0.3	0.3

ITEM	VALVE	VOLUMETRIC FLOW RATE		P in	P out	ΔP	CV
		(m³/hr)	(lpm)	(barG)	(barG)	(bar)	(Calculated)
320	TV-9700230	0.10	1.65	1.4	1.3	0.1	0.1
348	TV-970075	0.18	3.07	1.4	0.9	0.2	0.2
351	TV-970077	0.23	3.78	1.5	0.8	0.3	0.2
363	TV-970049	0.77	12.75	1.4	1.0	0.9	0.8
365	TV-9700254	0.28	4.72	1.4	1.0	0.3	0.3
367	TV-970025	1.81	30.22	1.4	1.0	2.1	1.8
369	TV-9700267	0.17	2.85	1.5	0.9	0.2	0.2
371	TV-9700281	1.06	17.71	1.5	1.0	1.2	1.1
378	TV-970045	0.20	3.31	1.5	0.9	0.2	0.2
380	TV-970047	1.06	17.71	1.5	0.8	1.3	1.2
399	TV-970056	0.85	14.17	1.6	0.7	1.2	1.0
406	TV-970069	0.18	3.07	1.6	0.5	0.3	0.2
408	TV-970073	0.23	3.78	1.7	0.5	0.4	0.3
410	TV-970058	0.23	3.78	1.7	0.6	0.3	0.3
412	TV-970061	0.28	4.72	1.6	0.8	0.4	0.3
414	TV-970063	1.27	21.25	1.7	0.6	1.9	1.6
416	TV-9700300	0.28	4.72	1.7	0.6	0.4	0.4
427	TV-970051	1.42	23.61	1.4	1.2	1.5	1.3
429	TV-970079	0.17	2.83	1.5	1.1	0.2	0.2
436	TV-970083	0.43	7.08	1.4	1.0	0.5	0.4
438	TV-970087	1.47	24.56	1.5	1.0	1.7	1.4
440	TV-970081	0.62	10.39	1.5	1.0	0.7	0.6
442	TV-970085	0.18	3.07	1.5	1.0	0.2	0.2
444	TV-9700320	0.06	0.94	1.5	1.0	0.1	0.1
446	TV-9700332	1.47	24.56	1.5	1.0	1.7	1.5
448	TV-9700106	0.21	3.54	1.6	0.9	0.3	0.2
450	TV-9700344	0.18	3.07	1.6	0.9	0.2	0.2
452	TV-9700104	0.45	7.56	1.6	0.9	0.6	0.5
454	TV-9700357	0.18	3.07	1.6	0.9	0.2	0.2
456	TV-9700369	0.09	1.42	1.6	0.8	0.1	0.1
463	TV-970091	0.09	1.42	1.7	0.4	0.1	0.1
465	TV-970071	0.38	6.38	1.8	0.3	0.8	0.7
467	TV-970093	0.18	3.07	1.7	0.6	0.3	0.2
469	TV-970095	0.23	3.78	1.7	0.6	0.3	0.3
476	TV-970097	0.13	2.13	1.8	0.3	0.3	0.2
478	TV-970099	0.35	5.90	1.9	0.2	0.9	0.8
480	TV-9700380	0.11	1.89	1.8	0.5	0.2	0.2
482	TV-9700101	0.26	4.25	1.8	0.4	0.5	0.4
484	TV-9700384	1.42	23.61	1.8	0.4	2.6	2.3
486	TV-9700388	1.42	23.61	1.9	0.4	2.6	2.3

ITEM	VALVE	VOLUMETRIC FLOW RATE		P in	P out	ΔP	CV
		(m³/hr)	(lpm)	(barG)	(barG)	(bar)	(Calculated)
488	TV-970065	0.96	16.06	1.9	0.3	2.0	1.7
490	TV-9700411	2.03	33.76	2.8	0.7	2.8	2.4
492	TV-9700415	2.03	33.76	2.8	0.7	2.9	2.5
494	TV-9700392	1.27	21.25	2.7	0.9	1.6	1.3
496	TV-9700115	1.27	21.25	2.8	0.7	1.7	1.5
503	TV-9700117	0.28	4.72	2.9	0.3	0.6	0.5
505	TV-9700398	0.27	4.49	2.9	0.3	0.6	0.5
507	TV-9700402	0.51	8.50	2.8	0.7	0.7	0.6
509	TV-9700119	1.57	26.21	2.8	0.7	2.2	1.9
511	TV-9700406	1.66	27.62	2.8	0.6	2.4	2.1
530	TV-970023	0.38	6.38	1.3	1.4	0.4	0.3
533	TV-970031	0.77	12.75	1.3	1.4	0.7	0.6
536	TV-970021	0.35	5.90	1.3	1.4	0.3	0.3
539	TV-970037	0.45	7.56	1.3	1.3	0.4	0.4
542	TV-9700155	0.77	12.75	1.4	1.3	0.8	0.7
550	TV-970041	0.96	16.06	1.4	1.0	1.1	0.9
553	TV-9700168	0.96	16.06	1.5	1.0	1.1	1.0
556	TV-9700180	0.77	12.75	1.4	1.3	0.8	0.7
559	TV-970039	0.45	7.56	1.4	1.3	0.5	0.4
568	TV-9700192	0.77	12.75	1.4	1.1	0.8	0.7
571	TV-9700204	0.26	4.25	1.5	1.1	0.3	0.2
609	TV-970033	1.29	21.58	1.5	1.2	1.3	1.2
610	TV-9700430	0.24	4.07	2.8	0.5	0.4	0.4

c) Minimum Condition – 10%

ITEM	VALVE	VOLUMETRIC FLOW RATE		P in	P out	ΔP	CV
		(m³/hr)	(lpm)	(barG)	(barG)	(bar)	(Calculated)
302	TV-970018	0.18	2.93	1.2	1.4	0.17	0.15
304	TV-9700216	0.01	0.14	1.2	1.4	0.01	0.01
308	TV-970027	0.03	0.57	1.2	1.4	0.03	0.03
320	TV-9700230	0.01	0.17	1.2	1.3	0.01	0.01
348	TV-970075	0.02	0.31	1.1	1.2	0.02	0.02
351	TV-970077	0.02	0.38	1.2	1.2	0.02	0.02
363	TV-970049	0.08	1.28	1.1	1.3	0.08	0.07
365	TV-9700254	0.03	0.47	1.1	1.3	0.03	0.02
367	TV-970025	0.18	3.02	1.1	1.3	0.18	0.16
369	TV-9700267	0.02	0.29	1.2	1.2	0.02	0.02
371	TV-9700281	0.11	1.77	1.2	1.3	0.11	0.09

ITEM	VALVE	VOLUMETRIC FLOW RATE		P in	P out	ΔP	CV
		(m³/hr)	(lpm)	(barG)	(barG)	(bar)	(Calculated)
378	TV-970045	0.02	0.33	1.1	1.3	0.02	0.02
380	TV-970047	0.11	1.77	1.2	1.3	0.11	0.09
399	TV-970056	0.08	1.42	1.2	1.2	0.09	0.08
406	TV-970069	0.02	0.31	1.2	1.1	0.02	0.02
408	TV-970073	0.02	0.38	1.2	1.0	0.03	0.02
410	TV-970058	0.02	0.38	1.2	1.1	0.02	0.02
412	TV-970061	0.03	0.47	1.2	1.3	0.03	0.03
414	TV-970063	0.13	2.13	1.2	1.2	0.13	0.12
416	TV-9700300	0.03	0.47	1.3	1.2	0.03	0.03
427	TV-970051	0.14	2.36	1.2	1.3	0.14	0.12
429	TV-970079	0.02	0.28	1.2	1.3	0.02	0.01
436	TV-970083	0.04	0.71	1.2	1.3	0.04	0.04
438	TV-970087	0.15	2.46	1.2	1.3	0.15	0.13
440	TV-970081	0.06	1.04	1.2	1.3	0.06	0.05
442	TV-970085	0.02	0.31	1.2	1.3	0.02	0.02
444	TV-9700320	0.01	0.09	1.2	1.3	0.01	0.00
446	TV-9700332	0.15	2.46	1.2	1.3	0.15	0.13
448	TV-9700106	0.02	0.35	1.2	1.3	0.02	0.02
450	TV-9700344	0.02	0.31	1.2	1.3	0.02	0.02
452	TV-9700104	0.05	0.76	1.2	1.3	0.05	0.04
454	TV-9700357	0.02	0.31	1.2	1.3	0.02	0.02
456	TV-9700369	0.01	0.14	1.2	1.3	0.01	0.01
463	TV-970091	0.01	0.14	1.2	1.1	0.01	0.01
465	TV-970071	0.04	0.64	1.3	1.0	0.04	0.04
467	TV-970093	0.02	0.31	1.2	1.2	0.02	0.02
469	TV-970095	0.02	0.38	1.2	1.2	0.02	0.02
476	TV-970097	0.01	0.21	1.2	1.1	0.01	0.01
478	TV-970099	0.04	0.59	1.4	1.0	0.04	0.04
480	TV-9700380	0.01	0.19	1.3	1.2	0.01	0.01
482	TV-9700101	0.03	0.43	1.3	1.2	0.03	0.02
484	TV-9700384	0.14	2.36	1.3	1.2	0.15	0.13
486	TV-9700388	0.14	2.36	1.3	1.2	0.15	0.13
488	TV-970065	0.10	1.61	1.3	1.2	0.10	0.09
490	TV-9700411	0.20	3.38	2.3	1.3	0.20	0.18
492	TV-9700415	0.20	3.38	2.3	1.3	0.20	0.18
494	TV-9700392	0.13	2.13	2.3	1.3	0.13	0.11
496	TV-9700115	0.13	2.13	2.3	1.3	0.13	0.11
503	TV-9700117	0.03	0.47	2.3	1.1	0.03	0.03
505	TV-9700398	0.03	0.45	2.4	1.1	0.03	0.03
507	TV-9700402	0.05	0.85	2.3	1.3	0.05	0.04

ITEM	VALVE	VOLUMETRIC FLOW RATE		P in	P out	ΔP	CV
		(m³/hr)	(lpm)	(barG)	(barG)	(bar)	(Calculated)
509	TV-9700119	0.16	2.62	2.3	1.3	0.16	0.14
511	TV-9700406	0.17	2.76	2.3	1.3	0.17	0.15
530	TV-970023	0.04	0.64	1.2	1.4	0.04	0.03
533	TV-970031	0.08	1.28	1.2	1.4	0.08	0.07
536	TV-970021	0.04	0.59	1.2	1.4	0.03	0.03
539	TV-970037	0.05	0.76	1.2	1.4	0.04	0.04
542	TV-9700155	0.08	1.28	1.2	1.4	0.08	0.07
550	TV-970041	0.10	1.61	1.2	1.3	0.10	0.08
553	TV-9700168	0.10	1.61	1.2	1.3	0.10	0.08
556	TV-9700180	0.08	1.28	1.2	1.4	0.08	0.07
559	TV-970039	0.05	0.76	1.2	1.3	0.04	0.04
568	TV-9700192	0.08	1.28	1.2	1.3	0.08	0.07
571	TV-9700204	0.03	0.43	1.2	1.3	0.03	0.02
609	TV-970033	0.13	2.16	1.2	1.3	0.13	0.11
610	TV-9700430	0.02	0.41	2.3	1.2	0.03	0.02

5.4 HEATING HOT WATER SKID

The utility used to heat the water is steam saturated at 2,0 barG at the steam nozzle – inlet skid.

The skid needs to have a temperature control valve to be controlled by TIC-970005, keeping the water temperature outlet 61.1 °C. For this temperature control valve (TV-970005) was considered a pressure drop of 0.5 barG for the design condition. The heat exchanger shall be sized to operate it 1.5 barG 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 barG
Enthalpy of Vaporization:	520.7 kcal/kg

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

5.4.1 DESIGN CONDITION

HEAT EXCHANGER - HX-7A-1		
SIDE - WATER		
Thermal Load	574,615.02	kcal/h
Flow rate	66,815.70	kg/h
Temperature Inlet	52.5	°C
Temperature Outlet	61.1	°C
SIDE – PLANT STEAM		
Operating Pressure	1.5	barG
Enthalpy of Vaporization	520.7	kcal/kg
Flow rate	1,103.54	kg/h

5.4.2 MAXIMUM CONDITION

HEAT EXCHANGER - HX-7A-1		
SIDE - WATER		
Thermal Load	469,591.83	kcal/h
Flow rate	57,974.30	kg/h
Temperature Inlet	53.0	°C
Temperature Outlet	61.1	°C
SIDE – PLANT STEAM		
Operating Pressure	1.5	barG
Enthalpy of Vaporization	520.7	kcal/kg
Flow rate	901.85	kg/h

5.4.3 MINIMUM CONDITION – 50%

HEAT EXCHANGER - HX-7A-1		
SIDE - WATER		
Thermal Load	235,439.36	kcal/h
Flow rate	36,787.40	kg/h
Temperature Inlet	54.7	°C
Temperature Outlet	61.1	°C
SIDE – PLANT STEAM		
Operating Pressure	1.5	barG
Enthalpy of Vaporization	520.7	kcal/kg
Flow rate	452.16	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 7A-M-0-5-47, 7A-M-0-5-48, 7A-M-0-5-49 and 7A-M-0-5-50, for this system were elaborated based on these calculations.

6. RESULTS

VISUAL REPORT

- Design Condition
- Maximum Operating Condition
- Minimum Operating Condition 10%
- Minimum Operating Condition 50%

Visual Report - Design Condition.p

Visual Report - Maximum Operating

Visual Report - Minimum Operating

Visual Report - Minimum Operating

OUTPUT

- Design Condition
- Maximum Operating Condition
- Minimum Operating Condition 10%
- Minimum Operating Condition 50%

Output - Design Condition.pdf

Output - Maximum Operating Conditio

Output - Minimum Operating Conditio

Output - Minimum Operating Conditio

7. PUMPS SELECTED

a) DESIGN CONDITION

Jct	Results Diagram	Name	Vol. Flow (m3/hr)	dH (meters)	Ideal Power (hp)	Overall Efficiency (Percent)	Overall Power (hp)	Speed (Percent)	NPSHA (meters)	P Static Suction (barG)	P Static Disc. (barG)	dP (bar)
3	Show ...	P-7A-X (A/B)	67,7	34,6	8,44	70,0	12,1	100	17,6	0,807	4,15	3,35

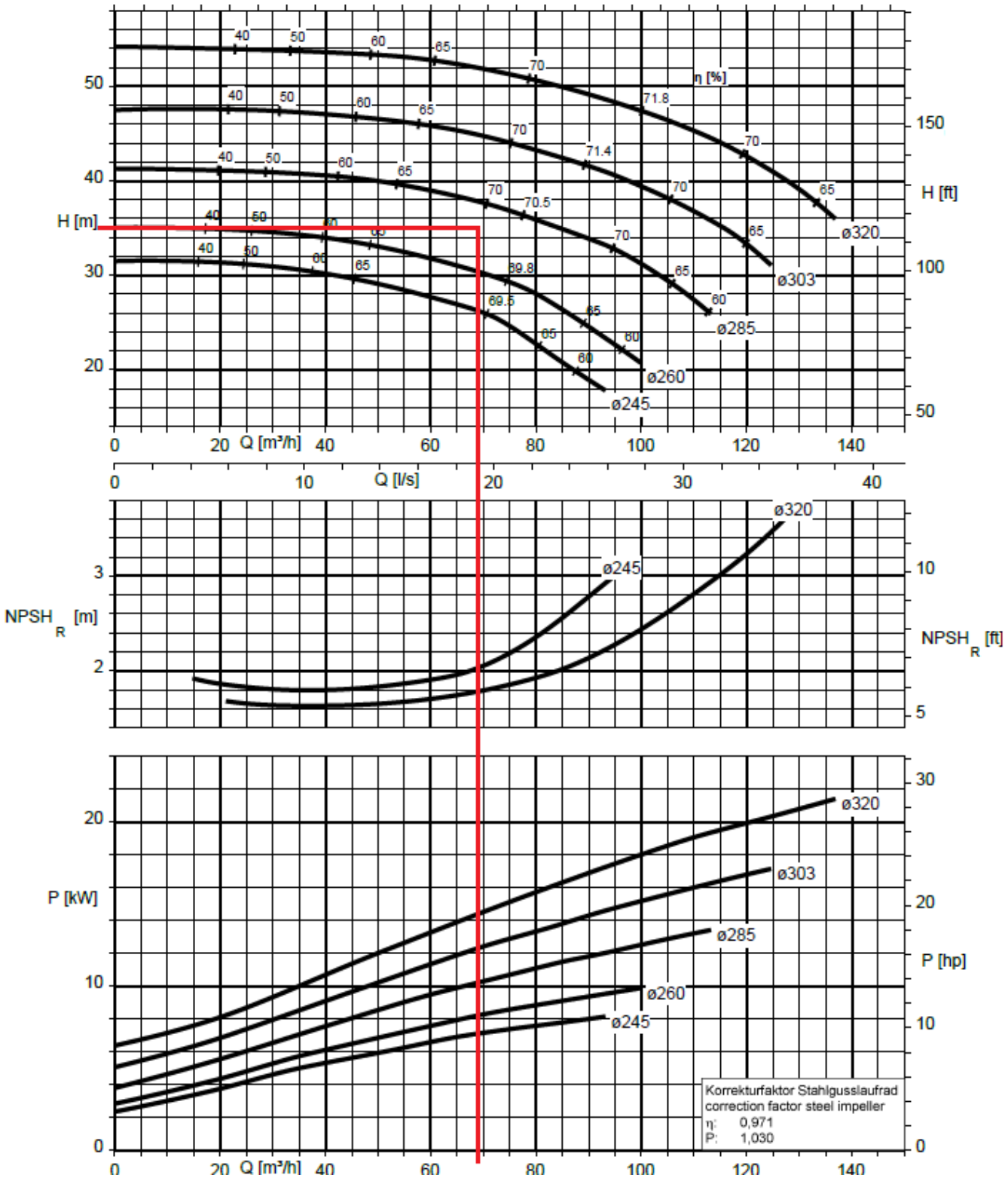
P-7A-X - The pump head will be rounded to 35 mlc.

b) MAXIMUM OPERATING CONDITION

Jct	Results Diagram	Name	Vol. Flow (m3/hr)	dH (meters)	Ideal Power (hp)	Overall Efficiency (Percent)	Overall Power (hp)	Speed (Percent)	NPSHA (meters)	P Static Suction (barG)	P Static Disc. (barG)	dP (bar)
3	Show ...	P-7A-X (A/B)	58,8	31,7	6,72	68,8	9,77	94,7	17,7	0,822	3,89	3,07

c) MINIMUM OPERATING CONDITION – 10%

Jct	Results Diagram	Name	Vol. Flow (m3/hr)	dH (meters)	Ideal Power (hp)	Overall Efficiency (Percent)	Overall Power (hp)	Speed (Percent)	NPSHA (meters)	P Static Suction (barG)	P Static Disc. (barG)	dP (bar)
3	Show ...	P-7A-X (A/B)	20,2	15,7	1,14	51,0	2,23	64,3	17,5	0,863	2,37	1,51

- Pump (P-7A-X)

Meganorm 100-065-315, 1750 rpm