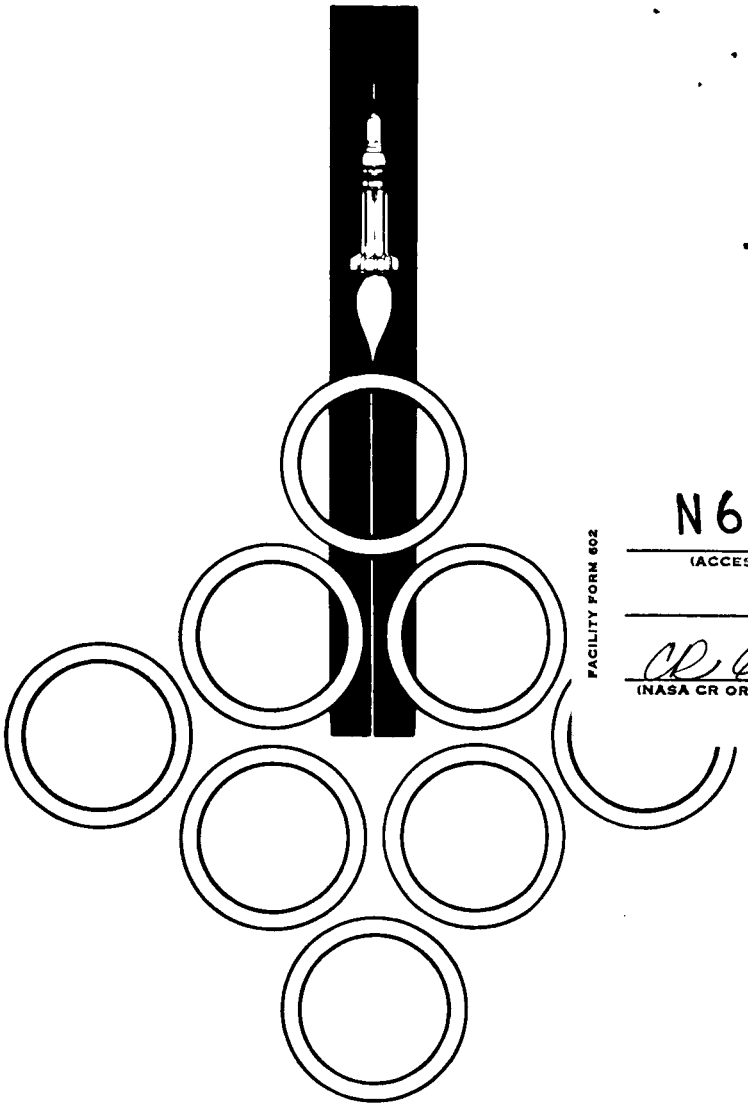

ENGINEERING DEPARTMENT

# TECHNICAL MANUAL

SDES-64-414



# Saturn I

## LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION

### Volume VI

ENVIRONMENTAL CONDITIONING SYSTEMS FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS



SPACE DIVISION CHRYSLER CORPORATION

SDES-64-414

# SATURN I
# LAUNCH VEHICLE SA-8
# AND
# LAUNCH COMPLEX 37B
# FUNCTIONAL SYSTEMS DESCRIPTION

## VOLUME VI
## ENVIRONMENTAL CONDITIONING SYSTEMS FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS

MAY 1964

CHRYSLER CORPORATION SPACE DIVISION - NEW ORLEANS, LOUISIANA

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# FOREWORD

This volume is part of a ten-volume set that describes the mechanical and electromechanical systems of launch vehicle SA-8 and launch complex 37B that function either during the prelaunch countdown or in the event of a launch abort. The mechanical and electromechanical systems of the launch vehicle that function during flight are also described. The ten-volume set is prepared for the Functional Integration Section, Systems Integration & Operations Branch, Vehicle Systems Division, P&VE Laboratory, MSFC, by Systems Engineering Branch, Chrysler Corporation Space Division under Contract NAS 8-4016.

This volume describes the environmental control systems of the launch complex and vehicle that function prior to vehicle flight. The information is presented in three sections: functional description, index of finding numbers, and mechanical schematics. The technical content reflects the functional system design information available on March 20, 1964.

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SECTION 1

FUNCTIONAL DESCRIPTION

## 1.1 INTRODUCTION N65-23069

Three launch complex 37B environmental conditioning systems regulate the atmospheric environment of the SA-8 vehicle prior to launch. The three systems are: environmental control system (ECS), the $GN_2$ deluge purge system, and water quench system.

Components of the system are located in several areas: Launch control center (LCC), automatic ground control station (AGCS), umbilical tower, and launcher area. See figure 1-1 for a block diagram of the three systems.

The ECS receives $GN_2$ from the nitrogen storage battery and ambient air from a remote air intake. Three conditioning units, each with the capability of conditioning air or $GN_2$, distribute the selected medium to a vehicle or launcher compartment.

The cooled medium is reheated by a control unit to the specific temperature to be maintained in the compartment.

The $GN_2$ deluge purge system provides a low temperature, inert environment in the S-I stage engine compartment in the event of an aborted launch. $GN_2$ for the deluge purge system is supplied from the pneumatic control distributor in the AGCS. The $GN_2$ flows through a launcher plumbing network and a distribution manifold in the S-I stage boattail. $GN_2$ deluge purge is controlled from the LCC.

The water quench system supplies water to the S-I stage engine compartment in the event of a fire within the compartment. Water for the system is supplied from a remote water storage facility. Water for the system flows through the same network as the $GN_2$ deluge purge. Control of the water quench is from a manual pushbutton located in the LCC.

## 1.2 ENVIRONMENTAL CONTROL SYSTEM (ECS)

The ECS (figure 1-1) is comprised of three similar but separate conditioning units. Each unit functions independently of the others to produce conditioned air or $GN_2$ for a particular area of the launch vehicle or launcher. The ECS consists of the following major components:

a. Remote air intake

b. Conditioning units A1, A2, A3

c. Control units B, C, and D

d. Water cooling tower

e. Distribution ducts

Air is supplied to the conditioning units from the remote air intake; $GN_2$ is supplied from the nitrogen storage battery (volume IV). The conditioning units select air or $GN_2$ and refrigerate, dehumidify, and deliver the selected medium to the control units. Each conditioning unit is capable of delivering a total flowrate of 300 pounds per minute through two passages across the evaporator. These two passages are designated "A" and "B". Passage "A" has a capacity of 100 pounds per minute, and "B" has a capacity of 200 pounds per minute. The evaporator cools the medium to a temperature lower than required so that the output will be dehumidified. The control unit then heats the medium to the temperature required by the vehicle and delivers it through damper-controlled ducts to the umbilical tower and into the vehicle compartments.

Heat removed from the medium during the cooling cycle is transferred from the refrigerant to water in the condenser-receiver. The water is then circulated to the water tower where the heat is dissipated to the atmosphere.

1.2.1 Remote Air Intake (Figure 3-1) - The remote air intake supplies ambient air to the conditioning units. Due to possible contamination by vapors, the air intake is located some distance from the launcher area. This unit consists of a supply fan, a filter, a pneumatic controller, and a vortex damper.

Air is drawn in through a screen, Filter A4209, and across Vortex Damper A4210 by Supply Fan A4211. A static air pressure equal to three inches of water is maintained at the conditioning units by Pneumatic Controller A4088. The controller places pressure on a diaphram actuator which positions the vortex damper for regulating the air flow. High Pressure Switch A4367 or low Pressure Switch A4358 will actuate if an abnormal condition occurs. The actuated pressure switch transmits a signal to an indicator located on the LCC control panel.

1.2.2 Conditioning Unit (figure 3-1) - Three basically identical conditioning units are located on the roof of the AGCS. The conditioning units cool and dehumidify the air or $GN_2$ and deliver the medium to the control units. The air/$GN_2$ output from the conditioning units is maintained at a static pressure of 55 in. $H_2O$.

Since the conditioning units are similar, only Conditioning Unit A2 is described. Conditioning Unit A2 operates with control unit C to supply a conditioned medium to the S-IV stage engine compartment. Only passage "B" in conditioning unit A2 is used; passage "A" is not operational.

1.2.2.1 Pneumatic Control Pressure. $GN_2$ at 8 psig and 20 psig is used to actuate the pneumatic control components of the conditioning units. $GN_2$ at 50 psig is supplied to the ECS from valve panel No. 5 (volume V). The $GN_2$ supply passes through Filter A4316 to Pressure Regulator A4270 where the pressure is reduced to 8 psig. The 8 psig $GN_2$ is supplied to Solenoid Valves A4145 and A4147 which control Pneumatic Valves A4254 and A4255.

The 50 psig $GN_2$ input to the ECS also passes through Filter A4317 and Pressure Regulator A4269. The pressure is reduced in the regulator to 20 psig and is then routed through Booster Regulators A4323 and A4324, $GN_2$ Flow Regulators A4140 and

A4141, Pneumatic Controllers A4252, A4253 and A4372; and Solenoid Valves A4138 and A4139. The 8 and 20 psig $GN_2$ control pressures may be monitored at Pressure Gages A4319 and A4318, respectively.

1.2.2.2 Air or $GN_2$ Flow. Air or $GN_2$ is selected by the AIR/$GN_2$ selector switch located in the LCC. The selected medium is conditioned by the conditioning unit and delivered to the control unit. With the selector switch in the AIR position, Solenoid Valves A4145 and A4147 energize and open Pneumatic Valves A4254 and A4255. Air from the remote air intake enters the conditioning unit through Filters A4146 and A4148. At the same time, Solenoid Valves A4138 and A4139 deenergize and close Flow Regulators A4140 and A4141 to block $GN_2$. Blowers A4142 and A4144 operated by Motor A4143 draw the air in and force it across Evaporator Coils A4149 and A4369 at approximately 57 in. $H_2O$. The conditioned air then flows out of the conditioning unit to the control unit.

When the AIR/$GN_2$ selector switch is set to the $GN_2$ position, Solenoid Valves A4138 and A4139 are energized and Solenoid Valves A4145 and A4147 are deenergized. The deenergized solenoid valves close Pneumatic Valves A4254 and A4255, stopping the flow of air into the unit. The energized Solenoid Valves A4138 and A4139 open Flow Regulators A4140 and A4141. $GN_2$ from the nitrogen storage battery then flows through Manual Valve A4271, Filter A4334, and the pneumatic valve into the conditioning unit. Blowers A4142 and A4144, operated by Motor A4143, draw in $GN_2$ and force it across Evaporator Coils A4149 and A4369 at approximately 57 in. $H_2O$. The conditioned $GN_2$ flows out of the conditioning unit to the control unit.

The air or $GN_2$ flow is cooled in the evaporator by transferring heat to the R-22 refrigerant flowing through the evaporator coils. Excess moisture in the medium condenses in the evaporator and drops into a drip pan located in the bottom of the evaporator housing. When the water reaches a preset depth, a float trap actuates and the collected water flows to a drain. The cooled and dehumidified air or $GN_2$ flows to the control unit.

1.2.2.3 R-22 Refrigerant Flow. The R-22 refrigerant flows through the evaporator in a closed-loop mechanical circuit. Liquid R-22 refrigerant flows from Condenser-Receiver A4117 through Manual Valves A4116 and A4121 and Filter A4118. The flow is then through Manual Valve A4120, Sight-Glass A4396, Heat Exchanger A4390, Solenoid Valve A4195, and Sight-Glass A4136 to Thermal Expansion Valves A4134 and A4151. From the expansion valves the refrigerant flows into the evaporator where it is vaporized and absorbs heat from the air or $GN_2$ flowing across the evaporator coils. The R-22 vapors then flow past Temperature Sensors A4133 and A4072, through Flow Regulator A4127, Heat Exchanger 4390, Manual Valve A4129, and past Temperature Sensor A4073 to Compressor A4126. The compressed refrigerant vapor flows through Manual Valve A4128 and is then distributed into three branches: (1) through Manual Valve A4277, through control unit Reheat Coil A4216, past Temperature Controller A4215, through Flow Regulator A4217, and Manual Valves A4276 and A4113 to Condenser-Receiver A4117; (2) through Flow Regulator A4123 and into the compressor suction line where it maintains a constant load on the compressor; and (3) through Pressure Regulator A4122 and Manual Valve A4113 into the condenser-receiver, where the vapor is

condensed. The refrigerant vapors are condensed in the condenser receiver by the cooling action of water circulating through the coils. Water flow is controlled by Pneumatic Valve A4111.

Maintenance and servicing of Filter A4118 is accomplished by closing Manual Valves A4120 and A4121 and opening Bypass Valve A4119, permitting refrigerant flow. Purging of the refrigerant lines can be accomplished by opening Manual Valves A4114 and A4375.

The function of system components in the refrigeration cycle is as follows:

a. Evaporator. The evaporator contains primary Evaporator Coil A4369 and secondary Evaporator Coil A4149. Each coil is fed by a thermal expansion valve and is separate from the other coil.

b. Thermal Expansion Valves A4151 and A4134. The thermal expansion valves regulate the flow rate of R-22 refrigerant entering the evaporator. Thermal Expansion Valves A4151 and A4134 are controlled by Temperature Sensor A4133 and A4072, respectively. The sensors monitor the temperature of R-22 vapor leaving the coil, and control valve opening to maintain the temperature of R-22.

   During conditions of low flow rates, the two thermal expansion valves cannot accurately control the flow of R-22. One valve thus becomes deenergized and the remaining valve is used if the temperature of the air or $GN_2$ entering the conditioning unit is low enough to cause a substantial decrease in R-22 refrigerant flow.

   Temperature Switch A4363 and Temperature Sensor A4364 sense temperatures below 105 F and energize Solenoid Valve A4137 and close Thermal Expansion Valve A4134. The circuit deactivates the secondary evaporator circuit and increases the load on Thermal Expansion Valve A4151. The valve will then operate at a higher and more sensitive rate than during low temperature conditions.

c. Flow Regulator A4127. The flow regulator maintains the temperature of the air or $GN_2$ leaving the evaporator to approximately 40 F by regulating the pressure of R-22 in the evaporator coils. The rate of heat absorption by R-22 depends on the temperature difference between air or $GN_2$ and the R-22 boiling point. The boiling temperature of R-22 is directly related to its pressure. By regulating the pressure of the R-22, the 40 F temperature is maintained. Decreasing the regulator opening increases the pressure of R-22 and increases the amount of heat absorbed by the refrigerant.

   Increasing the regulator opening reduces the amount of heat absorbed. The regulator is controlled by $GN_2$ pressure from Temperature Controller A4132. The opening of the controller is proportional to the temperature of air/$GN_2$ sensed by Thermistor A4080.

d. Compressor A4126. The compressor is an unloaded-start, reciprocating, suction-gas cooled, sealed unit with positive pressure lubrication. The unit compresses R-22 refrigerant vapors and circulates high-pressure vapors to the control unit, the condenser-receiver, and the hot-gas bypass regulator. The refrigerant vapors flowing to the compressor cools the compressor motor by passing over the motor windings. A heater in the crankcase maintains the oil reservoir temperature above ambient temperature to prevent refrigerant accumulation. The accumulation of refrigerant in the crankcase would damage the compressor upon resumption of operation after shutdown periods.

Differential Pressure Switch A4258 in the lubricating oil line protects the compressor against loss of oil pressure. A time-delay switch allows the compressor to operate for approximately 90 seconds to establish a pressure differential and to allow suspended oil in the system time to return to the crankcase. If the required pressure differential is not established within 90 seconds, or if pressure is lost for 90 seconds, Differential Pressure Switch A4258 will actuate and the compressor will stop. The differential pressure switch is equipped with a manual reset button. Pressure Switch A4279 will stop the compressor if either the discharge pressure is excessive, or if the suction line pressure is insufficient. Compressor discharge Manual Valve A4128 and compressor suction Manual Valve A4129 allow isolation of discharge and suction Pressure Gages A4278 and A4336, respectively.

e. Flow Regulator A4123. The flow regulator prevents overloading the compressor without compressor cycling or cylinder unloading.

A pilot valve within the regulator senses pressure changes in the compressor suction line caused by the throttling of Flow Regulator A4127. The pilot valve opens or closes accordingly to operate the main part of the valve, allowing the required amount of hot discharge gas to flow back to the compressor suction line. This keeps a constant load on the compressor and prevents cavitation. When the main blower control circuits are deenergized, the normally closed hot-gas bypass Solenoid Valve A4124 is deenergized. Liquid shutoff Solenoid Valve A4195 prevents leakage of liquid R-22 refrigerant to other parts of the system when the system is shut down. The valve opens when the blower starts, and closes when the blower stops. Safety interlock Pressure Switch A4393 controls the valve.

f. Desuperheater Valve A4125. The desuperheater valve controls the temperature of the R-22 refrigerant in the compressor suction line by injecting a controlled amount of liquid R-22 into the suction line, thereby preventing the compressor from overheating.

g. Pressure Regulator A4122. The pressure regulator forces hot R-22 refrigerant gas to flow to the control unit reheat coils. The regulator maintains the compressor discharge pressure approximately 10 psig higher than the condenser-receiver inlet pressure. The pressure differential forces the gas through the reheat coils and back to the condenser-receiver.

h. Condenser-Receiver A4117. The hot compressed gases are changed into a liquid in the condenser section of the condenser receiver. The unit then stores the liquid in the receiver section which has the capacity to hold the entire R-22 refrigerant charge when the conditioning unit is shut down. The condenser-receiver receives the hot, gaseous, R-22 refrigerant from the reheat coil. Water from Water Cooling Tower A4379 reduces the temperature of the R-22 to its dew point and the condensate is stored in the receiver for recycling. Water flow through the condenser-receiver is described in paragraph 1.2.4. Relief Valve A4115 relieves condenser pressure at 350 psig. Manual Valve A4114 may be used to vent or purge the refrigerant side of the condenser. Manual Valves A4113 and A4116 are used to isolate the condenser for maintenance purposes. Refrigerant charging Manual Valve A4337 is used to add R-22 to the system.

i. Filter A4118. The filter removes moisture and foreign particles from the R-22 refrigerant charge. The filter may be removed or replaced without losing the R-22 charge by closing Manual Valves A4120 and A4121. A bypass line and Manual Valve A4119 permit the filter to be changed while the system is operating.

j. Indicators. Sight-Glass A4396 provides a visual means of detecting moisture in the refrigerant charge. Sight-Glass A4136 is used to check whether or not the refrigerant charge is adequate.

1.2.3 Control Unit (Figure 3-1) - The control units receive preconditioned air or $GN_2$ at 40 F and heat it to the temperature required by the particular compartment which the unit services. The control units use hot R-22 refrigerant flowing through a reheat coil to heat the air or $GN_2$. Where the reheat coil is inadequate to raise the temperature of the air/$GN_2$, an electric heater further heats the medium.

Since the control units are similar, only control unit C is described. Control unit C operates with conditioning unit A2 to supply a conditioned medium to the S-IV stage engine compartment.

Reheat Coil A4216 uses R-22 refrigerant vapor to heat air or $GN_2$ to a maximum of 85 F. The R-22, after circulating through the reheat coil, returns to the condenser-receiver in the conditioning unit.

The unit may be vented by opening Manual Valve A4375. Temperature of the air or $GN_2$ leaving the control unit is regulated by controlling the flow of R-22 refrigerant through the reheat coil. A thermistor in the vehicle compartment transmits a continuous temperature signal to Temperature Controller A4215. The controller actuates the motor-drive to Flow Regulator A4217. Operation of the flow regulator throttles R-22 refrigerant flow through the reheat coil to maintain the vehicle compartment temperature.

When the vehicle compartment temperature requirement exceeds the capability of the reheat coil, Electric Heater A4245 is energized. The heater can heat the air or $GN_2$

to 150 F for the S-IV engine compartment. (Electric Heater A4246 can heat the medium to 210 F for the S-I engine compartment.) The electric heater has three fixed-capacity heating elements which are sequentially energized.

When Flow Regulator A4217 completely opens, indicating the reheat coil capacity has been reached, a limit switch closes and energizes a slow cam motor. As the cam motor rotates, a contactor closes and energizes one of the three heater elements. If one heating element satisfies the temperature controller, the limit switch opens and the cam motor stops at the new position. Flow Regulator A4217 will then modulate to control refrigerant flow. If additional heat is required, the cam motor will drive to the next position. If Flow regulator A4217 fully closes, a second limit switch is actuated. This causes the cam motor to reverse and sequentially deenergize the heater elements.

The capacity of the reheat coil exceeds the capacity of any single heating element. This feature allows the reheat coil to provide modulating temperature control and the electric heaters to supplement the reheat coil only as required.

Over-Temperature Cutout Switch A4350 deenergizes the electric heater when the sensed temperature exceeds the preset value for the control unit. The switch will reenergize the heaters when the temperature decreases 50 F below the preset value.

1.2.4 Water System (Figure 3-1) - Water at ambient temperature is used to cool the hot R-22 refrigerant gases in the condenser-receivers. The water is pumped within a recirculating system that cools the water and maintains a supply for the three conditioning units. The water is pumped from Water Cooling Tower A4379 to the condenser-receiver of each conditioning unit. Manual valves in the input and output lines to each condenser-receiver enable the units to be isolated for maintenance. An orifice in each condenser-receiver bypass line balances the water flow to each unit and compensates for differences in plumbing. The following paragraphs describe the major components in greater detail. Because the condenser-receivers are similar, only the condenser-receiver in Conditioning Unit A2 is described.

1.2.4.1 Water Cooling Tower A4379. The water cooling tower consists of an aerating system of trays, blower fans, and a catch-basin. The hot water enters the tower at the top. Spray pipes and a tier of trays break-up the water and Blower Motor A4053 forces ambient air through the resulting spray to cool the spray as it falls into the catch-basin. Float Valve A4052 maintains the basin water level by admitting make-up water through Manual Valve A4050. Manual Valve A4150 permits blow-down to keep mineral deposits out of the system; the valve must be opened whenever the system is operated. The basin is drained through Manual Valve A4051 as required. Pump A4054 draws cool water from the catch basin and pumps it through Check Valve A4320 to the condenser-receivers of the conditioning units.

1.2.4.2 Condenser-Receiver Water Regulation. Cooling water is admitted to the condenser-receiver through isolating Manual Valve A4360. The flow of water through the condenser-receiver is regulated by Pneumatic Valve A4111. The pneumatic valve is differential-pressure operated and controls flow through the condenser-receiver by diverting part of the flow through a bypass line. A 20 psig $GN_2$ reference pressure is

supplied to one side of the valve and a 5 to 15 psig $GN_2$ control pressure is supplied to the other side. The control pressure is proportional to the operating pressure inside the condenser-receiver and controls the opening of the bypass port of Pneumatic Valve A4111. Initially, condenser receiver pressure is zero and Pneumatic Valve A4111 is in full bypass position, resulting in minimal water flow into the condenser-receiver. As the pressure increases, the bypass port closes proportionately to progressively increase the flow of cooling water into the condenser-receiver. This action continues until the system stabilizes and flow through the condenser-receiver is approximately equal to the bypass flow. Orifice A4112 balances full bypass flow to Condenser-Receiver A4117 with full bypass flow to the other condenser-receivers. Manual Valve A4359 functions as a water service valve and as a vent for the condenser-receiver. Manual Valve A4359 is also used to drain the water from the condenser-receiver when required. Pneumatic Controller A4372 adjusts the pressure of the 20 psig $GN_2$ supply in accordance with the internal pressure of Condenser-Receiver A4117. This fluctuating pressure is supplied to Pneumatic Valve A4111 to regulate the flow of cooling water to the condenser-receiver. The heated water from the condenser-receiver is routed back to the cooling tower through isolating Manual Valve A4109.

1.2.5 Distribution Ducts (Figure 3-1) - Seven ducts conduct conditioned air or $GN_2$ from the environmental control units to the umbilical tower. Because the ducts and their related components operate in a similar manner, only the flow through the duct from Control Unit C is described.

The conditioned air/$GN_2$ from Control Unit C flows through Orifice A4303 where the flow is monitored by Differential Pressure Transducer A4305 and Differential Pressure Switch A4382. The transducer transmits a signal indicating the flowrate on a readout in the LCC. The pressure switch will shut down the conditioning unit if the flow rate is insufficient. The medium flows from the orifice through motor-operated Damper A4304, Check Valve A4353, and Quick-Disconnect Coupling A4900 into the S-IV stage engine compartment. The damper, controlled from the LCC, regulates the flow of air/$GN_2$ to the vehicle.

1.2.6 S-I Stage Engine Compartment Conditioning (Figure 3-2) - The S-I stage engine compartment receives conditioned air/$GN_2$ at 55 inches $H_2O$ pressure from Control Unit D. The air/$GN_2$ flows from the duct through normally-open Pneumatic Valve A4342 and into the distribution network of the launcher. From the pneumatic valve, the medium branches into two lines and flows to Pneumatic Valves A4903 and A4908. From each of the pneumatic valves, the flow is again branched into parallel paths. The flow through Pneumatic Valve A4903 passes through Manual Valves A4339 and A4340, and Quick-Disconnect Couplings A4343, A4344, and B503 into the distribution manifolds of the S-I stage engine compartment.

The manual valves balance the flow through each leg of the distribution manifold. Air/$GN_2$ flows through Pneumatic Valve A4908 and follows a path through Manual Valves A4347 and A4348 and Quick-Disconnect Couplings A4345, A4346, and B503. The conditioned air/$GN_2$ maintains the temperature of the compartment to approximately 60 F.

1.2.7 S-I Stage Forward Compartment Conditioning (Figure 3-2) - The conditioning medium for the S-I stage forward compartment flows from control unit B through the duct, through Quick-Disconnect Couplings A3058 and B320, and into the distribution manifolds. The medium is vented from the instrument compartments through a return line and Quick-Disconnect Couplings B321 and A3065. The medium maintains the temperature of the compartments to approximately 85 F.

1.2.8 S-IV Stage Engine Compartment Conditioning (Figure 3-2) - The conditioning medium for the S-IV stage engine compartment flows from Control Unit C through the ducts, through Quick-Disconnect Coupling A4900, and to the manifold. The temperature of the compartment is maintained to approximately 157 degrees F.

1.2.9 S-IV Stage/Instrument Unit Interstage Conditioning - (To be supplied, at a later date.)

1.2.10 ECS Controls - The environmental control system is operated by control equipment located in the LCC and the AGCS. The control equipment includes devices which control and monitor the operation of the ECS. The AGCS controls are used for operation of the ECS while the vehicle is being checked out and tested. Since the following paragraphs describe the operation of the ECS during a launching sequence, only the LCC controls are described.

Two ECS control racks in the LCC consist of twelve panels containing system starting controls, air/$GN_2$ temperature controls and indicators, flowrate controls and indicators, and malfunction indicators.

1.2.10.1 System Control Panel. The SYSTEM CONTROL panel contains the following controls:

a. D. C. POWER ON/OFF switch - Controls application of all dc power to the system.

b. System START pushbutton - Starts the system.

c. System STOP pushbutton - Shuts down the system.

d. AIR/$GN_2$ switches (4) - Selects the conditioning medium for the vehicle compartments and launcher.

1.2.10.2 Compartment Temperature Control Panels. The compartment temperature control panels contain controls and indicators for setting and monitoring the vehicle compartment temperatures. There are seven panels, one for each compartment. The controls, indicators and their functions are as follows:

a. COMPARTMENT TEMPERATURE Gage - Indicates either the temperature of vehicle compartment, or in the duct leading to the compartment, depending on the location of the sensor.

b. TEMP. SELECTOR - Presets the temperature the automatic circuit will control.

c. MANUAL/AUTO switch - Deenergizes the automatic control circuit to allow manual control of the compartment temperature.

d. TEMPERATURE CONTROL VALVE POSITION gage - Indicates the degree of opening of Flow Control Regulator A4217.

e. INCREASE/DECREASE switch - Operates Flow Control Regulator A4217 to increase or decrease the flow of refrigerant through the control unit reheat coils when the MANUAL/AUTO switch is in MANUAL position.

f. FLOW CONTROL gage - Indicates the flow rate of air/$GN_2$ through the duct.

g. FLOW CONTROL INCREASE/DECREASE switch - Operates the motor-driven dampers in the duct to increase or decrease the flow rate of air/$GN_2$.

1.2.10.3 Conditioned Gas Temp. - Evaporator Disch. Panel - The CONDITIONED GAS TEMP. - EVAPORATOR DISCH. panel contains gages for monitoring the temperature of the conditioned medium leaving each conditioning unit evaporator. There is one gage for each passage through the evaporator.

a. PAYLOAD/BLOWER "A" Gage - Indicates the temperature of the air/$GN_2$ leaving the evaporator of conditioning unit A1 passage "A" being routed to the payload forward and aft compartment.

b. INST. UNIT - S-I FORWARD/BLOWER "B" Gage - Indicates the temperature of the air/$GN_2$ leaving the evaporator of conditioning unit A1 passage "B". Passage "B" services S-I stage instrument compartments.

c. S-IV ENGINE/BLOWER "A" Gage - Indicates the temperature of the air/$GN_2$ leaving the evaporator of conditioning unit A2 passage"A". Passage "A" is not presently in operation.

d. S-IV ENGINE/BLOWER "B" - Indicates the temperature of the air/$GN_2$ leaving the evaporator of conditioning unit A2 passage "B". Passage "B" services the S-IV stage engine compartment.

e. S-I ENGINE-LAUNCHER/BLOWER "A" Gage - Indicates the temperature of the air/$GN_2$ leaving the evaporator of conditioning unit A3 passage "A". Passage "A" services the launcher compartment.

f. S-I ENGINE-LAUNCHER/BLOWER "B" Gage - Indicates the temperature of the air/$GN_2$ leaving the evaporator of conditioning unit A3 passage "B". Passage "B" services the S-I stage engine compartment.

1.2.10.4 Intake Air - Nitrogen Purge Panel. The INTAKE AIR - NITROGEN PURGE panel contains controls for the operation of the remote air intake. The controls are as follows:

a. INTAKE AIR BLOWER CONTROL/SLOW button - Starts and operates the remote air intake fan at slow speed.

b. INTAKE AIR BLOWER CONTROL/FAST button - Starts and operates the remote air intake fan at normal speed.

c. STOP button - Deenergizes the remote air intake fan.

1.2.11 ECS Operation - Initially all circuit breakers, switches, and selectors are set to their normal operating positions. The D.C. POWER switch on the SYSTEM CONTROL panel is placed to ON position. The INTAKE AIR BLOWER CONTROL/FAST button located on the INTAKE AIR - NITROGEN PURGE panel is pressed to energize the remote air intake fan.

1.2.11.1 System Starting. The system is ready for operation after the preliminary functions have been performed. The SYSTEM START pushbutton on the SYSTEM CONTROL panel is pressed to initiate the starting sequence.

When the SYSTEM START button is pressed, a lock-in relay in a panel in the AGCS will energize the cooling tower pump and fans. When the pump and fans reach operating speed, a switch is closed which actuates a sequence controller in the AGCS. The sequence controller is a motor-driven switch bank that starts the conditioning units in sequence to minimize the starting current surge.

1.2.11.2 Air/$GN_2$ Temperature Control. The temperature of the air/$GN_2$ delivered to a particular compartment is determined by the setting of the TEMP. SELECTOR control on the compartment temperature control panel. A sensing probe detects the temperature of the compartment and transmits a monitoring signal to the LCC. Any difference between the detected temperature and the selected temperature causes Flow Regulator A4217 to actuate accordingly. If the automatic control circuit should fail, a manual circuit can be activated by placing the MANUAL/AUTO switch to MANUAL position. This allows Flow Regulator A4217 to be controlled by the INCREASE/DECREASE switch. Placing the switch in INCREASE position opens the regulator further, thereby increasing the temperature of the compartment. Placing the switch in the DECREASE position reverses the action. TEMPERATURE control VALVE POSITION gage indicates the degree of regulator opening.

Figure 1-2 illustrates the temperature profile of the various conditioning operations performed on the air/$GN_2$ flow.

1.2.11.3 Air/$GN_2$ Flow Control (Figure 3-1). When $GN_2$ is the required conditioning medium, the AIR/$GN_2$ selector switch is set to the $GN_2$ position. This causes Solenoid Valves A4138, A4139, A4145 and A4147 to be deenergized. Deenergizing Solenoid Valves A4145 and A4147 causes their normally-open ports to pass 8 psig $GN_2$ to Pneu-

matic Valves A4254 and A4255. The 8 psig $GN_2$ inflates the bladders of the valves and blocks the flow of air. The normally open ports of deenergized Solenoid Valves A4138 and A4139 connect Pneumatic Controllers A4252 and A4253 to their respective passages. The normally-closed ports of the solenoid valves shut off the 20 psig $GN_2$ signal to the controllers. A pressure sensing line connects between the passages and the pneumatic controllers to transmit the passage pressure indication to the controllers. The controllers compares the passage pressure to a preset value. Any variation is transmitted as a throttling command through Booster Regulators A4323 and A4324 to Flow Regulators A4141 and A4140.

The booster regulators act as pneumatic amplifiers between the controllers and the regulators. Increased $GN_2$ flow from the controllers will tend to close the flow regulators, and decreased flow will tend to open the regulators. The pneumatic controllers, booster regulators, and flow control valve function to maintain a pressure of approximately 57 in. $H_2O$ in the passages.

Passage "A" and passage "B" in Conditioning Unit A4328 are operated independently. in this unit, passage "A" may have $GN_2$ flowing while passage "B" may have air flowing. However, in the other conditioning units the same medium must flow in both passages.

When air is the required conditioning medium, the AIR/$GN_2$ selector switch for the conditioning unit is set to the AIR position. With the selector switch in this position normally open Solenoid Valves A4145 and A4147 and normally closed Solenoid Valves A4138 and A4139 are energized. Closing Solenoid Valves A4145 and A4147 blocks the 8 psig $GN_2$ actuating pressure to Pneumatic Valves A4254 and A4255 and vents the valves. This action allows air from the fresh air intake to flow into the passages. Energizing Solenoid Valves A4138 and A4139 causes the pressure lines between the valves and the passages to close and 20 psig $GN_2$ is applied to Pneumatic Controller A4253 and A4252.

The 20 psig $GN_2$ produces an overpressure signal which acts through Pneumatic Controllers A4253 and A4252, and Booster Regulators A4324 and A4323 to close Flow Regulators A4140 and A4141 and block $GN_2$ to the conditioning unit.

1.2.11.4 Evaporator Refrigerant Regulation (Figure 3-1). Flow Regulator A4127 controls the flow of vaporous R-22 refrigerant from the evaporator to the compressor. A 20 psig $GN_2$ control pressure supplied to Temperature Controller A4132 is controlled by a signal from Thermistor A4080 that corresponds to the temperature of the air or $GN_2$ leaving the evaporator. The output of the controller actuates the flow regulator and throttles the refrigerant flow to the compressor. The throttling action of the regulator in turn controls the temperature of the R-22 refrigerant.

1.2.11.5 Condenser Water Regulation (Figure 3-1). Water Regulator Valve A4111 controls the flow of water through the condenser-receiver. Control pressure at 20 psig $GN_2$ is supplied to Pneumatic Controller A4372. A pressure signal from the condenser-receiver causes the pneumatic controller to vary the $GN_2$ supply. The varying $GN_2$ output of the pneumatic controller is supplied to Pneumatic Valve A4111

as control pressure and causes the pneumatic valve to throttle the water circulating through the condenser-receiver.

## 1.3 $GN_2$ DELUGE PURGE SYSTEM

The $GN_2$ deluge purge system (figure 3-2)provides a high-volume supply of $GN_2$ at 50 psig to the S-I engine compartment in the event of a malfunction causing engine shutdown. The purge provides a cool, inert atmosphere to reduce the possibility of fire. The $GN_2$ deluge purge system consists of the deluge purge panel, control valves, and distribution manifolds.

The deluge purge panel receives 3000 psig $GN_2$ from the pneumatic control distributor. The $GN_2$ flows to dome-loaded Pressure Regulator A2255 through Pressure Regulator A2252 and past Pressure Gage 2251. Pressure Regulator A2252 reduces the pressure to 50 psig for loading Pressure Regulator A2255. From Pressure Regulator A2252 the $GN_2$ flows past Pressure Gage A2261 to Solenoid Valve A2254. Manual Valve A2262 permits venting through Pneumatic Silencer A2266. When a deluge purge command is given, Solenoid Valve A2254 and A4387 are energized. Solenoid Valve A4387 closes Pneumatic Valve A4342 to isolate the $GN_2$ deluge purge system from the ECS. Solenoid Valve A2254 allows the reference pressure to flow through Orifice A2253 to the dome of Pressure Regulator A2255.

The regulator opens and reduces 3000 psig $GN_2$ to 50 psig in accordance with the reference pressure. The 50 psig $GN_2$ then flows past Shuttle Valve A2263, Pressure Switch A2256, and Pressure Gage A2258 into the distribution manifolds. The purge supply then branches the flows through Pneumatic Valves A4903 and A4908. From Pneumatic Valve A4903 the $GN_2$ flows through manual Valves A4339 and A4340, Quick-Disconnect Couplings A4343 and B503, and A4344 and B503 into the S-I engine compartment. From Pneumatic Valve A4908, the $GN_2$ flows through manual Valves A4347 and A4348 and Quick-Disconnect Couplings A4345 and B503, and A4346 and B503 into the S-I engine compartment.

## 1.4 WATER QUENCH SYSTEM

The water quench system (figure 3-2)supplies water at 125 psig to the S-I engine compartment and is used only in the event of a fire. The water quench system consists of valves and controls to admit water through the same distribution lines and manifolds used for environmental conditioning and $GN_2$ deluge purge.

The water quench system uses 750 psig $GN_2$ from the launcher manifold as a control pressure. Operation of the system is manually initiated in the LCC upon receipt of a signal from the fire detection system within the engine compartment. When Solenoid Valves A4902 and A4906 are energized, 750 psig $GN_2$ control pressure opens Pneumatic Valves A4901 and A4909. Water flows at 125 psig through the open pneumatic valves, through Manual Valves A4339, A4340, A4347, and A4348, Quick-Disconnect Couplings A4343, A4344, A4345, and A4346, and four Quick-Disconnect Couplings B503. The water is uniformly distributed through the manifolds to quench the fire and cool the engine compartment.

Figure 1-1. Environmental Conditioning Systems Block Diagram

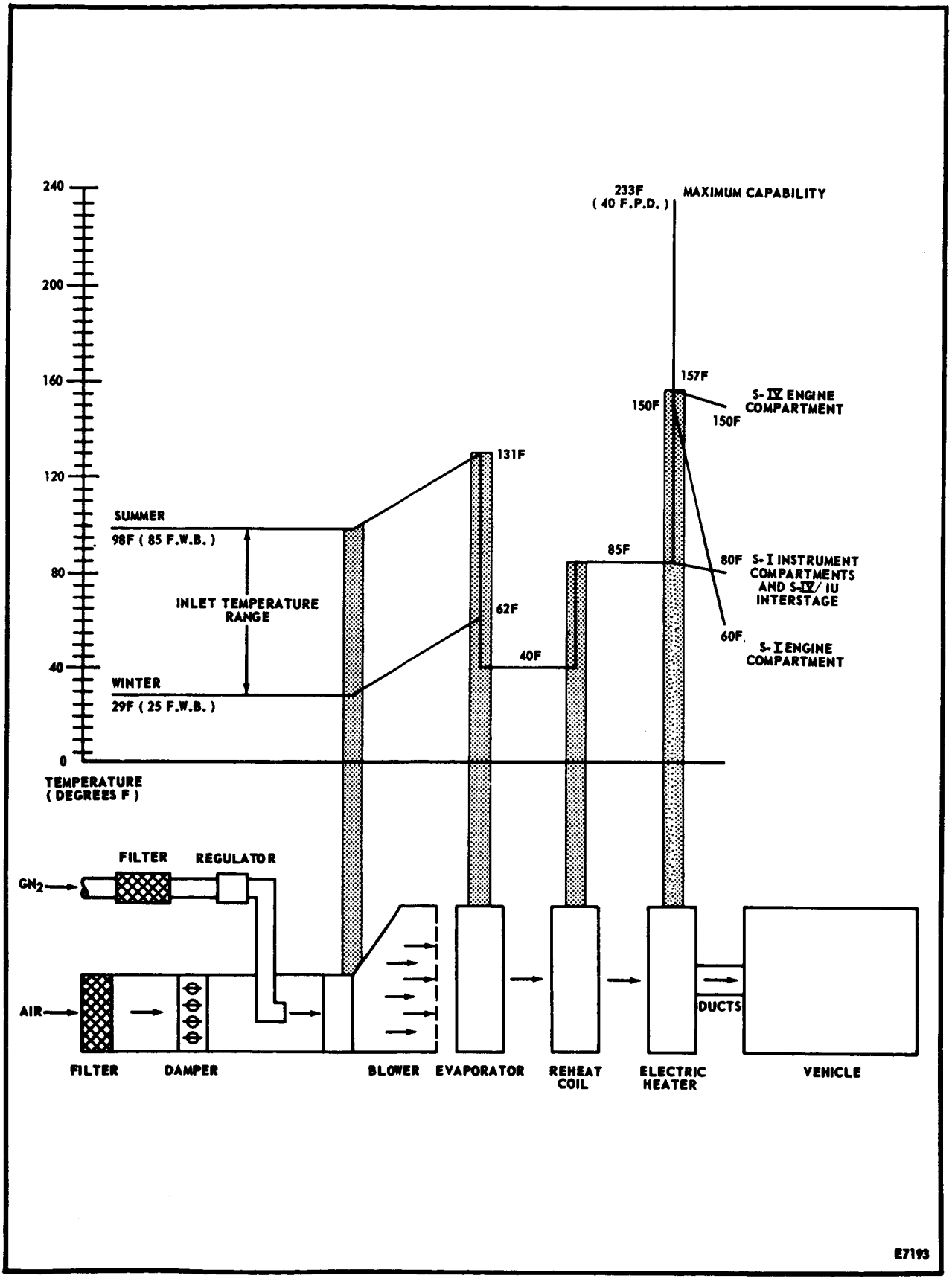



Figure 1-2. Temperature Profile of ECS

## SECTION 2

## INDEX OF FINDING NUMBERS

This section contains an alpha-numerical list, by finding number, of environmental conditioning system components. The finding numbers listed identify components on system schematic diagrams provided in Section III. Additional columns in the index of finding numbers provide such pertinent information as component description and function, part number, and the supplier's name and part number. A break will occur in the alpha-numeric sequence of finding numbers when a component, or component series is: non-functional during the countdown; functional only in the event of a malfunction; functional in terms of a maintenance operation only; or part of another functional system.

The letter prefix on finding numbers identify components with either the launch complex or an area of the launch vehicle. The area associated with each prefix is noted below.

| FINDING NUMBER PREFIX | DESIGNATED AREA |
|---|---|
| A | Launch complex |
| B | S-I stage components |
| E | S-IV stage components |
| G | Instrument unit |
| H | Payload |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A2251 | 1 | Gage, Pressure | 0-5000 psig range; 3000 psig normal indication | Marsh, P/N 210 3SSFMH | 75M50147-15 | |
| A2252 | 1 | Regulator, Pressure | 3150 (± 50) psig inlet; 50 (± 5) psig outlet | Wallace O. Leonard P/N 187050-27 | 10437835-2 | |
| A2253 | 1 | Orifice | 0.031 (+ 0.002, - 0.001) in. dia. | Rocketdyne, P/N 9504-45062 | 10430000 | |
| A2254 | 1 | Valve, Solenoid | NC | Marotta, P/N 202873-131 (MV-74) | 75M01351 | |
| A2255 | 1 | Regulator, Pressure | Deluge purge line, 3150 (± 50) psig inlet; 50 (± 5) psig outlet | Grove, P/N 10977A087B | 75M50341-3 | |
| A2256 | 1 | Switch, Pressure | Actuates at 20 (± 0.5) psig; deactuates at 1.5 psig below actuation pressure | Southwestern, P/N PS3704-20 | 10434297-5 | |
| A2257 | 1 | Valve, Relief | Relieves at 95 (± 5) psig; reseats at 70 psig | Fluid Mechanics, P/N 2-1084 | 10430216-9 | |
| A2258 | 1 | Gage, Pressure | 0-160 psig range; 50 psig normal indication | Marsh, P/N 210-CSFMH | 75M50147-5 | |
| A2259 and A2260 are not functionally applicable to this system. | | | | | | |
| A2261 | 1 | Gage, Pressure | 0-160 psig range; 50 psig normal indication | Marsh, P/N 210-CSFMH | 75M50147-5 | |
| A2262 | 1 | Valve, Manual | 1/4 in., vent | Robbins, P/N SSNA-250-4T-787 | 75M01305-1 | |
| A2263 | 1 | Valve, Shuttle | 1/4 in. | Clary, P/N 524255 | 10434448 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A2264 | 1 | Nipple | | Snaptite, P/N SPHN-4-4-56 | 75M50183 | |
| A2265 | 1 | Cap, Dust | | Snaptite, P/N SDCH-4 | 75M50181-1 | |
| A2266 | 1 | Silencer, Pneumatic | 3/8 in. | C. W. Morris, P/N AA-3 | 1043141-2 | |
| A2267 | 1 | Valve, Relief | Relieves at 140 (± 5) psig; reseats at 126 psig | James, Pond and Clark P/N 5159T1-4TB-140 | 10430079-3 | |
| A2268 through A3057 are not functionally applicable to this system. | | | | | | |
| A3058 | 1 | Coupling, Quick Disconnect | | | 75M02015 | |
| A3059 through A3064 are not functionally applicable to this system. | | | | | | |
| A3065 | 1 | Coupling, Quick Disconnect | | | | |
| A3066 through A4049 are not functionally applicable to this system. | | | | | | |
| A4050 | 1 | Valve, Manual | 1-1/2 in., make up water shutoff | Lunkenheimer, P/N 123 | 10791 | |
| A4051 | 1 | Valve, Manual | 3 in., water drain | Lunkenheimer, P/N 123 | 10792 | |
| A4052 | 1 | Valve, Float | Float operated fill | Baltimore Aircoil, P/N TMA175 | Part of 10765 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4053 | 1 | Motor, Blower | Cooling tower fan | Baltimore Aircoil, P/N TM175 | Part of 10765 | |
| A4054 | 1 | Pump | Water circulating | Allis Chalmers, P/N 5X5-L-C3 | 10766 | |
| A4055 | 1 | Valve, Manual | 1/4 in., condenser-receiver vent | Lunkenheimer, P/N 123 | 10738 | |
| A4056 | 1 | Valve, Manual | Condenser-receiver water shutoff | Lunkenheimer P/N 123 | 10738 | |
| A4057 | 1 | Valve, Manual | Condenser-receiver water shutoff | P/N 123 | 10738 | |
| A4058 | 1 | Valve, Manual | 1/4 in., condenser-receiver vent | Lunkenheimer, P/N 123 | 10738 | |
| A4059 | 1 | Valve, Pneumatic | 3 way water regulator | Minneapolis-Honeywell, P/N V5013A | | |
| A4060 | 1 | Orifice | Water flow balancing | | 10136-19 | |
| A4061 | 1 | Condenser-Receiver | Vapor to liquid converter | Trane Co., P/N CDS-153 | Part of 10703 | |
| A4062 | 1 | Valve, Manual | 2-1/8 in. O.D. flange condenser-receiver refrigerant shutoff | Mueller Brass, P/N A15168 | 10726 | |
| A4063 | 1 | Valve, Manual | 1/2 in. shutoff | Superior Valve and Fitting Co. P/N 605-8D | 10735 | |
| A4064 | 1 | Valve, Relief | Condenser-receiver pressure relief | Trane Co., P/N CDS-153 | Part of 10703 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4065 | 1 | Valve, Manual | Condenser-receiver refrigerant shutoff | Trane Co., P/N CDS-153 | | |
| A4066 | 1 | Valve, Manual | 1/4 in., R-22 refrigerant charge | Kero-Test Mfg. Co., P/N R-224-X1 | | |
| A4067 | 1 | Valve, Manual | 1-5/8 in. O.D. flange, filter shutoff | Superior Valve and Fitting Co., P/N 193-15S | | |
| A4068 | 1 | Valve, Manual | 1-5/8 in. O.D. flange, filter shutoff | Superior Valve and Fitting Co., P/N 193-15S | | |
| A4069 | 1 | Valve, Manual | 1-5/8 in. O.D. flange, filter bypass | Superior Valve and Fitting Co., P/N 193-15S | | |
| A4070 | 1 | Filter | 1-5/8 in. core | Sporlan Valve Co., P/N C19213 W/Rc 4864 | | |
| A4071 | 1 | Valve, Solenoid | 1-5/8 in. O.D. flange, NC, refrigerant flow | Sporlan Valve Co., Type 100-S | | |
| A4072 | 1 | Sensor, Temperature | Sensing bulb in evaporator output | | | |
| A4073 | 1 | Sensor, Temperature | Compressor suction line | | | |
| A4074 | 1 | Sensor, Temperature | Compressor suction line | | | |
| A4075 | 1 | Regulator, Pressure | 3 in., differential | Fisher Governor Co. P/N 644-AR | 10720 | |
| A4076 | 1 | Thermistor | Thermal sensing element for evaporator pressure regulator | Minneapolis-Honeywell Series 800, Type 12 | Part of 10717 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4077 | 1 | Valve, Solenoid | 3/8 in., hot gas bypass | Sporlan Valve Co. Type 105 | 10719 | |
| A4078 | 1 | Regulator, Flow | 0-80 psig range pilot, 1-5/8 O.D. flange, hot gas bypass | Alco Valve Co. P/N HGR-15H | 10718 | |
| A4079 | 1 | Compressor, Refrigerant | | Dunham-Bush P/N B10-H, Type 61AV | 10704 | |
| A4080 | 1 | Thermistor | Thermal sensing element for evaporator pressure | Minneapolis-Honeywell Series 800, Type 12 | Part of 10717 | |
| A4081 | 1 | Valve, Manual | Compressor output shutoff | Dunham-Bush P/N B10-H, Type 61AV | Part of 10704 | |
| A4082 | 1 | Valve, Manual | Compressor suction line shutoff | Dunham-Bush P/N B10-H, Type 61AV | Part of 10704 | |
| A4083 | 1 | Valve, Manual | 1/4 in., pressure gage shutoff | Mueller Brass P/N A-14838 | 10722 | |
| A4084 | 1 | Valve, Manual | 1/4 in., pressure gage shutoff | Mueller Brass P/N A-14838 | 10722 | |
| A4085 | 1 | Switch, Pressure | Compressor safety switch, actuates on high and low pressure | Penn. Controls P/N 4DP2#271 | 10725 | |
| A4086 | 1 | Controller, Temperature | NC, electrically operated | Minneapolis-Honeywell Series 800, Type 12 | Part of 10717 | |
| A4087 | 1 | Sensor, Temperature | | | Part of 10734 | |
| A4088 | 1 | Controller, Pneumatic | Air intake damper positioner | | | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4089 | 1 | Regulator, Pneumatic | 4 in., flow control | Minneapolis-Honeywell Series 800, Type 12 | 10717 | |
| A4090 | 1 | Valve, Thermal Expansion | 1-1/8 in. x 1-5/8 in. O.D. flange, evaporator secondary circuit | Sporlan Valve Co. P/N MVE-42 | Part of 10734 | |
| A4091 | 1 | Switch, Differential Pressure | Oil pressure failure | Penn Controls P/N 2D5-275A010 | 10859 | |
| A4092 | 1 | Sensor, Temperature | Sensor bulb in evaporator output | | | |
| A4093 | 1 | Valve, Solenoid | 3-way, NC, evaporator coil cutoff | Sporlan Valve Co. P/N Type 180 | 10736 | |
| A4094 | 1 | Valve, Thermal Expansion | 1-1/8 in. x 1-5/8 in. O.D. flange, evaporator primary circuit | Sporlan Valve Co. P/N MVE - 34 | Part of 10733 | |
| A4095 | 1 | Valve, Solenoid | 3-way, NC, 3/32-in. orifice, 20 psig $CN_2$ control pressure | Auto Switch Co. | 10854 | |
| A4096 | 1 | Valve, Solenoid | 3-way, NC, 3/32-in orifice, 20 psig $GN_2$ control pressure | Auto Switch Co. | 10854 | |
| A4097 | 1 | Regulator, Flow | 6 in., pneumatic operated, 50 psig $GN_2$ supply | Mason-Neilon, Model 137-3 | Part of 10710 | |
| A4098 | 1 | Regulator, Flow | 4 in., pneumatic operated, 50 psig $GN_2$ supply | Mason-Neilon P/N 137-3 | Part of 10730 | |
| A4099 | 1 | Blower | Air or $GN_2$ supply | Buffalo-Forge Co. P/N CB-40-3 | Part of 10702 | |
| A4100 | 1 | Motor | Blower motor | Buffalo-Forge Co. P/N CB40-3 | Part of 10702 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4101 | 1 | Blower | Air or $GN_2$ supply | Buffalo-Forge Co. P/N CB40-3 | Part of 10702 | |
| A4102 | 1 | Valve, Solenoid | 3-way, 1/2 in., N.O., 8 psig $GN_2$ control pressure | Auto Switch Co. P/N 8300A-74-G | 10864 | |
| A4103 | 1 | Valve, Solenoid | 3-way, 1/2 in., N.O., 8 psig $GN_2$ control pressure | Auto Switch Co. P/N 8300A-74-G | 10864 | |
| A4104 | 1 | Sight-Glass | Refrigerant flow | Superior Valve Fitting Co., P/N 2423 | 10713 | |
| A4105 | 1 | Evaporator Coil | Secondary circuit | Dunham-Bush, P/N 10701 | 10701 | |
| A4106 | 1 | Valve, Desuperheater | Electrically operated flow control valve | Sporlan Valve Co. P/N PV18-C | 10721 | |
| A4107 | 1 | Filter, Air | Fresh air supply | Farr Company P/N 10711 | 10711 | |
| A4108 | 1 | Filter, Air | Fresh air supply | Farr Company P/N 10711 | 10711 | |
| A4109 | 1 | Valve, Manual | Condenser-receiver water shutoff | | | |
| A4110 | 1 | Valve, Manual | 1/4 in., condenser-receiver vent | Lunkenhiemer P/N 123 | 10738 | |
| A4111 | 1 | Valve, Pneumatic | 3-way, water regulator | Minneapolis-Honeywell P/N V5013A | Part of 10739 | |
| A4112 | 1 | Orifice | Flow balancing | | 10136-19 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4113 | 1 | Valve, Manual | 2-1/8 in. O.D. flange, condenser-receiver shutoff | Mueller Brass P/N A15168 | 10726 | |
| A4114 | 1 | Valve, Manual | 1/2 in., condenser purge | Superior Valve and Fitting Co., P/N 605-8D | 10735 | |
| A4115 | 1 | Valve, Relief | Condenser-receiver pressure relief | Trane Co. P/N CDS-153 | Part of 10703 | |
| A4116 | 1 | Valve, Manual | Condenser-receiver shutoff | Trane Co. P/N CDS-153 | Part of 10703 | |
| A4117 | 1 | Condenser-Receiver | Condense vapors to liquid | Trane Co. P/N-153 | Part of 10703 | |
| A4118 | 1 | Filter | 1-5/8 in. core | Sporlan Valve Co., P/N C-19213W/RC4864 | 10714 | |
| A4119 | 1 | Valve, Manual | 1-5/8 in. O.D. flange, filter bypass | Superior Valve and Fitting Co., P/N 193-15S | 10731 | |
| A4120 | 1 | Valve, Manual | 1-5/8 in. O.D. flange, filter shutoff | Superior Valve and Fitting Co., P/N 193-15S | 10731 | |
| A4121 | 1 | Valve, Manual | 1-5/8 in. O.D. flange, filter shutoff | Superior Valve and Fitting Co., P/N 193-15S | 10731 | |
| A4122 | 1 | Regulator, Pressure | 3 in., differential | Fisher Governor Co. P/N 644-AR | 10720 | |
| A4123 | 1 | Regulator, Flow | 1-5/8 in. O.D. flange, 0-80 psig range, hot gas bypass | Alco Valve Co., P/N HGR-15H | 10718 | |
| A4124 | 1 | Valve, Solenoid | 3/8 in., NC, hot gas bypass | Sporlan Valve Co. Type 10S | 10719 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4125 | 1 | Valve, Desuperheater | Electrically operated flow control valve | Sporlan Valve Co. P/N PV18-C | 10721 | |
| A4126 | 1 | Compressor | Refrigerant | Dunham-Bush P/N B10-H, Type 61AV | Part of 10704 | |
| A4127 | 1 | Regulator, Flow | 4 in., pneumatically operated | Minneapolis-Honeywell Series 800, Type 12 | Part of 10717 | |
| A4128 | 1 | Valve, Manual | Compressor output shutoff | Dunham-Bush, P/N B10-H, Type 61AV | 10704 | |
| A4129 | 1 | Valve, Manual | Compressor suction shutoff | Dunham-Bush, P/N B10-H, Type 61AV | 10704 | |
| A4130 | 1 | Valve, Manual | 1/4 in., pressure gage shutoff | Mueller Brass P/N A-14838 | 10722 | |
| A4131 | 1 | Valve, Manual | 1/4 in., pressure gage shutoff | Mueller Brass P/N A-14838 | 10722 | |
| A4132 | 1 | Controller, Temperature | NC, electrically operated | Minneapolis-Honeywell Series 800, Type 12 | Part of 10717 | |
| A4133 | 1 | Sensor, Temperature | Sensing bulb in evaporator output | | Part of 10734 | |
| A4134 | 1 | Valve, Thermal Expansion | 1-1/8 in. x 1-5/8 in. O.D. flange, evaporator secondary circuit | Sporlan Valve Co. P/N MVE-42 | | |
| A4135 is not functionally applicable to this system. | | | | | | |
| A4136 | 1 | Sight-Glass | Refrigerant flow | Superior Valve and Fitting Co., P/N 22423 | 10713 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4137 | 1 | Valve, Solenoid | 3-way, NC | Sporlan Valve Co. Type 180 | 10736 | |
| A4138 | 1 | Valve, Solenoid | 3-way, 3/32-in. orifice, NC, 20 psig $GN_2$ control pressure | Auto Switch Co. Cat. No. 83147 | 10854 | |
| A4139 | 1 | Valve, Solenoid | 3-way, 3/32-in. orifice, NC, 20 psig $GN_2$ control pressure | Auto Switch Co. Cat. No. 83147 | 10854 | |
| A4140 | 1 | Regulator, Flow | 6 in., 50 psig $GN_2$ input supply | Mason-Neilon, Model 137-3 | Part of 10710 | |
| A4141 | 1 | Regulator, Flow | 4 in., 50 psig $GN_2$ input supply | Mason-Neilon P/N 137-3 | Part of 10730 | |
| A4142 | 1 | Blower | Air or $GN_2$ supply | Buffalo-Forge Co. P/N CB-40-3 | Part of 10702 | |
| A4143 | 1 | Motor | Blower motor, 405 VDC | Buffalo-Forge Co. P/N CB-40-3 | Part of 10702 | |
| A4144 | 1 | Blower | Air or $GN_2$ supply | Buffalo-Forge Co. P/N CB-40-3 | Part of 10702 | |
| A4145 | 1 | Valve, Solenoid | 3-way, 1/2-in., N.O., 8 psig $GN_2$ control pressure | Auto Switch Co. P/N 8300A-74-G | 10864 | |
| A4146 | 1 | Filter, Air | Fresh air input | Farr Company P/N 10711 | 10711 | |
| A4147 | 1 | Valve, Solenoid | 3-way, 1/2-in., N.O., 8 psig $GN_2$ control pressure | Auto Switch Co. P/N 8300A-74-G | 10864 | |
| A4148 | 1 | Filter, Air | Fresh air input | Farr Company P/N 10711 | 10711 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4149 | 1 | Coil, Evaporator | Secondary circuit | Dunham-Bush P/N 10701 | 10701 | |
| A4150 | 1 | Valve, Manual | Blowdown | | | |
| A4151 | 1 | Valve, Thermal Expansion | 1-1/8 x 1-5/8 in. O.D. flange primary circuit | Sporlan Valve Co. P/N MVE-34 | Part of 10733 | |
| A4152 | 1 | Valve, Manual | 1/4 in., condenser-receiver vent | Lunkenheimer P/N 123 | 10738 | |
| A4153 | 1 | Valve, Manual | Condenser-receiver inlet water shutoff | Lunkenheimer P/N 123 | 10738 | |
| A4154 | 1 | Valve, Manual | Condenser-receiver outlet water shutoff | Lunkenheimer P/N 123 | 10738 | |
| A4155 | 1 | Valve, Manual | 1/4 in., condenser-receiver vent | Lunkenheimer P/N 123 | 10738 | |
| A4156 | 1 | Valve, Pneumatic | 3-way, water regulator | Minneapolis-Honeywell P/N 5013A | | |
| A4157 | 1 | Orifice | Flow balancing | | 10136-19 | |
| A4158 | 1 | Condenser-Receiver | | Trane Co. P/N 153 | 10703 | |
| A4159 | 1 | Filter-Drier | 1-5/8 in. core | Sporlan Valve Co. P/N C19213 W/RC4864 | 10714 | |
| A4160 | 1 | Valve, Manual | 2-1/8 in. O.D. flange, condenser-receiver refrigerant shutoff | Mueller Brass P/N 15168 | 10726 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4161 | 1 | Valve, Manual | 1/2 in. condenser-receiver vent | Superior Valve and Fitting Co., P/N 605-8D | 10725 | |
| A4162 | 1 | Valve, Relief | | Trane Co., P/N CDS-153 | Part of 10703 | |
| A4163 | 1 | Valve, Manual | Condenser-receiver refrigerant shutoff | Trane Co., P/N CDS-153 | Part of 10703 | |
| A4164 | 1 | Valve, Manual | 1-5/8 in. O.D. flange, filter shutoff | Superior Valve and Fitting Co., P/N 193-15S | 10731 | |
| A4165 | 1 | Valve, Manual | 1-5/8 in. O.D. flange, filter shutoff | Superior Valve and Fitting Co., P/N 143-15S | 10731 | |
| A4166 | 1 | Valve, Manual | Filter bypass | Superior Valve and Fitting Co., P/N 143-15S | 10731 | |
| A4167 | 1 | Valve, Desuperheater | Electrically operated, flow control valve | Sporlan Valve Co. P/N PV18-C | 10721 | |
| A4168 | 1 | Compressor | Refrigerant | Dunham-Bush P/N B10-H, Type 61AV | Part of 10704 | |
| A4169 | 1 | Regulator, Differential Pressure | 3 in., refrigerant flow control | Fisher Governor Co. P/N 644-AR | 10720 | |
| A4170 | 1 | Regulator, Flow | 1-5/8 in. O.D. flange, 0-80 psig range pilot, hot gas bypass flow control | Alco Valve Co. P/N HGR-15H | 10718 | |
| A4171 | 1 | Valve, Solenoid | 3/8 in., NC, hot gas bypass | Sporlan Valve Co. Type 108 | 10719 | |
| A4172 | 1 | Valve, Manual | Compressor discharge shutoff | Dunham-Bush P/N B10-H Type 61AV | Part of 10704 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4173 | 1 | Valve, Manual | Compressor suction shutoff | Dunham-Bush P/N B10-H, Type 61AV | Part of 10704 | |
| A4174 | 1 | Valve, Manual | Gage shutoff | Mueller Brass P/N A-14838 | 10722 | |
| A4175 | 1 | Controller, Temperature | Electrically operated, 20 psig $GN_2$ control pressure | Minneapolis-Honeywell Series 800, Type 12 | 10707 | |
| A4176 | 1 | Sensor, Temperature | Sensing bulb in evaporator primary circuit | | Part of 10733 | |
| A4177 and A4178 are not functionally applicable to this system. | | | | | | |
| A4179 | 1 | Valve, Solenoid | 3-way, NC, refrigerant | Sporlan Valve Co. Type 180 | 10736 | |
| A4180 | 1 | Sensor, Temperature | Sensing bulb in evaporator secondary circuit | | Part of 10733 | |
| A4181 | 1 | Sight-Glass | Refrigerant flow | Superior Valve and Fitting Co., P/N 2423 | 10713 | |
| A4182 | 1 | Valve, Thermal Expansion | 1-1/8 in. x 1-5/8 in. O.D. flange, secondary circuit | Sporlan Valve Co. P/N MPE-34 | Part of 10733 | |
| A4183 | 1 | Valve, Solenoid | 3-way, NC, $GN_2$ control pressure | Auto Switch Co. | 10854 | |
| A4184 | 1 | Valve, Solenoid | 3-way, NC, $GN_2$ control pressure | Auto Switch Co. | 10854 | |
| A4185 | 1 | Regulator, Flow | 50 psig $GN_2$ supply | Mason-Neilon Mod. 137-3 | Part of 10710 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4186 | 1 | Regulator, Flow | 50 psig $GN_2$ supply | Mason-Neilon P/N 137-3 | Part of 10730 | |
| A4187 | 1 | Blower | Air or $GN_2$ | Buffalo Forge Co. P/N CB-40-3 | Part of 10702 | |
| A4188 | 1 | Blower | Air or $GN_2$ | Buffalo Forge Co. P/N CB-40-3 | Part of 10702 | |
| A4189 | 1 | Filter, Air | Fresh air supply | Farr Company P/N 10711 | 10711 | |
| A4190 | 1 | Filter, Air | Fresh air supply | Farr Company P/N 10711 | 10711 | |
| A4191 | 1 | Valve, Solenoid | 3-way, 1/2 in., N.O., 8 psig $GN_2$ control pressure | Auto Switch Co. P/N 8300A-74G | 10864 | |
| A4192 | 1 | Valve, Solenoid | 3-way, 1/2 in., N.O., 8 psig $GN_2$ control pressure | Auto Switch Co. P/N 8300A-74G | 10864 | |
| A4193 | 1 | Coil, Evaporator | Secondary circuit | Dunham-Bush P/N 10701 | 10701 | |
| A4194 | 1 | Thermistor | Thermal sensing element for evaporator pressure regulator | Minneapolis-Honeywell Series 800, Type 12 | Part of 10717 | |
| A4195 | 1 | Valve, Solenoid | 1-5/8 in. O.D. flange, NC, refrigerant flow | Sporlan Valve Co. Type 100-S | 10732 | |
| A4196 | 1 | Valve, Solenoid | 1-5/8 in. O.D. flange, NC, refrigerant flow | Sporlan Valve Co. Type 100-S | 10732 | |
| A4197 | 1 | Coil, Reheat | Air or $GN_2$ | Dunham-Bush P/N 10705 | 10705 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4198 | 1 | Controller, Temperature | Reheat coil | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4199 | 1 | Regulator, Flow | Motor operated | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4200 | 1 | Coil, Reheat | Air or $GN_2$ | Dunham-Bush P/N 10705 | 10705 | |
| A4201 | 1 | Controller, Temperature | Reheat coil | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4202 | 1 | Regulator, Flow | Motor operated | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4203 | 1 | Coil, Reheat | Air or $GN_2$ | Dunham-Bush P/N 10705 | 10705 | |
| A4204 | 1 | Controller, Temperature | Reheat coil | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4205 | 1 | Regulator, Flow | Motor operated | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4206 | 1 | Coil, Reheat | Air or $GN_2$ | Dunham-Bush P/N 10705 | Part of 10705 | |
| A4207 | 1 | Controller, Temperature | Reheat coil | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4208 | 1 | Regulator, Flow | Motor operated | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4209 | 1 | Filter | Air intake | | | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4210 | 1 | Damper, Vortex | Air intake | | | |
| A4211 | 1 | Fan, Supply | Air intake | | | |
| A4212 | 1 | Thermistor | | | | |
| A4213 | 1 | Thermistor | | | | |
| A4214 | 1 | Thermistor | | | | |
| A4215 | 1 | Controller, Temperature | | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4216 | 1 | Coil, Reheat | | Dunham-Bush P/N 10706 | 10706 | |
| A4217 | 1 | Regulator, Flow | Motor operated | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4218 is not functionally applicable to this system. | | | | | | |
| A4219 | 1 | Control, Reheater | | | | |
| A4220 | 1 | Controller, Temperature | Reheat coil | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4221 | 1 | Coil, Reheat | Air or $GN_2$ | Dunham-Bush P/N 10707 | 75M03136 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4222 | 1 | Regulator, Flow | Motor operated | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4223 | 1 | Coil, Reheat | | Dunham-Bush P/N 10707 | 75M03136 | |
| A4224 | 1 | Regulator, Flow | Motor operated | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4225 | 1 | Controller, Temperature | Reheat coil | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4226 | 1 | Thermistor | | Imperial Electronics P/N 10743 | Part of 10743 | |
| A4227 through A4243 are not functionally applicable to this system. | | | | | | |
| A4244 | 1 | Motor | Blower motor, 405 VDC | Buffalo-Forge Co. P/N CB-40-3 | 10702 | |
| A4245 | 1 | Heater, Electric | Air or $GN_2$ | General Electric P/N 10750 | 10750 | |
| A4246 | 1 | Heater, Electric | Air or $GN_2$ | General Electric P/N 10747 | 10750 | |
| A4247 is not functionally applicable to this system. | | | | | | |
| A4248 | 1 | Valve, Pneumatic | Air-flow shutoff, bladder actuated | Air Factors, Inc. P/N 5-8-9000 | 10708 | |
| A4249 | 1 | Valve, Pneumatic | Air-flow shutoff, bladder actuated | Air Factors, Inc. P/N 5-8-9000 | 10708 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4250 | 1 | Controller, Pneumatic | 20 psig $GN_2$ control pressure | Mason-Neilon P/N 972142-4 | Part of 10730 | |
| A4251 | 1 | Controller, Pneumatic | 20 psig $GN_2$ control pressure | Mason-Neilon P/N 972142-4 | Part of 10710 | |
| A4252 | 1 | Controller, Pneumatic | 20 psig $GN_2$ control pressure | Mason-Neilon P/N 972142-4 | Part of 10710 | |
| A4253 | 1 | Controller, Pneumatic | 20 psig $GN_2$ control pressure | Mason-Neilon P/N 972142-4 | Part of 10710 | |
| A4254 | 1 | Valve, Pneumatic | Air-flow shutoff, bladder actuated | Air Factors, Inc. P/N 5-8-9000 | 10708 | |
| A4255 | 1 | Valve, Pneumatic | Air-flow shutoff, bladder actuated | Air Factors, Inc. P/N 5-8-9000 | 10708 | |
| A4256 and A4257 are not functionally applicable to this system. | | | | | | |
| A4258 | 1 | Switch, Differential Pressure | Oil pressure failure | Penn Controls P/N AD5-275AP10 | 10859 | |
| A4259 is not functionally applicable to this system. | | | | | | |
| A4260 | 1 | Controller, Pressure | 20 psig $GN_2$ control pressure | Mason-Neilon P/N 972142-4 | Part of 10730 | |
| A4261 | 1 | Controller, Pressure | 20 psig $GN_2$ control pressure | Mason-Neilon P/N 472142-4 | Part of 10730 | |
| A4262 | 1 | Valve, Pneumatic | Air-flow shutoff, bladder actuated | Air Factors, Inc. P/N 5-8-9000 | 10708 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4263 | 1 | Valve, Pneumatic | Air-flow shutoff, bladder actuated | Air Factors, Inc. P/N 5-8-9000 | 10708 | |
| A4264 through A4266 are not functionally applicable to this system. | | | | | | |
| A4267 | 1 | Switch, Differential Pressure | Oil pressure failure | Penn Controls P/N 2D5-275AP10 | 10859 | |
| A4268 is not functionally applicable to this system. | | | | | | |
| A4269 | 1 | Regulator, Pressure | 20 psig $GN_2$ control pressure | Mason-Neilon Model 71 | 10860 | |
| A4270 | 1 | Regulator,Pressure | 8 psig $GN_2$ control pressure | Mason-Neilon Model 71 | 10860 | |
| A4271 | 1 | Valve, Manual | 12 in., 50 psig $GN_2$ supply shutoff | Keystone Valve Co. | 10793 | |
| A4272 | 1 | Valve, Manual | 1-1/8 in. O.D. flange, refrigerant shutoff | Superior Valve and Fitting Co., P/N 191-11S | 10888 | |
| A4273 | 1 | Valve, Manual | 1-1/8 in. O.D. flange, refrigerant shutoff | Superior Valve and Fitting Co., P/N 191-11S | 10888 | |
| A4274 | 1 | Gage, Pressure | 4-1/2 in. dial, compressor output | Marsh Instrument Co. P/N 1 FMRB | 10723 | |
| A4275 | 1 | Gage, Pressure | 4-1/2 in. dial, compressor suction | Marsh Instrument Co. P/N 3 FMRB | 10724 | |
| A4276 | 1 | Valve, Manual | 1-1/8 in. O.D. flange, refrigerant shutoff | Superior Valve and Fitting Co., P/N 191-11S | 10888 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4277 | 1 | Valve, Manual | 1-1/8 in. O.D. flange, refrigerant shutoff | Superior Valve and Fitting Co., P/N 191-11S | 10888 | |
| A4278 | 1 | Gage, Pressure | 4-1/2 in. dial, compressor output | Marsh Instrument Co. P/N 1 FMRB | 10723 | |
| A4279 | 1 | Switch, Pressure | Compressor safety switch, actuates on high and low pressure | Penn Controls P/N 4DP2# 271AP | 10725 | |
| A4280 | 1 | Valve, Manual | 1-1/8 in. O.D. flange, refrigerant shutoff | Superior Valve and Fitting Co., P/N 141-11S | 10888 | |
| A4281 | 1 | Valve, Manual | 1-1/8 in. O.D. flange, refrigerant shutoff | Superior Valve and Fitting Co., P/N 141-11S | 10888 | |
| A4282 | 1 | Gage, Pressure | 4-1/2 in. dial, compressor output | P/N 1 FMRB | 10723 | |
| A4283 | 1 | Switch, Pressure | Compressor safety switch, actuates on high and low pressure | Penn Controls 4DP2# 271AP 12AC, Mod. 2303 | 10725 | |
| A4284 | 1 | Gage, Pressure | 4-1/2 in. dial | Marsh Instrument Co. P/N 3 FMRB | 10724 | |
| A4285 | 1 | Valve, Manual | 1/4 in. O.D. flange, gage shutoff | Mueller Brass P/N A-14838 | 10722 | |
| A4286 | 1 | Regulator, Flow | Pneumatically operated | Minneapolis-Honeywell Series 800, Type 12 | Part of 10717 | |
| A4287 | 1 | Thermistor | Temperature indicating | Imperial Electronics P/N 1149-100 | Part of 10847 | |
| A4288 | 1 | Thermistor | Temperature indicating | Imperial Electronics P/N 1149-100 | Part of 10847 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4289 | 1 | Valve, Thermal Expansion | 1-1/8 in. by 1-5/8 in. O. D. flange, secondary circuit | Sporlan Valve Co. P/N MVE-42 | Part of 10734 | |
| A4290 | 1 | Sensor, Temperature | Compressor suction line | | Part of 10734 | |
| A4291 | 1 | Transducer, Differential Pressure | Air or $GN_2$ | Foxboro Co. P/N 61 3D 1-LK2 | Part of 10855 | |
| A4292 | 1 | Venturi | Air or $GN_2$ | | 10956-101 | |
| A4293 | 1 | Valve | Motor-operated damper | Minneapolis-Honeywell P/N M630A | 10807 | |
| A4294 | 1 | Transducer, Differential Pressure | Air or $GN_2$ | Foxboro Co., P/N 613D1-LK2 | Part of 10855 | |
| A4295 | 1 | Venturi | Air or $GN_2$ | | 10956-101 | |
| A4296 | 1 | Damper | Motor operated | Minneapolis-Honeywell P/N M630A, Type MG 30A-T205-2 | 10807 | |
| A4297 | 1 | Venturi | Air or $GN_2$ | | 75M03037-3 | |
| A4298 | 1 | Damper | motor-operated | Minneapolis-Honeywell P/N M630A, Type MG 30A-T205-2 | 10807 | |
| A4299 | 1 | Transducer, Differential Pressure | Air or $GN_2$ | Foxboro Co. P/N 613D-LK2 | Part of 10855 | |
| A4300 | 1 | Orifice | | | 75M03037 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4301 | 1 | Damper | Motor-operated | Minneapolis-Honeywell P/N M630A, Type MG 30A-T205-2 | 10807 | |
| A4302 | 1 | Transducer, Differential Pressure | Air or $GN_2$ | Foxboro Co. P/N 613DL-LK2 | Part of 10855 | |
| A4303 | 1 | Orifice | Air or $GN_2$ | | 75M03037-1 | |
| A4304 | 1 | Damper | Motor-operated | Minneapolis-Honeywell P/N 630A | 10807 | |
| A4305 | 1 | Transducer, Differential Pressure | Air or $GN_2$ | Foxboro Co. P/N 613DL-LK2 | Part of 10855 | |
| A4306 | 1 | Transducer, Differential Pressure | Air or $GN_2$ | Foxboro Co. P/N 613DL-LK2 | Part of 10855 | |
| A4307 | 1 | Damper | Motor-operated | Minneapolis-Honeywell P/N 630A | 10807 | |
| A4308 | 1 | Venturi | Air or $GN_2$ | | 10956-103 | |
| A4309 | 1 | Orifice | Air or $GN_2$ | | | |
| A4310 | 1 | Damper | Motor-operated | Minneapolis-Honeywell P/N 630A | | |
| A4311 | 1 | Transducer, Differential Pressure | Air or $GN_2$ | Foxboro Co. P/N 613DL-LK2 | Part of 10855 | |
| A4312 | 1 | Thermistor | Temperature indicating | Imperial Electronics P/N 1149-100 | Part of 10847 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4313 | 1 | Thermistor | Temperature indicating | Imperial Electronics P/N 1149-100 | Part of 10847 | |
| A4314 | 1 | Thermistor | Temperature indicating | Imperial Electronics P/N 1149-100 | Part of 10847 | |
| A4315 | 1 | Thermistor | Temperature indicating | Imperial Electronics P/N 1149-100 | Part of 10847 | |
| A4316 | 1 | Filter | 50 psig $GN_2$ control pressure | Mason-Neilon Co. Model 61 | 10861 | |
| A4317 | 1 | Filter | 50 psig $GN_2$ control pressure | Mason-Neilon Co. Model 61 | 10861 | |
| A4318 | 1 | Gage, Pressure | 20 psig $GN_2$ control pressure | Mason-Neilon Co. | Part of 10860 | |
| A4319 | 1 | Gage, Pressure | 8 psig $GN_2$ control pressure | Mason-Neilon Co. | Part of 10860 | |
| A4320 | 1 | Valve, Check | 4 in., water supply | Lunkenheimer, P/N 1790 | 10963 | |
| A4321 | 1 | Regulator, Booster | $GN_2$ control pressure to flow control regulator | | | |
| A4322 | 1 | Regulator, Booster | $GN_2$ control pressure to flow control regulator | | | |
| A4323 | 1 | Regulator, Booster | $GN_2$ control pressure to flow control regulator | | | |
| A4324 | 1 | Regulator, Booster | $GN_2$ control pressure to flow control regulator | | | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4325 | 1 | Regulator, Booster | $GN_2$ control pressure to flow control regulator | | | |
| A4326 | 1 | Regulator, Booster | $GN_2$ control pressure to flow control regulator | | | |
| A4327 | 1 | Control Unit | Unit B | | | |
| A4328 | 1 | Conditioning Unit | Unit A1 | | | |
| A4329 | 1 | Control Unit | Unit C | | | |
| A4330 | 1 | Conditioning Unit | Unit A2 | | | |
| A4331 | 1 | Control Unit | Unit D | | | |
| A4332 | 1 | Conditioning Unit | Unit A3 | | | |
| A4333 | 1 | Switch, Pressure | Low $GN_2$ pressure | Minneapolis-Honeywell P/N P444A-103301 | 10846 | |
| A4334 | 1 | Filter | 50 psig $GN_2$ supply | Permanent Filter Corp. P/N 18394-5 | 10858 | |
| A4335 | 1 | Switch, Temperature | 50 psig $GN_2$ supply | Minneapolis-Honeywell P/N T675A-1066 | 10842 | |
| A4336 | 1 | Gage, Pressure | 4-1/2 in. dial, compressor suction | Marsh instrument Co. P/N 3FMRB | 10724 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4337 | 1 | Valve, Manual | 1/4 in., refrigerant charge | Dero-Test Mfg. Co. P/N R-224-XL | 10728 | |
| A4338 | 1 | Valve, Manual | 1/4 in., refrigerant charge | Dero-Test Mfg. Co. P/N R-224-XL | 10728 | |
| A4339 | 1 | Valve, Manual | Deluge purge shutoff | | | |
| A4340 | 1 | Valve, Manual | Deluge purge shutoff | | | |
| A4341 is not functionally applicable to this system. | | | | | | |
| A4342 | 1 | Valve, Pneumatic | 12 in. conditioned air/$GN_2$ flow control | Keystone Valve Corp. | 10953 | |
| A4343 | 1 | Coupling, Quick-Disconnect | | | 75M-02200 | |
| A4344 | 1 | Coupling, Quick-Disconnect | | | 75M-02200 | |
| A4345 | 1 | Coupling, Quick-Disconnect | | | 75M-02200 | |
| A4346 | 1 | Coupling, Quick-Disconnect | | | 75M-02200 | |
| A4347 | 1 | Valve, Manual | Butterfly, water quench | | | |
| A4348 | 1 | Valve, Manual | Butterfly, water quench | | | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4349 | 1 | Switch, Over-Temperature Cutout | | | | |
| A4350 | 1 | Switch, Over-Temperature Cutout | | | | |
| A4351 | 1 | Valve, Check | Air or $GN_2$ | | 10920-107 | |
| A4352 | 1 | Valve, Check | Air or $GN_2$ | | 10920-107 | |
| A4353 | 1 | Valve, Check | Air or $GN_2$ | | 10920-107 | |
| A4354 | 1 | Valve, Check | Air or $GN_2$ | | 10920-101 | |
| A4355 | 1 | Valve, Check | Air or $GN_2$ | | 10920-103 | |
| A4356 | 1 | Valve, Check | Air or $GN_2$ | | 10920-101 | |
| A4357 | 1 | Valve, Check | Air or $GN_2$ | | 10920-101 | |
| A4358 | 1 | Switch, Pressure | Fresh air intake, low pressure | Minneapolis-Honeywell P/N C645A-1006-1 | 10760 | |
| A4359 | 1 | Valve, Manual | 1/4 in., condenser-receiver drain | Lunkenheimer, P/N 123 | 10738 | |
| A4360 | 1 | Valve, Manual | Condenser-receiver water shutoff | | | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4361 | 1 | Switch, Temperature | Thermostat | Minneapolis-Honeywell P/N T675A-1060 | 10893 | |
| A4362 | 1 | Sensor, Temperature | Air or $GN_2$ | | | |
| A4363 | 1 | Switch, Temperature | Thermostat | Minneapolis-Honeywell P/N T675A-1060 | 10893 | |
| A4364 | 1 | Sensor, Temperature | Air or $GN_2$ | | | |
| A4365 | 1 | Switch, Temperature | Thermostat | Minneapolis-Honeywell P/N T675A-1060 | 10893 | |
| A4366 | 1 | Sensor, Temperature | Air or $GN_2$ | | | |
| A4367 | 1 | Switch, Pressure | Fresh air intake high pressure | Minneapolis-Honeywell P/N C645A-006-1 | 10843 | |
| A4368 | 1 | Coil, Evaporator | Primary circuit | Dunham-Bush P/N 10701 | 10701 | |
| A4369 | 1 | Coil, Evaporator | Primary circuit | Dunham-Bush P/N 10701 | 10701 | |
| A4370 | 1 | Coil, Evaporator | Primary circuit | Dunham-Bush P/N 10701 | 10701 | |
| A4371 | 1 | Controller, Pneumatic | Water regulator | Black-Sivallis and Bryson | 10739 | |
| A4372 | 1 | Controller, Pneumatic | Water regulator | Black- Sivallis and Bryson | 10739 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4373 | 1 | Controller, Pneumatic | Water regulator | Black-Sivallis and Bryson | 10739 | |
| A4374 | 1 | Valve, Manual | Refrigerant vent | Mueller Brass Co. P/N A15802 | 10889 | |
| A4375 | 1 | Valve, Manual | Refrigerant vent | Mueller Brass Co. P/N A15802 | 10889 | |
| A4376 | 1 | Valve, Manual | Refrigerant vent | Mueller Brass Co. P/N A15802 | 10889 | |
| A4377 | 1 | Switch, Pressure | $GN_2$ high pressure supply | Minneapolis-Honeywell P/N P668A-1038-1 | 10845 | |
| A4378 | 1 | Switch, Temperature | $GN_2$ high temperature | Minneapolis-Honeywell P/N T675A-1060 | 10759 | |
| A4379 | 1 | Tower, Water Cooling | | Baltimore Aircoil P/N TMA175 | 10765 | |
| A4380 | 1 | Switch, Differential Pressure | Low flow rate cutout | F./W. Dwyer Co. P/N 1630-6 | 10967 | |
| A4381 | 1 | Switch, Differential Pressure | Low flow rate cutout | F./W. Dwyer Co. P/N 1630-6 | 10967 | |
| A4382 | 1 | Switch, Differential Pressure | Low flow rate cutout | F./W. Dwyer Co. P/N 1630-6 | 10967 | |
| A4383 | 1 | Switch, Differential Pressure | Low flow rate cutout | F./W. Dwyer Co. P/N 1630-6 | 10967 | |
| A4384 | 1 | Switch, Differential Pressure | Low flow rate cutout | F./W. Dwyer Co. P/N 1630-6 | 10967 | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4385 | 1 | Switch, Differential Pressure | Low flow rate cutout | F./W. Dwyer Co. P/N 1630-6 | 10967 | |
| A4386 | 1 | Switch, Differential Pressure | Low flow rate cutout | F. W. Dwyer Co. P/N 1630-6 | 10967 | |
| A4387 | 1 | Valve, Solenoid | 50 psig control pressure | Marotta Valve Co. P/N MV123C | 10952 | |
| A4388 | 1 | Valve, Solenoid | 50 psig control pressure | Marotta Valve Co. P/N MV123C | 10952 | |
| A4389 | 1 | Heat Exchanger | Refrigerant | | | |
| A4390 | 1 | Heat Exchanger | Refrigerant | | | |
| A4391 | 1 | Heat Exchanger | Refrigerant | | | |
| A4392 | 1 | Switch, Pressure | Safety interlock | | | |
| A4393 | 1 | Switch, Pressure | Safety interlock | | | |
| A4394 | 1 | Switch, Pressure | Safety interlock | | | |
| A4395 | 1 | Sight-Glass | Moisture indicator | | | |
| A4396 | 1 | Sight-Glass | Moisture indicator | | | |

| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4397 | 1 | Sight-Glass | Moisture indicator | | | |
| A4398 through A4899 are not functionally applicable to this system. | | | | | | |
| A4900 | 1 | Coupling, Quick-Disconnect | | | | |
| A4901 | 1 | Valve, Pneumatic | NC, ball shutoff | | | |
| A4902 | 1 | Valve, Solenoid | NC, control pressure | | | |
| A4903 | 1 | Valve, Pneumatic | NC, ball shutoff | | | |
| A4904 | 1 | Valve, Solenoid | NC, control pressure | | | |
| A4905 | 1 | Valve, Solenoid | NC, control pressure | | | |
| A4906 | 1 | Valve, Solenoid | NC, control pressure | | | |
| A4907 is not functionally applicable to this system. | | | | | | |
| A4908 | 1 | Valve, Pneumatic | NC, ball shutoff | | | |
| A4909 | 1 | Valve, Pneumatic | NC, ball shutoff | | | |

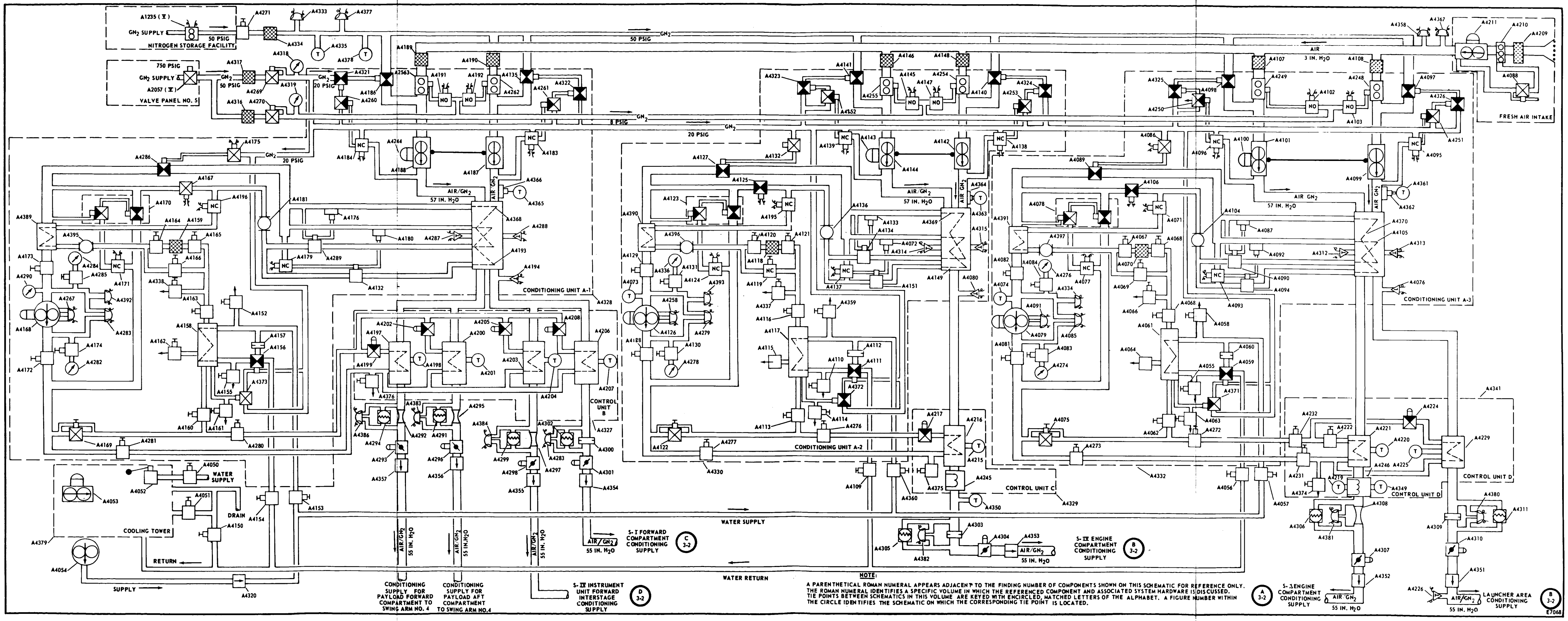
| Finding Number | Reqd | Component | Remarks | Vendor | Drawing Number | Elec. Sym. |
|---|---|---|---|---|---|---|
| A4910 through B319 are not functionally applicable to this system. | | | | | | |
| B320 | 1 | Coupling, Quick-Disconnect | Air or $GN_2$ input line connector | Calmec Mfg. Co., P/N 319 | 20M40000 | |
| B321 | 1 | Coupling, Quick-Disconnect | Air or $GN_2$ exhaust line | Calmec Mfg. Co., P/N 319 | 20M40000 | |
| B322 | 1 | Orifice | Fuel Container No. 1, vent | | 20M40117 | |
| B323 through B502 are not functionally applicable to this system. | | | | | | |
| B503 | 4 | Coupling, Quick-Disconnect | | Calmec Mfg. Co. | 20M30450 | |
| B504 through E58 are not functionally applicable to this system. | | | | | | |
| E59 | 1 | Thermistor | S-IV engine compartment | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

# SECTION 3

## MECHANICAL SCHEMATICS

This section provides mechanical schematics which reflect all of the components involved in the functional operation of the environmental conditioning systems.

For a definition of the mechanical symbols used, see MSFC-STD-162.




NOTE:
A PARENTHETICAL ROMAN NUMERAL APPEARS ADJACENT TO THE FINDING NUMBER OF COMPONENTS SHOWN ON THIS SCHEMATIC FOR REFERENCE ONLY. THE ROMAN NUMERAL IDENTIFIES A SPECIFIC VOLUME IN WHICH THE REFERENCED COMPONENT AND ASSOCIATED SYSTEM HARDWARE IS DISCUSSED. TIE POINTS BETWEEN SCHEMATICS IN THIS VOLUME ARE KEYED WITH ENCIRCLED MATCHED LETTERS OF THE ALPHABET. A FIGURE NUMBER WITHIN THE CIRCLE IDENTIFIES THE SCHEMATIC ON WHICH THE CORRESPONDING TIE POINT IS LOCATED.

Figure 3-1. Environmental Control System

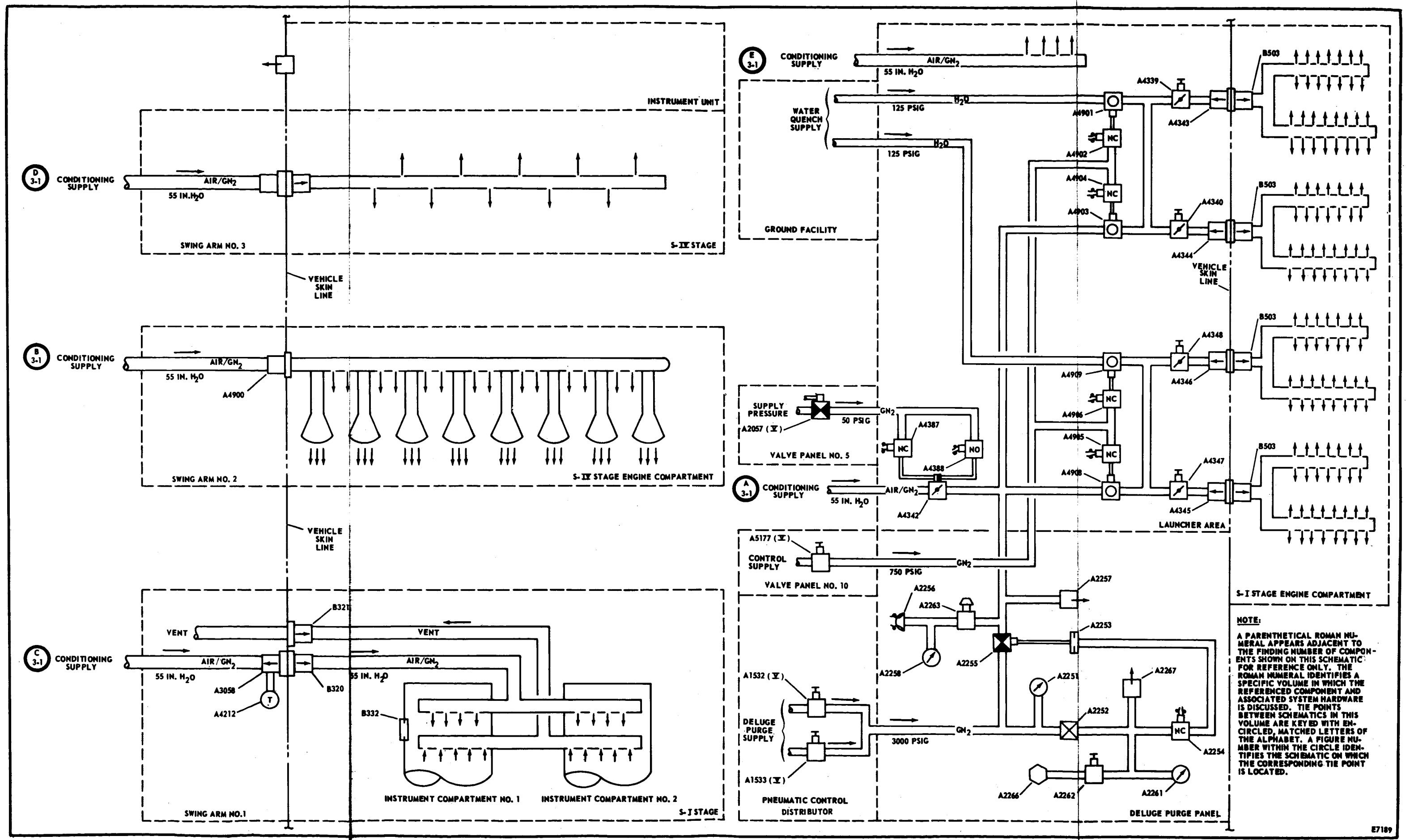



Figure 3-2. Vehicle Conditioning Systems

# APPENDIX A

## LISTING OF LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B VOLUMES

| Volume | Title |
|---|---|
| I | RP-1 Fuel System |
| II | LOX System |
| III | $LH_2$ System |
| IV | Nitrogen and Helium Storage Facility |
| V | Pneumatic Distribution System |
| VI | Environmental Conditioning Systems |
| VII | Launch Pad Accessories |
| VIII | H-I Engine and Hydraulic System |
| IX | RL10A-3 Engine and Hydraulic System |
| X | Separation and Flight Termination Systems |