TEMA Heat Exchanger Specification Sheet

Job No. HX-2026-0101			**TEMA**
Customer: —	PO No. —		
Address: —	Proposal No. —		
Plant Location: —	Date: 2026-10-18	Rev. A	
Service of Unit: Closed-loop hot water cooler (hot water / cooling water)	Item No. E-101	Sheet 1 of 2	

Size: **508 / 2325** mm TEMA Type: **BEU** Hor./Vert: **Horizontal** Connected in: **1** parallel **1** series

Surf/unit(eff.): **22.1** m² Shells/unit: **1** Surf/shell (eff.): **22.1** m² (gross outside surface incl. U-bends; 68 U-tubes)

PERFORMANCE OF ONE UNIT

Fluid Allocation: cold fluid → shell side; hot fluid → tube side

		Shell Side		Tube Side	
		Inlet	Outlet	Inlet	Outlet
Fluid Name:		Cooling tower water (treated)		Hot water, closed loop (inhibited)	
Fluid Quantity, Total:	kg/hr	38,000		36,000	
Vapor:	kg/hr	—	—	—	—
Liquid:	kg/hr	38,000	38,000	36,000	36,000
Steam:	kg/hr	—	—	—	—
Water:	kg/hr	—	—	—	—
Noncondensable:	kg/hr	—	—	—	—
Temperature:	°C	32.0	45.3	85.0	71.0
Density (Vapor / Liquid):	kg/m³	– / 995	– / 990	– / 969	– / 977
Viscosity (Vapor / Liquid):	mPa·s	– / 0.765	– / 0.596	– / 0.334	– / 0.400
Specific Heat (Vapor / Liquid):	kJ/(kg·°C)	– / 4.178	– / 4.180	– / 4.202	– / 4.191
Thermal Conductivity:	W/(m·°C)	– / 0.620	– / 0.637	– / 0.672	– / 0.663
Latent Heat:	kJ/kg @ °C	— @ —		— @ —	
Inlet Pressure (abs):	kPa(abs)	600		1,000	
Velocity:	m/s	0.5 (cross-flow)	1.4 (nozzle)	1.0 (in tubes)	1.4 (nozzle)
Pressure Drop, allowable/calculated:	kPa	50 / 5		50 / 10	
Fouling Resistance (Min.):	(m²·°C)/kW	0.35		0.18	
Average Film Coefficient:	W/(m²·°C)	3,500 (ref. to OD)		4,200 (ref. to OD; 6,500 inside)	

Heat exchanged: **587** kW Mean Temperature Difference (MTD) **38.6** (LMTD 39.4 × F 0.98) °C

Transfer Rate, Required: Fouled (service): **690** Clean: **1,600** W/(m²·°C)

CONSTRUCTION OF ONE SHELL

		Shell Side	Tube Side
Design Internal/External/Test pressure:	kPa(g)	1,600 / nil / per UG-99(b)	1,600 / nil / per UG-99(b)
Design Temperature / MDMT:	°C	150 / –45	150 / –45
Number of passes:		1	2
Corrosion allowance:	mm	3.0	3.0 (tubes: nil)
Future Machining Allow. (Tubesheet, Flange, Cover):	mm	Nil	Nil
Minimum Radiography:		Spot RT – UW-11(a)(5)(b)	Spot RT – UW-11(a)(5)(b)
Special Service (Lethal, Sour, etc.):		None	None
Post-weld Heat Treatment (PWHT) required:		No (UCS-56)	No (UCS-56)

Connections:			
Number/Size/Rating	In	N3: 4" 600# RF WN, top @ 230 from flg.	N1: 4" 600# RF WN, top of bonnet
Type and Facing	Out	N4: 4" 600# RF WN, bottom @ 2,049	N2: 4" 600# RF WN, bottom of bonnet
	Intermediate	None	None
	Vent	V3: 1" 3000# half-cplg + plug, on N3 neck	V1: 1" 3000# half-cplg + plug, on N1 neck
	Drain	D1: 1" 3000# full cplg + hex plug @ 649	V2: 1" 3000# half-cplg + plug, on N2 neck
	Other	V4 on N4 neck; nameplate bracket; 2 lugs	1 lifting lug on bonnet

EXCHANGER CONFIGURATION PER SHELL

Number of Tubes: **68 U-tubes** (136 holes)	Tube OD (mm): **21.3**	Tube thk. (mm): **3.73** (BWG): 9
Tube type (plain/finned/other): **Plain**, smls	Tube Pitch (mm): **25** (rows 25, stagger 12.5)	Tube min. or avg. wall: **Average**
Tube Length (m): **2.325** straight (tangent)	Tube Layout: **30° staggered** – see Rem. 1	☑◁30 ☐△60 ☐□90 ☐◇45 (25 × 25, offset 12.5)
Tube to Tubesheet Joint: **Expanded**, 2 grooves	Shell Diameter (mm): OD **508** (NPS 20 smls pipe)	Girth Flange Type: **Plate ring, loose type**, RF
Cross Baffle Type: **Single segmental**	Number of Cross Baffles: **6** (+1 full support)	Baffle Spacing (mm): **303** c/c (alternating cut)
Baffle Cut (% of Dia.) **35**	Vert. or Horiz. Cut: **Horizontal**	Inlet Spacing (mm): **350** (TS to 1st baffle)
Long. Baffle Seal Type: N/A	Tube Support Type: **Full support plate** @ 2,222	U-bend Support Type: None (bend tangent @ 2,325)
Expansion Joint Req. (Y/N): **N** (U-tube)	Expansion Joint Type: —	Bypass Seal Type: **None**
Impingement Protection Req. (Y/N): **N**	Impng. Protection Type: —	Sets of Spare Gaskets req'd: **1** set
Support Type: **2 saddles** (1 fixed + 1 sliding)	Number of Supports: **2** @ 1,250 mm c/c; CL height 615 mm; 2 anchor bolts per saddle	
ρV² Inlet Nozzle (kg/(m·s²)): **2,040**	ρV² Bundle Ent. (kg/(m·s²)): **220**	ρV² Bundle Exit (kg/(m·s²)): **220**
Total Weight/Shell Empty (kg): —	Full of Water (kg): —	Bundle Weight (kg): —

Remarks: 1. Tube layout: 4 rows per pass at 30 / 55 / 80 / 105 mm from the horizontal pass-partition centreline, 25 mm c/c in-row, alternate rows staggered 12.5 mm; 18 / 18 / 16 / 16 tubes per row (inner→outer) = 68 per pass; U-bend radii (CL) 30 / 55 / 80 / 105 mm; bundle envelope 446 w × 231 h mm.

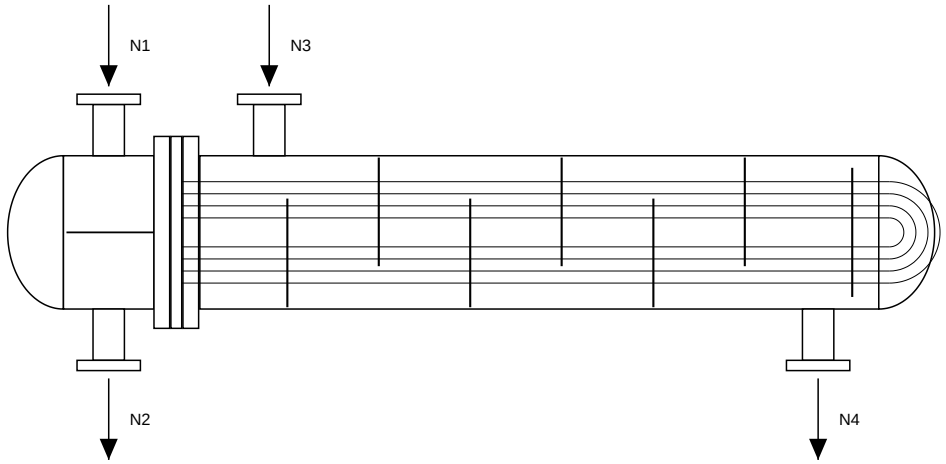
2. Baffle stations from tubesheet rear face: 350 (window up) / 653 (window down) / 956 / 1,259 / 1,563 / 1,866; full support plate 2,222; bend tangent 2,325; bundle overall length 2,441. Shell-side inlet nozzle ρV² 2,040 kg/(m·s²): no impingement protection required.

3. Heat balance: 36,000 kg/h × 4.197 kJ/kg·K × 14 K = 38,000 kg/h × 4.179 kJ/kg·K × 13.3 K = 587 kW; required surface 19.0 m² (fouled); installed surface 22.1 m² (16 % excess).

4. Mechanical design per ASME VIII Div. 1 (2025) and TEMA R: girth flanges loose-type plate rings per App. 2, tubesheet per UHX-12, nozzles per UG-37 / UG-45, saddles per Zick. Materials, NDE and testing: see Mechanical Datasheet MDS-E-101.

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EXCHANGER SKETCH



DESIGN AND CODE REQUIREMENTS

Design Code: **ASME VIII-1 (2025) + TEMA R**	Code Stamp Required: **Y** – ASME "U" + CRN	Calculate MAWP (Y/N): **Y** (hot & corroded)
TEMA Class (R, C, B): **R**	Customer Inspection (Y/N): **Y** (ITP; hydrotest)	Cyclic Service (Y/N): **N**
Baseline UT (Y/N): **N**	Baseline Eddy Current (Y/N): **N**	

DESIGN, OPERATING, AND UPSET CONDITIONS (if applicable)

		Shell Side			Shell	Tube Side			Tubes
	Design	Fluid Temperature		Pressure	Mean Metal	Fluid Temperature		Pressure	Mean Metal
Condition/Case	Cycles	In (°C)	Out (°C)	(kPa)	Temp. (°C)	In (°C)	Out (°C)	(kPa)	Temp. (°C)
Design	—	150	150	1,600 g	150	150	150	1,600 g	150
MDMT @ design P	—	–45	–45	1,600 g	–45	–45	–45	1,600 g	–45
Normal operating	—	32.0	45.3	500 g	40	85.0	71.0	900 g	65
Upset: CW failure	—	85	85	500 g	85	85	85	900 g	85
Winter start (cold)	—	5	5	500 g	5	5	5	900 g	5
Hydrotest (each side)	—	amb.	amb.	UG-99(b)	amb.	amb.	amb.	UG-99(b)	amb.

MATERIALS

	Shell Side	Tube Side
Tubes: **SA-179** smls, 21.3 OD × 3.73 wall		
Stat. Tubesheet: **SA-516 Gr 70N** (impact tested)	Shell: **SA-333 Gr 6** smls pipe, NPS 20	Channel/Bonnet: **SA-333 Gr 6** smls, NPS 20 × 286 lg
Floating Tubesheet: N/A	Shell Cover/Head: **SA-516 Gr 70N** torisph. L425/r77	Channel Cover/Head: **SA-516 Gr 70N**, as shell cover
Floating Head Cover: N/A	Girth Flanges: **SA-516 Gr 70N** plate ring, loose, RF	Girth Flanges: **SA-516 Gr 70N** plate ring, loose, RF
Cross Baffles: **SA-516 Gr 70** plate (6 + 1 full)	Gaskets: **CNAF** flat ring	Gaskets: **CNAF** flat ring with 13 mm partition rib
Long. Baffle: N/A	Nozzle Flanges: **SA-350 LF2**, 4" Cl.600 WN RF	Nozzle Flanges: **SA-350 LF2 Cl.1**, 4" Cl.600 WN RF
Tie Rods/Spacers: **SA-36** rods / **SA-106 B** pipe	Nozzle Necks: **SA-333 Gr 6** smls pipe, NPS 4	Nozzle Necks: **SA-333 Gr 6** smls pipe, NPS 4
Supports: **SA-36** fabricated saddles, 2 off	Expansion Joint: N/A (U-tube bundle)	
Insulation Type/Thk: None		
External Bolting: Girth studs **SA-193 B7** (double-end, UNC) with **SA-194 2H** heavy hex nuts; nozzle bolting by piping		
Internal Bolting: Tie-rod nuts **SA-194 2H**; pass partition welded (no internal bolting)		
Paint Requirements: ext. CS – SSPC-SP10 blast, inorganic zinc 75 µm + epoxy 125 µm + polyurethane 50 µm; internal none; machined faces rust-preventive		

Other Requirements and Applicable Specifications:

1. Couplings/plugs ASME B16.11 Cl.3000 threaded, 1" NPS, SA-350 LF2. Nameplate + SS 304 bracket per UG-116; grounding lug on fixed saddle.
2. Hydrotest UG-99(b): 1.3 × MAWP × LSR, each side separately (other side open); tube-to-tubesheet joints expanded, 2 grooves (TEMA R), tested under shell-side test.
3. NDE: spot RT on Cat. B/C butt welds (UW-11(a)(5)(b)); MT on lifting-lug & saddle welds; PT on nozzle (Cat. D) welds; UG-84 impact tests for –45 °C parts.
4. Registration: CRN per CSA B51 (provincial authority); MDR (Form U-1), material certs EN 10204 3.1, weld maps and NDE reports; TEMA R tolerances per RCB-1.
5. Units: dimensions mm, pressures kPa, temperatures °C; nozzle stations measured from flange faces, baffle stations from tubesheet rear face.
6. Component requirements, bundle geometry, overall dimensions, fabrication and testing: Mechanical Datasheet MDS-E-101.