

SPECIFICATIONS
OF
MECHANICAL VAPOR RECOMPRESSION EVAPORATOR

GENERAL

This system consists of a two-stage recirculated falling film, mechanical vapor recompression evaporator. The evaporator is designed to concentrate centrifuged thin stillage containing 5% to 7% total solids (4% to 6% dissolved plus 1% suspended) to 30% T.S. The feed is preheated using tubular preheaters with evaporator condensate as the heating medium.

The evaporator components are constructed of Type 304 stainless steel for all parts in contact with the liquor, vapor and condensate unless otherwise noted.

The vapor separator, steam chest, tubular preheater, condensate receiver, vapor duct and circulating piping have a mill finish. All welds are stainless steel power wire brushed. All mild steel parts are prime painted.

This equipment is designed and stamped in accordance with the ASME Code for Unfired Pressure Vessels, Volume VIII, latest edition for an internal pressure of 25 psig and full vacuum at 366°F. In addition, the tubular preheaters are designed for 200 psig and full vacuum at 366°F on the shell side and 175 PSIG and full vacuum on the tubeside.

VESSEL DESIGNS

All fabricated vessels excluding compressor lube oil system are designed, fabricated and tested in accordance with Section VIII of the ASME Code. Welding qualifications are in accordance with ASME Section IX. Each vessel is provided with an ASME stamp and supporting papers.

VAPOR SEPARATOR (DA-675X)

The vapor separator is 13'-0" diameter by 18'-0" on the straight side and has a dished head top and bottom. Construction is of Type 304 stainless steel in contact with liquor, vapors or its condensate and includes external carbon steel reinforcing and supports. The separator is complete with a two-stage entrainment

device, 6" sight glasses with wash, support lugs, 20" quick-opening manhole, liquor drain, vapor inlet and outlet, wash piping and spray nozzles.

STEAM CHEST (EA-676X)

The steam chest is of the vertical recirculated falling film design with Type 304 stainless steel construction in contact with the liquor, vapors or its condensate. The unit has external carbon steel reinforcing and supports. The chest is provided with vapor inlet, liquor chambers, liquor connections, vapor impingement baffles, vent and condensate connections, pressure gauge connections, 20" quick-opening manholes and 6" sight glasses with wash.

The recirculated falling film chest is 109" diameter and contains 1-1/2" O.D. 18 gauge 44'-0" long welded and annealed Type 304 stainless steel tubes rolled into 1-1/4" thick tubesheets. This chest has the equivalent of 45,600 square feet of heat transfer surface when measured on the outside of the tubes. The chest is designed for two-pass operation on the tubeside.

TUBULAR FEED PREHEATERS (EA-675XA/675XB)

A tubular preheating system utilizes the evaporator condensate to preheat the feed. There are two (2) vertical heat exchangers of Type 304 stainless steel construction in contact with the liquor, vapors or its condensate. The units have external carbon steel reinforcing and supports. The exchanger is arranged for four passes each on the tubeside or liquor side, and each shellside is baffled for the condensate flow.

Each exchanger is 18" diameter and contains 1" O.D. 18 gauge 36'-0" long welded and annealed Type 304 stainless steel tubes rolled into 1" thick Type 304 stainless steel tubesheets. Each heater has the equivalent of 867 square feet of heat transfer surface when measured on the outside of the tubes. All necessary nozzles, support pads and flanged covers are supplied.

CONDENSATE RECEIVERS (FA-676X/FA-677X)

Two (2) 3'-0" diameter by 6'-0" straight side, horizontal condensate receivers of Type 304 stainless steel in contact with the liquor, vapors or its condensate are provided. The units have external carbon steel reinforcing and supports. The receivers are complete with process connections, 20" quick-opening manhole, level gauge and support lugs.

COMPRESSOR AND DRIVE (GB-675X)

The following are provided:

- One (1) AC Compressor Corporation Single Stage Centrifugal Compressor Model D24JR
- Cast iron (ASTM A-278 Class 40) casing and inlet nozzle with liberal 1/4" corrosion allowance
 - Backplate and baseplate are of heavy fabricated steel
 - Inlet nozzle is nickel plated
 - 400 Series stainless steel open radial bladed impeller that has been dynamically balanced, oversped and subjected to rigorous inspection
 - 1/4" nominal clearance between impeller and backplate
 - Steel shaft with integral thrust collar
 - Type 316 stainless steel shaft sleeve under seal
 - Pivoted shoe radial bearings are provided for optimum shaft stability
 - Kingsbury type double acting thrust bearing
 - Special alloy labyrinth shaft seal with provisions for steam buffering. Oil baffle is supplied with air purge provision to exclude steam from bearing housing
 - Casing drain and lifting lugs on casing
 - Heavy duty bearing housing is horizontally split for ease of inspection and maintenance
 - Spacer type coupling for ease of train disassembly
 - Horizontally split shaft seal
- One (1) Inlet guide vane mechanism with cast Type 316 stainless steel vanes. Guide vanes are supplied with Miller air cylinder Model 84B. The cylinder is adequate to operate the vanes with a supply pressure of 60 psig minimum and 100 psig maximum. Housing is nickel plated.
- One (1) Speed Increasing Gear
- supplied with a shaft driven main oil pump.
- Service factor: 1.5 minimum
Approximate Input RPM: 1785
- One (1) Induction Motor (General Electric)
- | | |
|------------------|-------|
| Rated HP: | 2000 |
| Service Factor: | 1.0 |
| Approximate RPM: | 1785 |
| Enclosure: | WP2 |
| Voltage: | 4000 |
| Phase: | 3 |
| Cycle: | 60 Hz |
- Two (2) Couplings and guards
- One (1) Bedplate for compressor, gear and motor

One (1) Standard pressure lubricating system with the following features:

- Oil Reservoir, ASTM A13 Grade B (equivalent to SA-36) including the following:
 - Three (3) minute retention time based on equipment requirements
 - Sloping reservoir bottom with pump suction at high end and drain at low end
 - "Manhole" access cover to reservoir
 - Oil level gauge mounted on oil reservoir
 - Dust-tight oil fill opening
 - Heater (Electric)
- One shell and tube cooler with fixed bundle
- Dual oil filter with throw-away 10 micron filtration cartridge and transfer valve
- Shaft driven main oil pump, off gear low speed side
- Motor driven auxiliary oil pump (motor manufacturers standard)
- United Electric, or equal, pressure switches to:
 - Alarm on falling oil pressure
 - Start auxiliary oil pump
 - Shutdown compressor on minimum oil pressure
- Carbon steel oil piping supplied upstream of the oil filters and stainless steel downstream

Note: All interconnecting piping between equipment and the oil system furnished by others.

One (1) Bentley Nevada 7200 series vibration monitoring system: The system provides the following:

Compressor:	Monitor inboard radial bearing	1 point
	Monitor outboard radial bearing	1 point
	Monitor axial position	1 point
Gear:	Monitor two radial H.S. bearings	2 points
	Monitor axial position	1 point

This system has rack mounted monitors and power supply suitable for mounting in panel. Included are the proximitors and weatherproof mounting boxes and cables between probe and proximitor. Cables between proximitors and monitors are not included.

Scope of Supply:

- Four (4) radial vibration probes
- Two (2) axial position probes
- Six (6) proximitors
- One (1) proximitor mounting rack

- Six (6) extension cables, probe-to-proximator
- Four (4) axial thrust position monitors
- One (1) power supply
- One (1) mounting rack for monitors and power supply

One (1) Temperature monitor system, Bentley Nevada 9000 series; for alarm and shutdown points that accepts connection to the compressor and gear. Includes RTD's at the following:

Compressor: Three RTD's. One for each journal bearing; one for thrust bearing.

Gear: Four RTD's. One for each High Speed journal bearing (2 bearings); one for each Low Speed journal bearing (2 bearings)

One (1) Annunciator

One (1) Ammeter

One (1) Panel

The following is not included with compressor

- Utilities
- Motor starters
- Foundation
- Electrical wiring
- Process piping

No supplier service or start-up time for the compressor train has been included in the price. This service can be procured directly from the manufacturer.

INTERCONNECTING VAPOR DUCT AND PIPING

Type 304 stainless steel vapor duct and Type 304 stainless steel expansion joints are included to interconnect the separator, chest and centrifugal compressor. This piping is prefabricated with a minimum of field welds as required for proper alignment.

INTERCONNECTING CIRCULATING PIPE

Type 304 stainless steel liquor circulating piping and Type 304 stainless steel expansion joints are supplied to connect the circulating pumps with the steam chest. Type 304 stainless steel piping is supplied to connect the condensate outlet of EA-676X to FA-676X, and the liquor drain line from DA-675X to the liquor circulating piping. This piping is prefabricated with a minimum of field welds as required for proper alignment.

PUMPS AND MOTORS

The following centrifugal pumps, Goulds or equivalent, are supplied complete with baseplates, couplings, coupling guards, mechanical seals and TEFC Mill and Chem duty motors manufactured in the U.S. suitable for 3/60/230-460 current. The pumps are of Type 316 stainless steel construction.

<u>Service</u>	<u>BHP</u>	<u>Motor HP</u>	<u>RPM</u>	<u>S.F.</u>
1A Circulating	104	125	1200	1.15
1B Circulating	104	125	1200	1.15

VALVES AND INSTRUMENTS

Valves and instruments critical to the control and monitoring of system performance follows.

I/P transducer when associated with a valve is part of valve.

<u>Instrument Tag</u>	<u>Description</u>
FE 6703X	Steam Orifice Plate
FT 6703X	Steam Flow Transmitter
FY 6703X	I/P Transducer (part of valve)
FV 6703X	Steam Control Valve
LT 6703X	Filled Capsule Level Transmitter
LT 6704X	Filled Capsule Level Transmitter
LY 6704X	I/P Transducer (part of valve)
LV 6704X	Level Control Valve
DE 6701XZ	Density Element
DT 6701X	Density Transmitter
PT 6703X	Suction Pressure Transmitter
PY 6703X	I/P Transducer (part of valve)
PV 6703X	Vent Control Valve
PT 6714X	Compressor Suction Pressure Transmitter
TT 6706X	RTD Temperature Probes (2 required)
TY 6706X	I/P Transducer (part of valve)
TV 6706X	Superheat Control Valve
HY 6706X	I/P/ Transducer (part of valve)
HV 6706X	Antisurge/Start-up Control Valve
PT 6715X	Compressor Discharge Pressure Transmitter

<u>Instrument Tag</u>	<u>Description</u>
LSH 6706X	Level Sensing Transmitter
LT 6701X	FA-676X Level Transmitter
LT 6705X	FA-677X Level Transmitter
FE 6704X	Desuperheating Water Vortex Flow Element
FT 6704X	Flow Transmitter
FE 6708X	Tray Wash Vortex Flow Element
FT 6708X	Flow Transmitter
PDI 6708X	Pressure Drop Mesh (local only)
PDI 6712X	Pressure Drop Tray (local only)
HY 6707X	Guide Vane I/P Transducer (not part of guide vane)
PT 6713X	Compressor Oil Pressure Transmitter
PSL 6713AX	Alarm Low Oil Pressure
PSL 6713BX	Start Auxiliary Oil Pump
PSL 6713CX	Shutdown Compressor
LG 6707X	Bullseye-type Level Glass
LG 6702X	FA-676X Level Glass
LG 6708X	FA-677X Level Glass
PG 6702X	Pressure Gauge FA-676X
PG 6706X	Pressure Gauge Steam Line
PG 6705X	Pressure Gauge Liquor Pipe
PG 6707X	Pressure Gauge Liquor Pipe
PG 6716X	Pressure Gauge FA-677X
PG 6717X	Pressure Gauge EA-676X
PG 6718X	Pressure Gauge DA-675X
PG 6719X	Pressure Gauge in Compressor Discharge Pipe
TG 6704X	Temperature Gauge
TG 6705X	Temperature Gauge
TG 6715X	Temperature Gauge Suction Pipe Compressor
TG 6716X	Temperature Gauge Discharge Pipe Compressor
IIT 6701X	GB-675X Compressor Motor Current

The following manual valves are supplied:

<u>Quantity</u>	<u>Description</u>
14	1/4" diameter with screwed ends for the 14 wash-type sight glasses
3	2" diameter with flanged ends for the 3 spray wash connections on DA-675X
2	Appropriate diameter with appropriate ends for manual control upstream and downstream of Item FE-6708
2	Appropriate diameter with appropriate ends for manual control upstream and downstream of Item FE-6704
6	1" diameter or smaller with appropriate ends to isolate Items PT-6703, PT-6714, PT-6715, PDI-6708 and PDI-6712
1	6" diameter with flanged ends (normally closed) to connect suction lines of liquor circulating pipe

Control panel and field required air and electrical interconnections is supplied by Customer. No calibration and/or start-up time is included. This may be procured locally by Customer.

SPARE PARTS

No spare parts have been included.

OPERATION

The following statements reflect Dedert Corporation's process guarantee for capacity, utilities, operating time and cleaning time.

The following qualifications are assumed in guarantee:

Stillage Properties

Feed: 4% to 6% dissolved solids (maximum)
Feed: 0.5% to 1% suspended solids (maximum)
Feed: 87.8°C (minimum)

Product: 30% total solids (minimum)
Product: Viscosity of product not to exceed 35 cps at 102°C
Product: Boiling point elevation of product not to exceed 2.8°C at atmospheric boiling

Evaporation: 107,000 lb/hr

Utilities Guarantee

Compressor BHP: 1800 average over length of operating time

Make-up steam: 1,500 lb/hr at 20 psig (average over operating time) includes 1.5% for radiation losses. This excludes steam required for start up, cleaning cycle and steam ejector on compressor seal.

Motor: 2000 HP, WP11, 3/60/4160V, 1.15 S.F.

Operating Time

Operation: 10 days consecutive (minimum)
Cleaning: 12 hours (the time for Buyer's addition and removal of cleaning solution will not exceed 1 hour)