

# Validation

## Valve Test Requirements

ID	Requirement	Symbol / Range	Units	Notes / Justification
V1	Valve types under test	TXV, EXV (PAM style)	–	Project scope: both TXV & Fujikoki EXV
V2	Valve size variance (nameplate)	0.5 – 25	tons	Meet Daikin spec for 0.5–25 ton range
V3	TXV mass flow range	20 – 2000	lb/hr	From Daikin requirement; wide characterization window
V4	EXV mass flow range	80 – 1700	lb/hr	Practical EXV range based on PAM + bench capability (your choice)
V5	Approx. working tonnage (bench capability)	~0.8 – 15 (focus 2–6)	tons	Reflects realistic compressor/HX sizing for this prototype
V6	Characterization accuracy	±3	%	Design requirement for measurement accuracy
V7	Required SH range during tests	6 – 10	K	Standard SH band for stable characterization (Daikin-like practice)

## Operating Envelope

ID	Quantity	Symbol	Min	Nominal	Max	Notes
O1	Cooling capacity	Q_evap	0.8 ton	4 ton	15 ton	Focus on 2–6 ton range for current components
O2	Refrigerant mass flow	m_ref	0.0025	0.05	0.25	kg/s, consistent with 20–2000 lb/hr window
O3	Compressor speed	N_comp	N_low	N_nom	N_high	Fill with real rpm/Hz when you pick compressor
O4	Condenser water inlet T	T_cw,in	20 °C	30 °C	40 °C	Room-temp → hot-day supply
O5	Evaporator water inlet T	T_ew,in	5 °C	12 °C	18 °C	Cold coil → nominal building loop
O6	Superheat at compressor inlet	SH_comp	>0 K	11.1 K	maybe 15 K	Control target band
O7	Subcooling at condenser outlet	SC_cond	2 K	8.3 K	12K	Reasonable AC values

ID	Quantity	Symbol	Min	Nominal	Max	Notes
O8	Condenser pressure	p_cond	~1.5 MPa	~2.5 MPa	~3.5 MPa	For R-32, tune later with P-h check
O9	Evaporator pressure	p_evap	~0.5 MPa	~1.0 MPa	~1.4 MPa	Ditto, tune with P-h

## Safety Limits

ID	Limit Description	Symbol	Limit Value	Justification
S1	Max discharge pressure (bench)	p_dis,max	4.0 MPa	Below EXV 4.29 MPa and piping/compressor rating
S2	Min suction pressure	p_suct,min	> 0.2 MPa	Avoid near-vacuum, compressor limits
S3	Max discharge temperature	T_dis,max	from compressor datasheet (e.g. 120–140 °C)	To be filled once compressor is chosen
S4	Min evaporator outlet temperature	T_evap,out,min	2–3 °C above freezing	Freeze protection margin
S5	EXV operating temp range	T_EXV,op	–30 to 70 °C	From PAM spec
S6	Max SH≈0 duration at compressor	t_SH≈0,max	e.g. 5–10 s	Your design call for safe start-up/load steps

## Signal Mapping

Signal ID	Physical Quantity	Symbol	Model Variable Name	Sensor Location on Bench	Used in Which Phases?
M1	Discharge pressure	p_dis	e.g. p_comp_out	Pressure transducer at compressor discharge	2,4,6
M2	Suction pressure	p_suct	e.g. p_comp_in	Sensor at compressor inlet	2,4,6
M3	Valve $\Delta p$	$\Delta p_{\text{valve}}$	p_up_valve – p_down_valve	Two sensors around EXV	1,2,3
M4	Refrigerant mass flow	$\dot{m}_{\text{ref}}$	m_flow_EXV	Coriolis meter in liquid line	1,2,3,5

## README — EXV Component Validation

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