

SS-1924-R

# APOLLO BLOCK II ECS COMPONENTS

DECEMBER 1966



*E. Wright* *nasa.*

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# APOLLO BLOCK II ECS COMPONENTS

Brief technical descriptions  
and summaries of performance  
requirements for components  
of the Environmental Control  
System (ECS) used on Project  
Apollo Block II Systems (Lunar  
Mission Systems)

DECEMBER 1966



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7	System Flow Schematic

\*Illustrations appear at the back of the booklet.

## INTRODUCTION

This booklet, intended primarily for field use, describes the individual components of the Environmental Control System (ECS) used on Project Apollo Block II Systems (Lunar Mission Systems). Performance requirements for all components are listed in summary form. Brief technical descriptions are included for most components.

Three indexes are included: item number, part number, and functional. The item-number index provides cross-reference from item number to component name; this index also shows component location within the spacecraft. The part-number index provides cross-reference from part number to item number. The functional index provides cross-reference from component function or type to item number and component name.

Block diagrams of electronic controls, system electrical schematics, and the system flow schematic are included at the back of the booklet. Blank pages for the reader's notes are provided.

# ITEM NUMBER INDEX

This index provides a cross-reference between item number and component or unit name. Component or unit location within spacecraft is also shown. Abbreviations used in the "Location" column are defined at the end of the index.

<u>Item</u> <u>No.</u>	<u>Location</u>	<u>Title</u>
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## GROUP 0. UNITS

0.1	CM	Environmental Control Unit (ECU)
0.2	CM	Oxygen Control Panel (OCP)
0.3	CM	Water Control Panel (WCP)
0.4	CM	Pump Assembly (PA)

## GROUP 1. SUIT CIRCUIT

1.3	ECU	Suit Circuit Return Check Valve
1.8	ECU	Debris Trap
1.10	ECU	Suit Compressor
1.11	ECU	Suit Compressor Check Valve
1.14	ECU,CM	CO <sub>2</sub> Absorber Element
1.15	ECU	CO <sub>2</sub> and Odor Absorber Canister
1.16	ECU	Suit Bypass Valve
1.29	ECU	Suit Heat Exchanger Assembly
1.31	CM	Suit Flow Limiter
1.34	CM	Suit Hose Connector Assembly
1.36	ECU	Cyclic Accumulator Selector Valve
1.38	ECU	Cyclic Accumulator Control
1.39	ECU	Cyclic Accumulator Sensor
1.40	ECU	Cyclic Accumulator Signal Conditioner
1.46	ECU	Water-Glycol Selector Valve

## GROUP 2. COOLANT CIRCUIT

2.1	SM,CM	Space Radiator Check Valve
2.5	SM,CM,ECU	Glycol Check Valve
2.6	ECU	Primary Glycol Evaporator
2.7	ECU	Secondary Glycol Evaporator

## ITEM NUMBER INDEX (Continued)

<u>Item No.</u>	<u>Location</u>	<u>Title</u>
<b>GROUP 2. COOLANT CIRCUIT (Continued)</b>		
2.13	CM	Cabin Temperature Control Valve
2.20	SM	Space Radiator Isolation Valve
2.22	ECU	Glycol Temperature Control
2.23	ECU	Glycol Temperature Sensor
2.24	SM	Glycol Fill Connection
2.28	CM	Glycol Shutoff Valve
2.29	CM	Glycol Reservoir
2.35	CM	Glycol Metering Valve
2.36	CM	Glycol Diverter Valve
2.39	ECU	Backpressure Control Valve
2.40	ECU	Glycol Evaporator Temperature Control
2.42	ECU	Glycol Temperature Control Valve
2.45	ECU	Glycol Temperature Sensor
2.46	SM	Glycol Shutoff Valve
2.47	ECU	Glycol Temperature Sensor
2.48	PA	Glycol Pump
2.49	ECU	Wick Temperature Sensor
2.50	ECU	Glycol Temperature Sensor
2.51	SM	Pressure Cap
2.52	ECU	Glycol Diverter Valve

## GROUP 3. CABIN PRESSURE AND TEMPERATURE CONTROL

3.1	CM	Cabin Pressure Relief Valve
3.2	CM	Cabin Heat Exchanger
3.6	CM	Cabin Temperature Anticipator
3.7	CM	Cabin Temperature Control
3.8	CM	Cabin Temperature Sensor
3.18	CM	Cabin Fan
3.28	OCP	Cabin Pressure Regulator
3.30	CM	LEM Pressure Valve
3.31	CM	Tunnel Pressure Equalization Valve
3.32	CM	Tunnel Pressure Gauge

## ITEM NUMBER INDEX (Continued)

<u>Item</u> <u>No.</u>	<u>Location</u>	<u>Title</u>
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### GROUP 4. OXYGEN SUPPLY

4.16	ECU	Demand Pressure Regulator
4.17	CM	Manual Oxygen Metering Valve
4.22	OCF	Emergency Oxygen Inflow Control Valve
4.24	OCF	Oxygen Pressure Regulator
4.25	OCF,CM	High Pressure Oxygen Check Valve
4.26	CM	Manual Shutoff Valve
4.27	CM	Relief Valve
4.28	OCF	Cabin Depressurization Shutoff Valve
4.34	CM	Three-Position Selector Valve
4.35	ECU	Oxygen Filter

### GROUP 5. WATER SUPPLY

5.2	WCP	Water Check Valve
5.10	CM	Potable Water Tank
5.14	ECU	Water Chiller
5.15	CM	Waste Water Tank
5.18	CM,WCP	Water Shutoff Valve
5.19	WCP	Water Tank Pressure Relief Valve
5.22	CM	Potable Water Supply Assembly
5.23	WCP	Water Pressure Relief Valve
5.24	OCF	Tank Pressure Regulator
5.29	ECU	Glycol Evaporator Water Control Valve
5.33	ECU	Water Filter

### GROUP 6. VENTILATION

6.1	CM	Post Landing Ventilation Fan
6.7	CM	Post Landing Ventilation Gate Valve

### GROUP 7. SUIT CIRCUIT INSTRUMENTATION

7.6	ECU	Suit Supply Inlet Pressure Transducer
7.12	ECU	Suit Compressor Differential Pressure Transducer
7.17	CM	Suit Supply Inlet Temperature Sensor

## ITEM NUMBER INDEX (Continued)

<u>Item No.</u>	<u>Location</u>	<u>Title</u>
<b>GROUP 8. COOLANT CIRCUIT INSTRUMENTATION</b>		
8.1	PA	Glycol Pump Outlet Pressure Transducer
8.16	PA	Glycol Accumulator Quantity Transducer
8.17	ECU	Evaporator Steam Duct Pressure Transducer
8.22	CM	Steam Duct Temperature Sensor
8.23	CM	Radiator Outlet Temperature Sensor
8.24	ECU	Steam Pressure Switch

### GROUPS 9 AND 10. OXYGEN SUPPLY AND CABIN INSTRUMENTATION

9.2	OCP	Oxygen Flow Transducer
9.8	OCP	Oxygen Pressure Transducer
9.11	CM	Cabin Temperature Transducer
10.5	CM	Cabin Pressure Transducer

### GROUP 12. INSTRUMENTATION POWER SUPPLIES

12.1	ECU	Temperature Transducer Power Supply
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### GROUP 13. INSTRUMENTATION AMPLIFIERS

13.1	ECU,CM	Temperature Sensor Amplifier
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### GROUP 15. ELECTRICAL FILTERS

15.1	ECU	Capacitor Assembly
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## LOCATION ABBREVIATIONS

<u>Location Abbreviation</u>	<u>Location</u>	
ECU	Environmental Control Unit	} Components located in ECS end-item units
OCP	Oxygen Control Panel	
PA	Pump Assembly	
WCP	Water Control Panel	
CM	Command Module	} Component or unit is ECS end item
SM	Service Module	

## PART NUMBER INDEX

This index provides cross-reference between part number and item number. The index is organized numerically by part number. To permit rapid location of a part number, numbers having the same first three digits are grouped together and these subdivisions are separated by three asterisks. Braces flag part numbers that have the same basic number.

<u>Part No.</u>	<u>Item No.</u>	<u>Part No.</u>	<u>Item No.</u>
810230-1	3.28	820920-2	2.23
810340-2	5.24	820928-1	1.39
810450-3	3.1	820930-2	1.40
810520-2	1.16	820956-2	2.40
810602-1	1.31	820964-1	3.8
810856-1	1.34	820972-2	2.49
* * *		{ 820980-2-1	2.45
811100-4	1.8	820980-4	2.47
811400-7	1.15	{ 820980-4	2.50
811510-2	1.14	* * *	
* * *		821220-3	2.20
812150-1	3.2	* * *	
812260-1	5.15	825070-2	2.48
812370-1	5.10	* * *	
812400-3	5.14	826000-2	1.10
812580-2	2.7	826010-2	3.18
812590-2	2.6	826070-4	6.1
812850-1	2.29	* * *	
812870-5	5.33	827360-2	5.2
812950-2	5.22	827410-1	5.18
* * *		827830-3	5.23
813410-2	1.29	827990-1	2.5
* * *		* * *	
816032-1	6.7	828020-2	1.36
* * *		828260-1	4.25
{ 820010-4	2.22	828350-1	2.24
{ 820010-4	3.7	828370-1	2.1
820110-3	3.6	828490-2	2.46
820914-3	1.38	828510-4	4.22
		828540-3	2.42
		828560-1	4.17



# PART NUMBER INDEX (Continued)

Part No.    Item No.

828570-2    2.28  
828650-2    4.27  
828660-2    5.18  
828730-5    4.16

828740-2    4.26  
828750-2    2.28  
828760-1    5.19  
828860-2    4.34

828920-1    3.30  
828930-1    3.31  
828940-1    3.32  
828950-1    2.36  
828960-1    4.28  
828990-1    2.35

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829130-1    5.29  
829140-1    2.51  
829150-2    4.24  
829160-1    1.46  
829170-1    2.39  
829190-1    2.52

\* \* \*

836056-2    13.1  
836058-1    8.23  
836066-3    12.1  
836112-2    9.2

Part No.    Item No.

836114-1    8.24  
836130-1    8.1  
836132-1    10.5  
836930-1    9.11

{836950-1    7.17  
{836950-2    8.22  
{836995-1    15.1  
{836995-2    15.1

\* \* \*

837016-2    9.8  
837026-4    8.16  
837036-1    8.17  
837044-4    7.6  
837054-1    7.12

\* \* \*

848220-3    0.1 (ECU)  
848320-3    0.3 (WCP)  
848330-2    0.2 (OCP)  
848340-2    0.4 (PA)  
848353-2    4.35

\* \* \*

850026-1    1.3  
850028-2    2.13  
850137    1.11  
850138    1.11

# FUNCTIONAL INDEX

This index provides cross-reference from component function or type to item number and component name. Components which have more than one function have multiple entries. Such entries have cross-reference numbers in the right-hand column; these numbers refer to the codes in the left-hand column. Each component is listed once and only once under a "Primary Function" heading, although in a few cases the "Secondary Function" is equally important. Listings under "Primary Function" headings are enclosed in brackets for quick location.

## 1 ABSORBERS, CHEMICAL

<u>Primary Function</u>	
1.14	CO <sub>2</sub> Absorber Element

## 2 ACCUMULATORS, FLUID

Note: See PUMPS for cyclic accumulator.

### Secondary Function

2.48	Glycol Pump (glycol accumulators)	18a
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## 3 AMPLIFIERS, ELECTRONIC

<u>Primary Function</u>	
13.1	Temperature Sensor Amplifier (for instrumentation temperature sensors)

## 4 CANISTERS

<u>Primary Function</u>	
1.15	CO <sub>2</sub> and Odor Absorber Canister 26b,28e,28g

## 5 CAPS, PRESSURE

<u>Primary Function</u>	
2.51	Pressure Cap (for sealing glycol fill connection)

## FUNCTIONAL INDEX (Continued)

### 6 COMPRESSORS, FLUID

[	<u>Primary Function</u>	]
	1.10 Suit Compressor	

### 7 CONNECTORS, FLUID

[	<u>Primary Function</u>	]
	1.34 Suit Hose Connector Assembly	26b, 28c
	2.24 Glycol Fill Connection	

### 8 CONTROLS, ELECTRONIC

[	<u>Primary Function</u>	]
	1.38 Cyclic Accumulator Control	
	2.22 Glycol Temperature Control (for mixing control)	
	2.40 Glycol Evaporator Temperature Control	
	3.7 Cabin Temperature Control	

### 9 EVAPORATORS, FLUID

[	<u>Primary Function</u>	]
	2.6 Primary Glycol Evaporator	
	2.7 Secondary Glycol Evaporator	

### 10 FANS

[	<u>Primary Function</u>	]
	3.18 Cabin Fan	
	6.1 Post Landing Ventilation Fan	

### 11 FILTERS, ELECTRICAL \*

[	<u>Primary Function</u>	]
	15.1 Capacitor Assembly	

\*Noise filters which are internal to electrical and electronic units are not listed.

## FUNCTIONAL INDEX (Continued)

### 12 FILTERS, FLUID

[ 12a	<u>Primary Function</u>	]
	4.35 Oxygen Filter (for ECU oxygen supply)	
	5.33 Water Filter (for glycol evaporator)	29b
12b	<u>Secondary Function*</u>	
	2.48 Glycol Pump (water-glycol inlet filter)	18a
	4.16 Demand Pressure Regulator (oxygen inlet filter)	19
	4.22 Emergency Oxygen Inflow Control Valve (oxygen inlet filter)	19
	4.24 Oxygen Pressure Regulator (oxygen inlet filter)	19
	4.27 Relief Valve (oxygen inlet filter)	29a

### 13 FLOW LIMITERS, FLUID

[	<u>Primary Function</u>	]
	1.31 Suit Flow Limiter	

### 14 GAUGES AND INDICATORS, PRESSURE

[ 14a	<u>Pressure Gauges/Primary Function</u>	]
	3.32 Tunnel Pressure Gauge	
14b	<u>Pressure Indicators/Secondary Function</u>	
	3.31 Tunnel Pressure Equalization Valve (door pressure-differential indicator)	28f

### 15 HEATERS, ELECTRICAL

	<u>Secondary Function</u>	
5.22	Potable Water Supply Assembly (hot water reservoir heaters)	23

\*In-line filters only are listed; filters and screens on sense ports are not shown.

## FUNCTIONAL INDEX (Continued)

### 16 HEAT EXCHANGERS

#### Primary Function

- |      |                              |               |
|------|------------------------------|---------------|
| 1.29 | Suit Heat Exchanger Assembly | 18b, 26b, 28e |
| 3.2  | Cabin Heat Exchanger         |               |
| 5.14 | Water Chiller                |               |

### 17 POWER SUPPLIES, ELECTRONIC\*

#### Primary Function

- |      |   |  |
|------|---|--|
| 12.1 | Temperature Transducer Power Supply<br>(for instrumentation temperature sensors<br>and temperature sensor amplifiers) |  |
|------|---|--|

### 18 PUMPS, FLUID

#### Primary Function

- |      |             |                  |
|------|-------------|------------------|
| 2.48 | Glycol Pump | 2, 12b, 26b, 28g |
|------|-------------|------------------|

#### Secondary Function

- |      |  |    |
|------|--|----|
| 1.29 | Suit Heat Exchanger (cyclic accumulators<br>for waste water pumping) | 16 |
|------|--|----|

### 19 REGULATORS, PRESSURE, FLUID

#### Primary Function

- |      |   |                        |
|------|---|------------------------|
| 3.28 | Cabin Pressure Regulator                                | 28g                    |
| 4.16 | Demand Pressure Regulator<br>(for suit circuit)         | 12b, 28e, 29b, 30      |
| 4.22 | Emergency Oxygen Inflow<br>Control Valve (for cabin)    | 12b, 28e, 28g, 29b, 30 |
| 4.24 | Oxygen Pressure Regulator<br>(oxygen supply regulation) | 12b, 26b, 28e, 29b     |
| 5.24 | Tank Pressure Regulator                                 | 28e, 29b               |

\*Internal power supplies in electronic controls and transducers are not listed.

## FUNCTIONAL INDEX (Continued)

### 20 SENSORS, FLUID AND TEMPERATURE

#### 20a Fluid Sensors/Primary Function

- 1.39 Cyclic Accumulator Sensor (for instrumentation; detects O<sub>2</sub> in waste water)

#### 20b Temperature Sensors, Cabin/Primary Function

Note: See TRANSDUCERS for Cabin Temperature Transducer

- 3.6 Cabin Temperature Anticipator (for cabin temperature control)
- 3.8 Cabin Temperature Sensor (for cabin temperature control)

#### 20c Temperature Sensors, Glycol/Primary Function

- 2.23 Glycol Temperature Sensor (for instrumentation and glycol evaporator temperature control)
- 2.45 Glycol Temperature Sensor (for glycol mixing temperature control)
- 2.47 Glycol Temperature Sensor (for temperature override of glycol evaporator temperature control)
- 2.50 Glycol Temperature Sensor (for glycol evaporator temperature control)
- 8.23 Radiator Outlet Temperature Sensor (for instrumentation)

#### 20d Temperature Sensors, Steam and Wick/Primary Function

- 2.49 Wick Temperature Sensor (for glycol evaporator temperature control)
- 8.22 Steam Duct Temperature Sensor (for instrumentation)

#### 20e Temperature Sensors, Suit/Primary Function

- 7.17 Suit Supply Inlet Temperature Sensor (for instrumentation)

### 21 SIGNAL CONDITIONERS, ELECTRONIC

#### Primary Function

- 1.40 Cyclic Accumulator Signal Conditioner (for instrumentation)

## FUNCTIONAL INDEX (Continued)

### 22 SWITCHES, ELECTRICAL

- |       |   |     |
|-------|---|-----|
| 22a   | <u>Cam Operated/Secondary Function</u>  |     |
|       | 2.39 Backpressure Control Valve (limit switch)  | 27a |
| 22b   | <u>Flow Operated/Secondary Function</u>   |     |
|       | 9.2 Oxygen Flow Transducer (overflow warning)   | 24a |
| [ 22c | <u>Pressure Operated/Primary Function</u>   |     |
|       | 8.24 Steam Pressure Switch (for pressure<br>override of glycol evaporator temperature<br>control) | ]   |
| 22d   | <u>Temperature Operated/Secondary Function</u>  |     |
|       | 5.22 Potable Water Supply Assembly<br>(hot-water reservoir thermostats)                           | 23  |

### 23 TANKS AND RESERVOIRS, FLUID

- |   |   |              |
|---|---|--------------|
| [ | <u>Primary Function</u>                                     |              |
|   | 2.29 Glycol Reservoir                                       |              |
|   | 5.10 Potable Water Tank                                     | 24d          |
|   | 5.15 Waste Water Tank                                       | 24d          |
|   | 5.22 Potable Water Supply Assembly<br>(hot-water reservoir) | 15, 22d, 28a |
| ] |   |              |

### 24 TRANSDUCERS, FLOW, PRESSURE, QUANTITY, AND TEMPERATURE

- |       |   |     |
|-------|---|-----|
| [ 24a | <u>Flow Transducers/Primary Function</u>  |     |
|       | 9.2 Oxygen Flow Transducer (for instru-<br>mentation; measures ECS O <sub>2</sub> usage)                | 22b |
| [ 24b | <u>Pressure Transducers/Primary Function</u>  |     |
|       | 7.6 Suit Supply Inlet Pressure Transducer<br>(for instrumentation)                                      |     |
|       | 7.12 Suit Compressor Differential Pressure<br>Transducer (for instrumentation)                          |     |
|       | 8.1 Glycol Pump Outlet Pressure Transducer<br>(for instrumentation)                                     |     |
|       | 8.17 Evaporator Steam Duct Pressure Transducer<br>(for instrumentation)                                 |     |
|       | 9.8 Oxygen Pressure Transducer (for<br>instrumentation; measures ECS O <sub>2</sub> supply<br>pressure) | ]   |



# FUNCTIONAL INDEX (Continued)

## 24 TRANSDUCERS, FLOW, PRESSURE, QUANTITY, AND TEMPERATURE (Continued)

[ 24b	<u>Pressure Transducers/Primary Function (Continued)</u>	]
10.5	Cabin Pressure Transducer (for instrumentation)	
[ 24c	<u>Quantity Transducers/Primary Function</u>	]
8.16	Glycol Accumulator Quantity Transducer (for instrumentation)	
24d	<u>Quantity Transducers/Secondary Function</u>	
5.10	Potable Water Tank (water quantity transducer)	23
5.15	Waste Water Tank (water quantity transducer)	23
[ 24e	<u>Temperature Transducer/Primary Function</u>	]
9.11	Cabin Temperature Transducer (for instrumentation)	

## 25 TRAPS, PARTICLE

[ 25a	<u>Primary Function</u>	
1.8	Debris Trap (for suit circuit)	29b
25b	<u>Secondary Function</u>	
1.3	Suit Return Check Valve (inlet port screen)	26a

## 26 VALVES, CHECK, FLUID

[ 26a	<u>Primary Function</u>	
1.3	Suit Circuit Return Check Valve	25b.28g
1.11	Suit Compressor Check Valve	
2.1	Space Radiator Check Valve	
2.5	Glycol Check Valve	
4.25	High-Pressure Oxygen Check Valve	
5.2	Water Check Valve	
26b	<u>Secondary Function</u>	
1.15	CO <sub>2</sub> and Odor Absorber Canister (outlet check valves to isolate open canister)	4
1.29	Suit Heat Exchanger Assembly (cyclic accumulator water inlet and outlet check valves)	16



# FUNCTIONAL INDEX (Continued)

## 26 VALVES, CHECK, FLUID (Continued)

### 26b Secondary Function (Continued)

1.34	Suit Hose Connector Assembly (suit return check valve)	7
2.48	Glycol Pump (pump discharge check valves)	18a
4.24	Oxygen Pressure Regulator (outlet check valves)	19
4.34	Three-Position Selector Valve (high- pressure oxygen check valve)	28d

## 27 VALVES, FLUID, ELECTRICALLY ACTUATED

### [ 27a Modulating Type/Primary Function

2.13	Cabin Temperature Control Valve*	22a
2.39	Backpressure Control Valve (for glycol evaporator)	
2.42	Glycol Temperature Control Valve (for mixing control)*	

### [ 27b Selector Type/Primary Function

1.46	Water-Glycol Selector Valve (for suit heat exchanger water-glycol flow selection)*	29b
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### [ 27c Shutoff Type/Primary Function

1.36	Cyclic Accumulator Selector Valve***	28e
2.20	Space Radiator Isolation Valve	
2.46	Glycol Shutoff Valve (for service module glycol fill line)	
4.28	Cabin Depressurization Shutoff Valve (for remote oxygen supply shutoff)*	28g
5.29	Glycol Evaporator Water Control Valve***	
6.7	Post Landing Ventilation Gate Valve	

\*Valve can be set with manual knob when power is removed.

\*\*Valve has integral selector or shutoff valve for manual control.

# FUNCTIONAL INDEX (Continued)

## 28 VALVES, FLUID, MANUALLY ACTUATED

### Notes:

1. Valves 1.46, 2.13, 2.42, and 4.28, listed under VALVES, FLUID, ELECTRICALLY ACTUATED, can be operated as manual valves when power is removed.
2. Valves 1.16 and 3.1, listed under VALVES, RELIEF, FLUID, have manual overrides. (Valve 3.1 has two separate override controls.)
3. The following listing of manual valves, with the inclusion of the above two notes, comprises a complete tabulation of all ECS manual controls.

### 28a Dispensing Type/Secondary Function

- 5.22 Potable Water Supply Assembly (cold and hot water fixed-volume dispensing valves) 23

### [ 28b Modulating Type/Primary Function ]

- 2.35 Glycol Metering Valve (for cabin temperature adjustment)  
4.17 Manual Oxygen Metering Valve (for suit circuit)

### 28c Modulating Type/Secondary Function

- 1.34 Suit Hose Connector Assembly (flow control valve); ECS quantity = 3 7

### [ 28d Selector Type/Primary Function ]

- 2.36 Glycol Diverter Valve (to divert flow from service module); ECS quantity = 2  
2.52 Glycol Diverter Valve (to divert flow from suit heat exchanger)  
3.30 LEM Pressure Valve (for equalizing pressures of spacecraft compartments)  
4.34 Three-Position Selector Valve (high-pressure oxygen) 26b

### 28e Selector Type/Secondary Function

- 1.15 CO<sub>2</sub> and Odor Absorber Canister (diverter valve) 4  
1.29 Suit Heat Exchanger Assembly (GSE servicing valve) 16  
1.36 Cyclic Accumulator Selector Valve (automatic, manual, or off selection); ECS quantity = 2 27c  
4.16 Demand Pressure Regulator (inlet selector valve and suit test valve) 19

## FUNCTIONAL INDEX (Continued)

### 28 VALVES, FLUID, MANUALLY ACTUATED (Continued)

#### 28e Selector Type/Secondary Function (Continued)

4.22	Emergency Oxygen Inflow Control Valve (inlet selector valve)	19
4.24	Oxygen Pressure Regulator (inlet selector valve)	19
5.23	Water Pressure Relief Valve (inlet selector valve)	29a
5.24	Tank Pressure Regulator (regulator selector valve and relief valve selector valve)	19

#### [ 28f Shutoff Type/Primary Function

2.28	Glycol Shutoff Valve; ECS quantity = 4	14b
3.31	Tunnel Pressure Equalization Valve	
4.26	Manual Shutoff Valve (high-pressure oxygen); ECS quantity = 2	
5.18	Water Shutoff Valve; ECS quantity = 4	

#### 28g Shutoff Type/Secondary Function

1.3	Suit Return Check Valve (manual shutoff)	26a
1.15	CO <sub>2</sub> and Odor Absorber Canister (canister A and canister B bleed valves)	4
2.48	Glycol Pump (accumulator isolation valve)	18a
3.28	Cabin Pressure Regulator (manual repressurization valve)	19
4.22	Emergency Oxygen Inflow Control Valve (press-to-test button)	19
4.27	Relief Valve (relief valve shutoff)	29a
5.19	Water Tank Pressure Relief Valve (relief valve shutoff)	29a
5.29	Glycol Evaporator Water Control Valve (manual shutoff); ECS quantity = 2	27c

### 29 VALVES, RELIEF, FLUID

#### [ 29a Primary Function

1.16	Suit Bypass Valve*	12b, 28g 28e
3.1	Cabin Pressure Relief Valve*	
4.27	Relief Valve (high-pressure oxygen)*	
5.19	Water Tank Pressure Relief Valve*	
5.23	Water Pressure Relief Valve*	

\*Valve has manual override or integral shutoff valve for manual override.

## FUNCTIONAL INDEX (Continued)

### 29 VALVES, RELIEF, FLUID (Continued)

#### 29b Secondary Function

1.8	Debris Trap (clogged filter bypass)	25a
1.46	Water-Glycol Selector Valve (suit heat exchanger water-glycol thermal relief valve)	27b
4.16	Demand Pressure Regulator (suit vent valve and reference chamber pressure relief valves)	19
4.22	Emergency Oxygen Inflow Control Valve (reference chamber pressure relief valves)	19
4.24	Oxygen Pressure Regulator (outlet pressure relief valve)	19
5.24	Tank Pressure Regulator (outlet pressure relief valve)*	19
5.33	Water Filter (clogged filter bypass)	12a

### 30 VALVES, FLUID, SPECIAL

#### Secondary Function

4.16	Demand Pressure Regulator (aneroid test valve, vacuum-actuated)	19
4.22	Emergency Oxygen Inflow Control Valve (aneroid test valve, fixture-actuated)	19

\*Valve has manual override or integral shutoff valve for manual override.

# COMPONENT PERFORMANCE REQUIREMENTS

## GROUP 1. SUIT CIRCUIT

### SUIT CIRCUIT RETURN CHECK VALVE

850026-1

1.3

#### Type

Assembly with manual shutoff valve and two check valves (one redundant), all connected in series

#### Ports

- Inlet (screened opening exposed to cabin)
- Outlet (duct flange)
- Test port (boss fitted with plug); test port connected to plenum between inlet and outlet check valves

#### Manual Override Valve Positions

- Valve detented in each position; PULL TO RELEASE knob pulled, rotated, and released to change valve position

O

Open; assembly operates normally

C

Closed; flow through check valves blocked

#### Function

- Check valves permit cabin gas inflow to suit circuit for CO<sub>2</sub>, H<sub>2</sub>O vapor, and odor removal during shirtsleeve mode
- Filter screen on inlet port prevents debris from entering suit circuit
- Check valves prevent suit circuit depressurization during cabin emergency
- Manual override valve used to isolate suit circuit from cabin if cabin gas contaminated

#### ΔP

2 in. H<sub>2</sub>O max with 55 lb/hr O<sub>2</sub> at 5 psia and 70F inlet

#### Leakage

##### Shutoff Valve

0.005 lb/minute (0.3 lb/hr) O<sub>2</sub> max with 5 psia and 70F inlet and 10 in. H<sub>2</sub>O inlet-to-outlet ΔP

Inlet Check Valve	<ul style="list-style-type: none"><li>□ Shutoff valve open</li><li>● 0.0004 lb/minute (0.024 lb/hr) O<sub>2</sub> max with inlet at 0 psia and outlet and test ports at 4 psia and 70F</li></ul>
Outlet Check Valve	0.0004 lb/minute O <sub>2</sub> max with test port at 0 psia and outlet at 4 psia and 70F

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DEBRIS TRAP	811100-4	1.8
Configuration and Operation	<ul style="list-style-type: none"><li>● Two-inlet, one-outlet solid-particle trap</li><li>● Filtration screen traps particles from either inlet</li><li>● Internal relief valve flows and bypasses screen if screen becomes clogged</li></ul>	
Ports		
INLET	<ul style="list-style-type: none"><li>● Inlet from pressure suits</li><li>● 3-in. duct coupling nut</li><li>● This port is oxygen return connection of ECU interface</li></ul>	
OUTLET	<ul style="list-style-type: none"><li>● Outlet to suit compressors (1.10)</li><li>● 3-in. duct coupling nut</li></ul>	
Cabin Gas Inlet	<ul style="list-style-type: none"><li>● Inlet from suit circuit return check valve (1.3)</li><li>● 3-in. duct flange</li></ul>	
Filtration	0.04 in. max particle size	
ΔP	<ul style="list-style-type: none"><li>□ ΔP with no trapped particles and at normal suit circuit weight flow</li><li>● 0.25 in. H<sub>2</sub>O max with 56 lb/hr O<sub>2</sub> at 5.01 psia and 86F inlet (inlet density = 0.0274 lb/cu ft)</li></ul>	
Relief Valve	<ul style="list-style-type: none"><li>□ Relief valve characteristics with clogged filter screen</li></ul>	
Cracking Pressure	0.5 in. H <sub>2</sub> O max	
ΔP at Full Flow	5.9 in. H <sub>2</sub> O max with 56 lb/hr O <sub>2</sub> at 5.01 psia and 86F inlet	
External Leakage	6 x 10 <sup>-6</sup> lb/hr O <sub>2</sub> max at 4.0 psig	

SUIT COMPRESSOR	826000-2	1.10
Flow Rate		
Normal Operation	35 cfm with 10.0 in. H <sub>2</sub> O pressure rise and inlet gas density of 0.0266 lb/cf	
Emergency Operation	33.6 cfm with 7.3 in. H <sub>2</sub> O pressure rise and inlet gas density of 0.01815 lb/cf	
Power Requirement		
Normal Operation	85 w max, 115/200 v, 3Ø, 400 cps	
Emergency Operation	67 w max, 115/200 v, 3Ø, 400 cps	
External Leakage	2 scf/hr O <sub>2</sub> max at 4 psi above cabin	

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SUIT COMPRESSOR	850137	1.11
CHECK VALVE	850138	
Configuration and Operation	<ul style="list-style-type: none"> <li>• Wedge-shaped screen (850138) which serves as valve seat, and soft elastomer tube (850137) which serves as checking membrane</li> <li>• Screen and tube installed in suit compressor discharge duct, which serves as valve housing</li> <li>• Tube assumes shape of seat-screen when checked and assumes shape of duct wall when flowing</li> <li>• Check valve is installed at outlet of each suit compressor (1.10); check valve prevents reverse flow through standby 1.10</li> </ul>	
ΔP	0.25 in. H <sub>2</sub> O max with 2.03 lb/minute (121.8 lb/hr) air (test fluid)	
Check Leakage	0.024 lb/minute (1.44 lb/hr) air (test fluid) max at 15 in. H <sub>2</sub> O check ΔP	

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CO <sub>2</sub> ABSORBER ELEMENT	811510-2	1.14
Flow Capacity	28 lb/hr O <sub>2</sub> at 5.2 psia, 113F, and 1.4 in. H <sub>2</sub> O max ΔP	
Absorbing Rate	0.142 lb/hr CO <sub>2</sub> max average	
Absorbing Capacity	Max rate for 24 hr (3.4 lb CO <sub>2</sub> = 93 percent utilization)	
Max CO <sub>2</sub> Partial Pressure	7.6 mm Hg absolute (two elements in parallel)	
LiOH (for CO <sub>2</sub> )	1805 +0, -9 gm	
Activated Charcoal (for Odors)	66 +3, -0 gm	

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CO <sub>2</sub> AND ODOR ABSORBER CANISTER	811400-7	1.15
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Function	<ul style="list-style-type: none"> <li>• Houses two parallel CO<sub>2</sub> absorber elements (1.14)</li> <li>• Includes hinged covers, valves, and interlocks to facilitate 1.14 replacement</li> </ul>	
Ports		
INLET	3-in. duct flange	
OUTLET	3-in. duct coupling nut	
Canister A Bleed Valve Outlet	Direct opening to cabin	
Canister B Bleed Valve Outlet	Direct opening to cabin	
Controls and Interlocks		
Manually Operated Controls	<ul style="list-style-type: none"> <li>• Diverter valve</li> <li>• Canister bleed valves (A and B)</li> <li>• Cover handles (A and B)</li> </ul>	
Interlocks	<ul style="list-style-type: none"> <li>• Pressure interlocks (A and B)</li> <li>• Diverter valve lockout plungers (A and B)</li> </ul>	
Check Valves	Outlet check valves (A and B)	
Diverter Valve	<input type="checkbox"/> Operated to isolate one canister during venting and 1.14 replacement	
Center (Normal)	<ul style="list-style-type: none"> <li>• INLET port flow split between canisters A and B</li> </ul>	



A

B

Canister Bleed Valves  
(A and B)

Pressed

Released (Normal)

Pressure Interlocks  
(A and B)

Pin Extended

Pin Retracted

Diverter Valve  
Lockout Plungers  
(A and B)

Canister A  
Plunger Extended

Canister B  
Plunger Extended

- Interlocks both cover handles closed by direct mechanical engagement
- Operated to this position to open cover B
- INLET port flow diverter to canister A
- Interlocks cover handle A closed
- Operated to this position to open cover A
- INLET port flow diverter to canister B
- Interlocks cover handle B closed
- Actuated to vent isolated canister prior to cover opening
- Vents associated canister to cabin
- Isolates canister from cabin
- Prevents movement of associated cover handle until venting completed
- Canister-to-cabin differential extends pin
- Associated cover handle interlocked to close-cover position
- Equalized canister-to-cabin differential retracts pin
- Associated cover handle free to move to open-cover position
- Each lockout plunger actuated by associated cover handle
- Canister A plunger prevents diverter valve movement to position A if cover handle A is in cover-open position
- Canister B plunger prevents diverter valve movement to position B if cover handle B is in cover-open position
- Diverter valve interlocked to position B
- Diverter valve interlocked to position A

Cover Handles  
(A and B)

- Cover handle moved from cover-closed to cover-open position and pulled to open cover for 1.14 replacement
- When cover is closed, handle is returned to cover-closed position; hook-cam on handle engages pin on 1.15 housing; as handle is moved, force is applied to cover through cam; force compresses absorber element spring retainer attached to inside of cover

Close-Cover  
Position (Normal)

- Hook-cam locks cover closed
- Associated diverter valve lock-out plunger retracted

## Open-Cover Position

- Cover unlocked (ready for opening)
- Associated diverter valve lock-out plunger extended

Outlet Check  
Valves (A and B)

- Each check valve permits flow from its canister to OUTLET port during normal operation
- Check valve checks as its associated canister is vented and prevents suit circuit gas escape to cabin during venting and 1.14 replacement

 $p\Delta P$ 

- $p\Delta P$  with both canister compartments empty and diverter valve in center position
  - 0.0033 in.  $H_2O$ -lb/ft<sup>3</sup> @ 20 phr
  - 0.0049 in.  $H_2O$ -lb/ft<sup>3</sup> @ 30 phr
  - 0.0065 in.  $H_2O$ -lb/ft<sup>3</sup> @ 40 phr
  - 0.0083 in.  $H_2O$ -lb/ft<sup>3</sup> @ 50 phr
  - 0.0102 in.  $H_2O$ -lb/ft<sup>3</sup> @ 60 phr
  - 0.0125 in.  $H_2O$ -lb/ft<sup>3</sup> @ 70 phr
  - 0.0148 in.  $H_2O$ -lb/ft<sup>3</sup> @ 80 phr
  - 0.0178 in.  $H_2O$ -lb/ft<sup>3</sup> @ 90 phr
  - 0.0210 in.  $H_2O$ -lb/ft<sup>3</sup> @ 100 phr

Typical  $\Delta P$ 

- $\Delta P$  with both compartments empty and diverter valve in center position
- $\Delta P$  will be greater than indicated with  $CO_2$  absorber elements installed

Conditions	<ul style="list-style-type: none"> <li>□ Typical conditions for 5 psia cabin</li> <li>• 60 lb/hr suit gas weight flow</li> <li>• 0.025 lb/cu ft suit gas density (<math>\rho</math>)</li> </ul>	
$\Delta P$	0.41 in. H <sub>2</sub> O	
External Leakage	$1.2 \times 10^{-5}$ lb/hr O <sub>2</sub> max at 4 psig	
Internal Leakage	<ul style="list-style-type: none"> <li>□ Inlet-port-to-cabin leakage with one canister cover open</li> <li>• 0.015 lb/minute (0.9 lb/hr) O<sub>2</sub> max at 4 psig inlet</li> </ul>	
<hr/>		
SUIT BYPASS VALVE	810520-2	1.16
Flow Capacity	12 lb/hr O <sub>2</sub> min at 3.69 psia with 5.6 in. H <sub>2</sub> O at 70F	
External Leakage	$3 \times 10^{-5}$ lb/hr O <sub>2</sub> max at 4 psig	
Internal Leakage	0.05 lb/minute O <sub>2</sub> max at 3.69 psia with 4.8 in. H <sub>2</sub> O $\Delta P$ at 70F	
<hr/>		
SUIT HEAT EXCHANGER ASSEMBLY	813410-2	1.29
Type	<ul style="list-style-type: none"> <li>• Plate-fin, sandwich construction, suit-gas-to-water-glycol heat exchanger and water separator</li> <li>• Two independent coolant circuits (primary and secondary water-glycol)</li> <li>• Single-pass on coolant sides; two-pass on suit-gas side</li> <li>• Suit-gas flow is counter-cross to water-glycol flow</li> </ul>	
Ports		
Suit Gas	<ul style="list-style-type: none"> <li>• OXYGEN INLET (3-in. threaded duct)</li> <li>• OXYGEN OUTLET (3-in. threaded duct)</li> <li>• CABIN BYPASS (1-1/2-in. duct flange); oxygen outflow to suit bypass valve (1.16)</li> </ul>	

Water-Glycol	<ul style="list-style-type: none"> <li>• SENSOR PORT (boss); instrumentation boss on oxygen outlet duct</li> <li>• PRIMARY GLYCOL INLET (fitting end)</li> <li>• PRIMARY GLYCOL OUTLET (fitting end)</li> <li>• SECONDARY GLYCOL INLET (fitting end)</li> <li>• SECONDARY GLYCOL OUTLET (fitting end)</li> </ul>
Water	<ul style="list-style-type: none"> <li>• SERVICE (boss with plug installed)</li> <li>• WATER OUT (fitting end); cyclic accumulator 1 waste water outlet</li> <li>• WATER OUT (fitting end); cyclic accumulator 2 waste water outlet</li> </ul>
High-Pressure Oxygen	<ul style="list-style-type: none"> <li>• PRESSURE INLET (boss); cyclic accumulator 1 high-pressure oxygen inlet</li> <li>• PRESSURE INLET (boss); cyclic accumulator 2 high-pressure oxygen inlet</li> </ul>
SERVICE Valve Positions	
SEP	SERVICE port connected to water collection system for GSE servicing
OFF (Normal)	Water collection system connected to cyclic accumulators
ACCUM	SERVICE port connected to cyclic accumulators for GSE servicing
Operation	<ul style="list-style-type: none"> <li>• Water-glycol flow through heat exchanger cools suit gas</li> <li>• As gas is cooled below dew point, water condenses on suit-gas fins</li> <li>• Feltmetal wicks in contact with fins transfer water by capillary action to air-blocking sintered metal plate</li> <li>• Water is transferred through plate to water plenum (suit gas is blocked)</li> </ul>

- Water plenum is connected to water side of cyclic accumulators through water collection channel, water lines, and SERVICE valve
- Cyclic accumulators are reciprocating pumps consisting of spring-loaded, oxygen-actuated diaphragm and water inlet and outlet check valves
- High-pressure oxygen pulses cycle diaphragm, forcing water through outlet check valve during pulse period
- During pulse interperiod, diaphragm spring forces diaphragm towards rest position, drawing available water from plenum through inlet check valve
- Oxygen on pulsed side of diaphragm bleeds into suit gas circuit of heat exchanger through orifice during pulse interperiod, providing make-up oxygen

Heat Transfer Rate  
(Emergency Operation,  
Primary or Secondary  
Cooling)

- ☐ Heat transfer rate with listed gas-side and water-glycol-side parameters

- 2100 Btu/hr total min
- 766 Btu/hr sensible

$\Delta P$

Gas Side (Emergency  
Operation)

- ☐  $\Delta P$  with listed gas-side parameters and wet core

- 0.2 in. H<sub>2</sub>O max

Water-Glycol Side

- ☐  $\Delta P$  with listed water-glycol-side parameters

- 1.08 psi max

Gas Side Parameters  
(Emergency Operation)

Inlet Flow

38.3 lb/hr suit gas (principal constituents are O<sub>2</sub> and H<sub>2</sub>O vapor)

Inlet Pressure

3.71 psia

Inlet Temperature

138F

Inlet Specific  
Humidity

438 gr H<sub>2</sub>O/lb dry gas

Outlet Temperature	51F max
Condensation Rate	1.24 lb/hr
Water-Glycol Side Parameters (Primary or Secondary)	
Flow	167 lb/hr
Inlet Temperature	45F
Inlet Pressure	60 psig max
Cyclic Accumulator Parameters (Each Accumulator)	
O <sub>2</sub> Pulse Inflow	0.05 lb/minute O <sub>2</sub> max at 100 psig inlet for 10 sec every 10 minutes
O <sub>2</sub> Bleed Outflow (to Suit Gas Circuit)	0.55 lb/hr O <sub>2</sub> max (peak) at 100 psig upstream
Capacity	130 cc H <sub>2</sub> O min
Pumping Rate	<ul style="list-style-type: none"> <li>□ Rate at listed gas-side and water-glycol-side parameters</li> <li>• 1.24 lb/hr H<sub>2</sub>O</li> </ul>
Gas-Side External Leakage	$6 \times 10^{-6}$ lb/hr O <sub>2</sub> max at 4.0 psia gas side and 1 mm Hg abs external
Water-Glycol-Side Total Leakage (Primary or Secondary)	$6.8 \times 10^{-4}$ cc/hr water-glycol max at 60 psig and 70F

SUIT FLOW LIMITER	810602-1	1.31
Type	Venturi	
Operation		
Normal Cabin or Emergency Cabin	Imposes minimal pressure drop at normal (recirculating) suit flows	
Suit Emergency	<ul style="list-style-type: none"> <li>• Prevents torn suit from de- pressurizing suit supply and, with it, other suits</li> <li>• Limits flow from suit supply to torn suit to rate which suit supply is capable of supporting without significant pressure decrease</li> </ul>	

	<ul style="list-style-type: none"> <li>• As flow limiter outlet pressure (suit pressure) drops, flow increases until sonic (choked) flow occurs; flow becomes function of flow limiter inlet pressure (suit supply pressure) only and is unaffected by further outlet pressure decrease</li> </ul>
Ports	<ul style="list-style-type: none"> <li>• Inlet (from suit supply)</li> <li>• Outlet (to pressure suit)</li> </ul>
$\Delta P$	<ul style="list-style-type: none"> <li>□ <math>\Delta P</math> with recirculating suit flow; <math>\Delta P</math> listed is for cabin emergency mode (cabin depressurized, but suit intact)</li> <li>• 0.6 in. H<sub>2</sub>O max with 11.3 lb/hr O<sub>2</sub> at 3.65 psia and 70F inlet</li> </ul>
Choked Flow	<ul style="list-style-type: none"> <li>□ Flow for suit emergency mode (cabin depressurized and suit torn)</li> <li>• 0.7 lb/minute (42 lb/hr) O<sub>2</sub> max at 3.5 psia and 70F inlet</li> </ul>
External Leakage	<ul style="list-style-type: none"> <li>• <math>6 \times 10^{-6}</math> lb/hr O<sub>2</sub> max at 4 psig and 70F</li> </ul>

# SUIT HOSE CONNECTOR ASSEMBLY

810856-1

1.34

## Function

- Provides means of connecting pressure suit supply/return hose to ECS suit circuit
- Permits adjustment of suit flow when suit is connected
- Provides flow of conditioned gas from suit supply into cabin when astronaut is not suited

## Ports

- Inlet (inflow to 1.34 from suit flow limiter); 1-1/2-in. threaded duct
- Outlet (outflow from 1.34 to debris trap); 1-1/2-in. threaded duct

- Suit hose connector; split (two-port) twist-lock hose connector; mates with pressure suit supply/return hose coupling; one port outflows from 1.34 to suit hose (suit mode) or to cabin (shirtsleeve mode); other port inflows to 1.34 from suit hose (suit mode only)

## Controls and Interlocks

Interlock	Hose coupling lock pin
Hose-Actuated Control	Check valve unloading pin
Manually Operated Control	Flow control lever
Hose Coupling Lock Pin Positions	<ul style="list-style-type: none"> <li>□ Pin position set by flow control lever: retracted when flow control lever is OFF, extended when flow control lever is in any other position</li> </ul>
Retracted	Permits connection or removal of twist-lock suit hose coupling
Extended	Prevents connection or removal of suit hose coupling
Check Valve Unloading Pin Positions	<ul style="list-style-type: none"> <li>□ Pin actuated when suit hose connected, released when hose is removed</li> </ul>
Actuated	<ul style="list-style-type: none"> <li>• Removes preload on return check valve, opening flow path from hose connector inflow port to 1.34 outlet port</li> <li>• Displaces flow control lever stop, permitting movement of lever from CABIN FLOW to SUIT FULL FLOW</li> </ul>
Released	<ul style="list-style-type: none"> <li>• Applies preload to return check valve, closing hose connector inflow port</li> <li>• Returns flow control lever stop, preventing movement of lever from CABIN FLOW to SUIT FULL FLOW</li> </ul>



Flow Control Lever  
Positions

OFF

- Position limited by check valve unloading pin
- Coupling lock pin retracted
- Flow from 1.34 inlet port to hose connector outflow port blocked
- Control lever set to OFF position when astronaut is absent from command module or during suit hose connection or removal procedure

CABIN FLOW

- Coupling lock pin extended
- Suit gas flows from 1.34 inlet port to hose connector outflow port
- Flow restricted to minimum rate
- Control lever set to CABIN FLOW when astronaut is not suited; flow from hose connector outflow port into cabin provides conditioned gas for astronaut

CABIN FLOW to  
SUIT FULL FLOW

- Coupling lock pin extended
- Position of control lever continuously variable in this range
- Suit gas flow from 1.34 inlet port to hose connector outflow port modulated by control lever position
- Control lever adjusted for comfortable suit flow

Operation

- Flapper valves in flow path between 1.34 inlet port and hose connector outflow port are positioned by flow control lever
- Flapper valves block flow in control lever OFF position, provide metered flow in CABIN FLOW position, and provide modulated to full flow as lever is moved from CABIN FLOW to SUIT FULL FLOW

O<sub>2</sub> Inlet Pressure  
 $\Delta P$

- Flapper check valve in flow path between hose connector inflow port and 1.34 outlet port is controlled by check valve unloading pin
  - Check valve is preloaded closed when suit hose is removed, preventing cabin-to-suit-circuit flow
  - Preload is removed when hose is connected
  - During normal suit operation, gas from pressure suit returns to suit circuit through check valve
  - During suit emergency, check valve checks, preventing depressurization of suit circuit through suit tear
- 3.5 to 14.7 psia

Total Leakage

- Total  $\Delta P$  (inlet-port-to-hose-connector  $\Delta P$  plus hose-connector-to-outlet-port  $\Delta P$ ) in depressurized-cabin mode
- 0.6 in. H<sub>2</sub>O max total  $\Delta P$  with 12.2 lb/hr O<sub>2</sub> flow and 3.69 psia, 50F inlet in SUIT FULL FLOW position

Valve Leakage

- Valve leakage plus external leakage
- Hose-connector-outflow-port-to-cabin leakage plus hose-connector-inflow-port-to-cabin leakage with suit hose disconnected and flow selector in OFF position (i.e., total leakage to cabin minus external leakage)
- 10 std cc/minute ( $1.79 \times 10^{-3}$  lb/hr) O<sub>2</sub> max with 4 psia and 70F at 1.34 inlet and outlet ports and cabin at 1.8 psia or less

## External Leakage

- Total leakage to cabin minus valve leakage with suit hose disconnected and flow selector in OFF position (this leakage can be measured directly with pressure applied to 1.34 inlet and outlet ports and hose connector capped)
- $3 \times 10^{-6}$  lb/minute ( $1.8 \times 10^{-4}$  lb/hr)  $O_2$  max with 4 psia and 70F at 1.34 inlet and outlet ports and cabin at 1.8 psia or less

CYCLIC ACCUMULATOR  
SELECTOR VALVE

828020-2

1.36

 $O_2$  Temperature Range

0 to 160F

Flow Capacity

0.04 lb/minute  $O_2$  at 85 psia and 70F inlet with outlet at 50 to 60 psia

External Leakage

 $1.2 \times 10^{-5}$  lb/hr  $O_2$  max at 140 psig and 70F

Internal Leakage

- $3 \times 10^{-6}$  lb/minute  $O_2$  max at 140 psig, 70F inlet with valve in OFF position
- $6 \times 10^{-6}$  lb/minute  $O_2$  max at 140 psig, 70F inlet and 0 to 140 psig outlet with valve in AUTO position

Power Requirement

3 va max at 70F, 28 vdc

CYCLIC ACCUMULATOR  
CONTROL

820914-3

1.38

Type

- Solid-state electronic control

Configuration and  
Operation

- Transistor switch output circuit connects between +28-v d-c supply and load (1.36 solenoid)
- When input timing signal (on condition) is applied, switch closes and applies supply voltage to load
- When input timing signal terminates (off condition), switch opens

## Input Timing Signal

On Condition

- +6.1 v max d-c level
- 10  $\pm$ 1 sec duration

Off Condition

- +0.1 v max d-c level
- 10  $\pm$ 1 minutes duration

Input Impedance

100 ohms min

Output

On Condition

- Within +0, -1.5 v of power input voltage
- 3 w max

Off Condition

0 v dc

Power Input

Voltage

28  $\pm$ 2, -3 v dc

Power

- 3.5 w max during on condition
- 0 w max during off condition

CYCLIC ACCUMULATOR  
SENSOR

820928-1

1.39

Configuration and  
Operation

- Three metal rings along waste-water flow path
- D-c voltage applied between downstream ring (+) and upstream ring (common)
- Signal taken between center ring and common
- Waste water resistance between rings produces voltage divider
- O<sub>2</sub> bubble flow between rings upsets voltage division and produces positive and negative signal pulses

Output Signal Use

Only 40 mv min positive pulses used to activate remote signal conditioner

Output Load

50,000  $\pm$ 2500 ohms

Waste Water

Resistance

3K to 1 meg between outer elements

Temperature

40 to 150F

Pressure

20 to 40 psig

Flow		
Operating Range	0 to 5 lb/minute	
Capacity	5 lb/minute H <sub>2</sub> O at 1.5 psi $\Delta$ P max	
External Leakage	31 x 10 <sup>-4</sup> cc/hr H <sub>2</sub> O max at 40 psig and 70F	
Power Requirement	5.7 ma max at 15 $\pm$ 2 vdc	
<hr/>		
CYCLIC ACCUMULATOR SIGNAL CONDITIONER	820930-2	1.40
Turn-On (Input Signal)	3 positive pulses, 40 mv min and 40 usec rise time	
Turn-Off	Turn-off (reset) accomplished by disconnecting 28 vdc power source to signal conditioner	
Output Circuit		
Function	Completes negative return circuit for external 28 vdc indicator light (ON condition)	
Rating	120 ma steady, 800 ma peak surge at 28 vdc	
Auxiliary Output Voltage (for Cyclic Accumulator Sensor)	15 $\pm$ 2 vdc continuous, 5.7 ma max	
Power Requirement	1.5 w max, 28 vdc	
<hr/>		
WATER-GLYCOL SELECTOR VALVE [SUIT HT EXCH PRIMARY GLYCOL]*	829160-1	1.46
Valve Type	Two inlet, two-outlet, two-position, electrically actuated selector valve with provision for manual operation	
Valve Ports	<ul style="list-style-type: none"> <li>• IN (inlet)</li> <li>• OUT (outlet)</li> <li>• TO HE (outlet)</li> <li>• FROM HE (inlet)</li> </ul>	

\*Names in brackets indicate ECU coolant control panel markings

## Valve Positions

Normal [FLOW]\*

- Water-glycol flows from "IN" to "TO HE"
- Water-glycol flows from "FROM HE" to "OUT"

Bypass

Water-glycol flows from "IN" to "OUT"

## Valve Rotation

Approximately 80 deg clockwise from normal to bypass

## Actuator Inputs

Suit Heat Exchanger  
OnContinuous 115-v a-c, 1- $\phi$ ,  
400-cps signal actuates valve  
to normal positionSuit Heat Exchanger  
BypassContinuous 115-v a-c, 1- $\phi$ ,  
400-cps signal actuates valve  
to bypass position

## Operation

- Directs flow through suit heat exchanger (1.29) in normal position; directs flow around 1.29 in bypass position
- Provides additional  $\Delta P$  (equal to  $\Delta P$  of 1.29) in bypass position so that total  $\Delta P$  from "IN" to "OUT" is same in both positions
- Incorporates thermal relief valve, connected between "FROM HE" and "IN" ports; to relieve 1.29 pressure increases due to water-glycol thermal expansion in bypass position
- Hex socket in manual control knob mates with turning tool; valve is adjusted manually when actuator power is removed; control knob is pressed (disengaging actuator), rotated to desired position, and released

Water-Glycol Operating  
Pressure

0 to 60 psig

Water-Glycol Temperature

35 to 160F

\*Names in brackets indicate ECU coolant control panel markings

$\Delta P$ 

## Normal Position

- Total  $\Delta P$  ("IN" to "TO HE"  $\Delta P$  plus "FROM HE" to "OUT"  $\Delta P$ ) shown
- 9 in.  $H_2O$  (0.325 psi) max with 167 lb/hr water-glycol, 50 psig and 45F at "IN", and 56F at OUT

## Bypass Position

- $\Delta P$  from "IN" to "OUT"
- 3.3 +0.2, -0.4 in. Hg (1.62 +0.098, -0.196 psi) max with 167 lb/hr water-glycol at 45F

## Actuation Time

10 to 20 sec for full rotational stroke in either direction with continuous power applied

## Internal Leakage

## Normal Position

- Total leakage outflow from "FROM HE" and "OUT" with pressure applied simultaneously to "TO HE" and "IN"
- 0.064 cc/hr water-glycol max at 60 psi  $\Delta P$

## Bypass Position

- Total leakage outflow from "FROM HE" and "TO HE" with pressure applied simultaneously to "OUT" and "IN"
- 0.064 cc/hr water-glycol max at 60 psi  $\Delta P$

## External Leakage

$3.9 \times 10^{-4}$  cc/hr water-glycol max at 60 psig and 70F

## Power Consumption

8 va at 115 v, 1  $\phi$ , 400 cps

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## GROUP 2. COOLANT CIRCUIT

SPACE RADIATOR CHECK VALVE	828370-1	2.1
Type	<ul style="list-style-type: none"> <li>• Check valve for 5/8-in. water-glycol line</li> <li>• Umbrella-shaped elastomer disk seats against metal plate with hole cluster</li> </ul>	
Water-Glycol Temperature	-40 to +150F	
Water-Glycol Inlet Pressure (Flow Direction)	60 psig max	
$\Delta P$ (Check)	1 to 60 psi	
$\Delta P$ (Flow)	0.25 psi max with 200 lb/hr water-glycol at 70F	
External Leakage	$2.6 \times 10^{-4}$ cc/hr water-glycol max at 60 psig and 70F	
Check Leakage	$3.2 \times 10^{-2}$ cc/hr water-glycol max at 1 to 60 psi check $\Delta P$	

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GLYCOL CHECK VALVE	827990-1	2.5
Type	<ul style="list-style-type: none"> <li>• Check valve for 3/8-in. water-glycol line</li> <li>• Umbrella-shaped elastomer disk seats against metal plate with hole cluster</li> </ul>	
Water-Glycol Temperature	-20 to +150F	
Water-Glycol Inlet Pressure (Flow Direction)	60 psig max	
$\Delta P$ (Check)	1 to 60 psi	
$\Delta P$ (Flow)	0.35 psi max with 200 lb/hr water-glycol at 70F	
External Leakage	$2.4 \times 10^{-4}$ cc/hr water-glycol max at 60 psig and 70F	
Check Leakage	$3.2 \times 10^{-2}$ cc/hr water-glycol max at 1 to 60 psi check $\Delta P$	

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## PRIMARY GLYCOL EVAPORATOR

812590-2

2.6

Type	Evaporative heat exchanger
Function	Cools water-glycol by evaporation of waste water into low-pressure steam with minimum water carry-over into steam duct
Ports	<ul style="list-style-type: none"><li>• GLYCOL INLET (fitting end)</li><li>• GLYCOL OUTLET (fitting end)</li><li>• WATER INLET (fitting end)</li><li>• Steam outlet (duct flange)</li><li>• Two steam-pressure sensing ports</li></ul>
Outputs	Resistances of wick temperature sensor (2.49) elements
Operation	<ul style="list-style-type: none"><li>• Water-glycol flows through two plate-fin heat exchangers: superheat (single-pass) heat exchanger and main (two-pass) heat exchanger</li><li>• Water flows to feltmetal wicks through distribution lines, orificed distribution plates, and distribution sponges</li><li>• Wicks are in contact with steam fins of both heat exchangers so that water-glycol heat evaporates water</li><li>• Most evaporation is accomplished by main heat exchanger</li><li>• Water not evaporated by main heat exchanger flows to superheat portion of wicks; superheat (hottest) portion of wicks is maintained relatively dry to ensure total evaporation (no water carry-over)</li><li>• Wick temperature sensor (2.49) is integral part of 2.6 and contacts superheat portion of wicks; 2.49 is used to control wick wetness at this point</li><li>• Evaporated water exits at steam outlet port</li></ul>

## Operation at Maximum Heat Load

## Conditions

Water-Glycol  
Side

- 40F max outlet temperature
- 200 lb/hr water-glycol flow
- 60 psig max inlet pressure

Evaporant Side

- 35 to 150F water inlet temperature
- 0.1 psia (5.17 mm Hg) nom steam outlet pressure (steam saturation temperature at 0.1 psia = 35F)
- 7.5 lb/hr nom evaporation rate with 70F water inlet

## Requirement

Heat Transfer  
Rate

7620 Btu/hr min

## Operation in Subsystem\*

## Conditions

Water-Glycol  
Flow Rate

180 to 220 lb/hr

Water-Glycol  
Inlet Temp  
Transients

- 4F/minute max ramp during normal flight
- 45 to 96F step change during reentry

Water Inlet  
Pressure

- 13 to 32 psia
- Above range corresponds to waste water tank pressure range of 8 to 27 psig with 5 psia cabin

Heat Load

0 to 7620 Btu/hr

## Requirements

Water-Glycol  
Outlet  
Temperature

40 to 48F at all heat loads

Steam Water-  
Content

1 percent max

\*Connected as shown in system flow schematic

$\Delta P$ (Water-Glycol Side)	1 psi max with 200 lb/hr water-glycol at 75F
Water-Glycol External Leakage	$2.6 \times 10^{-4}$ cc/hr water-glycol max at 60 psig and 70F
Evaporant Side Leakage	$6 \times 10^{-4}$ lb/hr $O_2$ max from cabin to steam pan at 5 psi $\Delta P$

# SECONDARY GLYCOL EVAPORATOR

812580-2

2.7

Description and requirements same as 2.6 (differs from 2.6 only in orientation of ports).

# CABIN TEMPERATURE CONTROL VALVE\*

850028-2

2.13

## Valve Type

- Electrically actuated, flow-modulating valve with provision for manual control
- Two independent valves are modulated simultaneously; inlet valve splits one inflow into two outflows; outlet valve mixes two inflows into one outflow

## Valve Ports

### Inlet Valve

- I (inflow)
- A (outflow)
- B (outflow)

### Outlet Valve

- C (inflow)
- D (inflow)
- R (outflow)

## Actuator Inputs

- Pulsed or continuous 115 v ac, 1  $\phi$ , 400 cps ac
- Ac applied to pin B rotates valve clockwise (viewed into manual control knob) to decrease cabin air temperature
- Ac applied to pin A rotates valve counterclockwise to increase cabin air temperature

\*Refer to cabin temperature and glycol pump control block diagram

## Operation

- Directs hot water-glycol (heating modes) or cold water-glycol (cooling modes) through cabin heat exchanger (3.2) in response to actuator rotation inputs from cabin temperature control (3.7)
- Valve position determines flowrate of hot or cold water-glycol
- Valve remains in last selected position until actuated electrically or manually
- Rotates from last selected position when actuator rotation input is applied; rotational speed is function of percent modulation of input
- Manual control knob permits valve adjustment when 3.7 is off; control knob is pressed (disengaging actuator), rotated to desired position, and released
- Port B has orifice to compensate for differences in flow restrictions of devices connected to ports A and B

## Valve Positions

		Valve Position* (deg)				
		0	0 to 90	90	90 to 180	180
		Max Heating	Intermediate Heating	No Heating or Cooling	Intermediate Cooling	Max Cooling
Inlet Valve Flow	I to A	0	0	0	0 to max	max
	I to B	max	max	max	max to 0	0
Outlet Valve Flow	C to R	0	0 to max	max	max	max
	D to R	max	max to 0	0	0	0

\*Position of manual control knob;

0 deg = fully counterclockwise = full "H";

180 deg = fully clockwise = full "C"

Operating Pressure	60 psig water-glycol max	
$\Delta P$		
Fixed Conditions for Listed $\Delta P$ 's	<ul style="list-style-type: none"><li>• 50 psig and 70F water-glycol at inflow port (I, C, or D)</li><li>• 200 lb/hr water-glycol flow*</li></ul>	
I to A	1 in. Hg (0.491 psi) max with valve fully clockwise	
I to B	2.5 in. Hg (1.23 psi) max with valve fully counterclockwise	
C to R	1 in. Hg max with valve fully clockwise	
D to R	1 in. Hg max with valve fully counterclockwise	
Actuation Time	45 sec max for full rotational stroke in either direction with continuous power (100 percent modulation) applied	
External Leakage	10.4 x 10 <sup>-4</sup> cc/hr water-glycol max at 60 psig and 70F	
Power Consumption	8 va at 115 v, 1 $\phi$ , 400 cps	
<hr/>		
SPACE RADIATOR ISOLATION VALVE	821220-3	2.20
Valve Type	Electrically actuated water-glycol rotary shutoff valve	
Valve Ports	<ul style="list-style-type: none"><li>• INLET</li><li>• RADIATOR (outflow port)</li></ul>	
Function	<ul style="list-style-type: none"><li>• Passes or shuts off flow to service module space radiators</li><li>• Controlled automatically by NAA flow proportioning valve controller or manually by switches on command module main display console</li></ul>	
Actuator Inputs	<ul style="list-style-type: none"><li>• Continuous 115 v ac, 1 <math>\phi</math>, 400 cps</li><li>• Ac applied to pin A closes valve</li><li>• Ac applied to pin B opens valve</li></ul>	

\*Test flowrate; equal to "C to R" and "D to R" system full flows; "I to A" and "I to B" system full flows are 167 lb/hr

Limit Switches	□ Limit switches remove actuator power when valve reaches rotational extremes
Closed Valve Switch	Opens actuator motor connection to pin A when valve reaches full-closed position
Open Valve Switch	Opens actuator motor connection to pin B when valve reaches full-open position
Water-Glycol Inlet Pressure	60 psig max
$\Delta P$	0.5 psi max with 200 lb/hr water-glycol at 70F
Actuation Time	17 sec max for full rotational stroke in either direction
External Leakage	$1.04 \times 10^{-3}$ cc/hr water-glycol max at 60 psig and 70F
Internal Leakage	$3.2 \times 10^{-2}$ cc/hr water-glycol max at 60 psi $\Delta P$ and 70F
Power Requirement	8.4 va max at 115 v, 1 $\phi$ , 400 cps

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**GLYCOL TEMPERATURE CONTROL\***

820010-4\*\*

2.22

**Type and Function**

- Solid-state electronic control
- Controls a-c power to glycol temperature control valve (2.42)
- Modulates position of 2.42 to control mixing of hot water-glycol (from ECS heat loads) and cold water-glycol (from space radiator) to produce mixed temperature of  $45 \pm 3F$

**Input**

Mixed water-glycol temperature: resistance of glycol temperature sensor (2.45)

\*Refer to primary glycol temperature control block diagram

\*\*Part number for this item same as 3.7; differences in external connections account for differences in requirements

## Outputs

Valve Rotation  
Outputs

- Pulsed or continuous 115 v ac, 400 cps ac
- Modulation variable from 0 percent (no output) to 100 percent (continuous ac)
- Pin D ac closes 2.42 to decrease mixed temperature
- Pin E ac opens 2.42 to increase mixed temperature

Valve Braking  
Output

32  $\pm$  6 v dc across pins D (-) and E (+) if no ac (valve rotation output) is present

## Operation

- Compares actual mixed water-glycol temperature (2.45 resistance) with desired water-glycol temperature (value of fixed internal reference resistance, which is equal to resistance of 2.45 at 45F)
- Comparison produces difference or error signal, which is amplified and applied to 2.42; 2.42 is driven in direction to reduce sensed error towards zero

Temperature Control  
Points

- Listed control points show outputs produced as result of 2.45 temperatures and resistances
- 57.8F (1380  $\pm$  1 ohms): 30  $\pm$  20 percent modulation of pulses which close 2.42
- 47.0F (1776 ohms): sustained 15 to 35 ms pulses which close 2.42
- 45.3F (1850 ohms): no pulses
- 45.0F (1860 ohms): deadband center (no pulses)
- 44.7F (1876 ohms): no pulses
- 43.0F (1956 ohms): sustained 15 to 35 ms pulses which open 2.42
- 31.5F (2600  $\pm$  1 ohms): 30  $\pm$  20 percent modulation of pulses which open 2.42

Deadband	<ul style="list-style-type: none"> <li>□ Deadband as 2.45 temperature is varied; listed requirements are summary of preceding temperature control points</li> </ul>
Deadband Center	45.0F (actual water-glycol temperature = desired temperature)
Minimum Deadband	<ul style="list-style-type: none"> <li>□ Required temperature range producing no output</li> <li>• 44.7 to 45.3F</li> </ul>
Maximum Deadband	<ul style="list-style-type: none"> <li>□ Allowable temperature range producing no output</li> <li>• Down to (but not including) 43F</li> <li>• Up to (but not including) 47F</li> </ul>
Power Requirement	<ul style="list-style-type: none"> <li>• 2.5 va max with no ac output</li> <li>• 115 v, 1 <math>\phi</math>, 400 cps</li> </ul>

## GLYCOL TEMPERATURE SENSOR

820920-2

2.23

## Thermistor

8064 $\pm$ 242	ohms at 20°F
6246 $\pm$ 150	ohms at 30°F
4874 $\pm$ 88	ohms at 40°F
4320 $\pm$ 65	ohms at 45°F
3832 $\pm$ 69	ohms at 50°F
3039 $\pm$ 73	ohms at 60°F
2429 $\pm$ 73	ohms at 70°F

## Pressure Loss

1.5 in. H<sub>2</sub>O max with 200 lb/hr glycol at 45FOutput Signal  
(Instrumentation Section)

0 at 25F to 29.5 mv rms at 75F with load impedance of 270 ohms; 300 cps sq-type wave with rms magnitude proportional to temperature

Bridge Excitation Voltage  
(Instrumentation Section)2.70  $\pm$ 0.02 v rms, 300 cps sq-type waveOperating Current  
(Instrumentation Section)

140 ma max (effective)

## External Leakage

2.6  $\times 10^{-4}$  cc/hr water-glycol max at 60 psig and 70F



GLYCOL FILL CONNECTION	828350-1	2.24
Temperature Range	35 to 150F	
Flow Capacity	<ul style="list-style-type: none"> <li>• 200 lb/hr water-glycol at 76F and 2 psi <math>\Delta P</math> max</li> <li>• 300 lb/hr water-glycol without damage</li> </ul>	
Prelaunch Leakage	3.2 x 10 <sup>-2</sup> cc/hr water-glycol max at 0 to 60 psig and 70F (connected or disconnected)	
Post Launch Leakage	<ul style="list-style-type: none"> <li>• 3.2 x 10<sup>-2</sup> cc/hr water-glycol max at 0 to 60 psig and 0 to 150F</li> <li>• 1 cc/hr water-glycol max at 0 to 60 psig and -240 to 240F</li> </ul>	

GLYCOL SHUTOFF VALVE	828570-2 828750-2	2.28
Configuration	<ul style="list-style-type: none"> <li>• 1/4-turn manual shutoff valve</li> <li>• Poppet type with bellows shaft seal</li> <li>• Hex socket in shaft mates with turning tool</li> <li>• 828750-2 has extended shaft</li> </ul>	
Valve Positions		
ON	Open	
OFF	Closed	
Valve Rotation	90 deg clockwise from ON to OFF	
Water-Glycol Inlet Temperature	-40 to +150F	
Water-Glycol Inlet Pressure	0 to 60 psig	
$\Delta P$	0.25 psi max with 200 lb/hr water-glycol at 70F	
External Leakage	3.9 x 10 <sup>-4</sup> cc/hr water-glycol max at 0 to 60 psig and 70F	
Internal Leakage	2 cc/hr water-glycol max at 0 to 60 psi $\Delta P$	

# GLYCOL RESERVOIR

812850-1

2.29

## Design and Operation

- Tank with oxygen-pressurized bladder for water-glycol expulsion at zero g
- Baffled inlet and outlet water-glycol ports minimize intermixing during flow through (stored fluid used as cooling mass)
- Protection tabs (thickened portions) on bladder prevent extrusion into ports
- Ribs on both sides of bladder prevent trapping of oxygen (reservoir full) or water-glycol (reservoir empty)

## Ports

- OXYGEN
- INLET (water-glycol)
- OUTLET (water-glycol)

## Capacity

210 cu in. (8.2 lb water-glycol at 70F) min

## Expulsion Gas Pressure

18 to 27 psig

## Water-Glycol Pressure

### Capability

0 to 60 psig

### Normal

Equal to expulsion gas pressure (reservoir neither full nor empty)

## ΔP (Flow-Through)

0.5 psi max with 200 lb/hr water-glycol at 45F

## Thermal Cooling (Boost Flight Phase)

### Conditions for Listed Outlet Temperatures

- Reservoir filled with 45F water-glycol at T = 0
- 200 lb/hr flow
- 50F inlet temperature step change (45 to 95F) at T = 0

### Outlet Temperatures

- 45F at T = 0
- 59F max at T = 1 minute
- 75F max at T = 3 minutes
- 84F max at T = 5 minutes
- 89F max at T = 7 minutes

## External Leakage

### Coolant

$3.9 \times 10^{-3}$  cc/hr water-glycol max at 60 psig and 70F

### Expulsion Gas

$1 \times 10^{-6}$  lb/hr O<sub>2</sub> max at 25 psig

## Bladder Leakage

$5.4 \times 10^{-2}$  cc/hr water-glycol  
max when filled with water-  
glycol at 60 psig and 70F  
with  $O_2$  side at 25 psig

## GLYCOL METERING VALVE

828990-1

2.35

## Valve Type and Function

- One-inlet, two-outlet manual flow metering valve
- Permits continuously variable flow split between two outlet ports

## Valve Ports

- IN
- BYPASS (outlet)
- HX (outlet)

## Valve Positions and Rotation

- BP (fully counterclockwise)
- HX (fully clockwise)
- Continuous rotation between BP and HX (180 deg)

## Operation

- In BP position (and in initial portion of 180-deg clockwise rotation) all flow is from IN to BYPASS
- In intermediate positions, flow is split; as valve clockwise rotation is continued, IN to BYPASS flow decreases from max to zero as IN to HX flow increases from zero to max
- In final portion of 180-deg clockwise rotation and in fully clockwise position (HX position), all flow is from IN to HX
- Valve shaft has hex socket which mates with manual turning tool

## Water-Glycol Inlet Pressure

0 to 60 psig

## Water-Glycol Temperature

40 to 150F

 $\Delta P$ 

0.30 psi max with 200 lb/hr  
water-glycol at 70F in HX or  
BP position

## External Leakage

$3.9 \times 10^{-4}$  cc/hr water-glycol  
max at 0 to 60 psig and 70F  
in BP or HX position

Internal Leakage	2 cc/hr water-glycol max at 0 to 60 psi $\Delta P$ (IN to HX in BP position or IN to BYPASS in HX position)
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GLYCOL DIVERTER VALVE	828950-1	2.36
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Valve Type	<ul style="list-style-type: none"> <li>• One-inlet, two-outlet, two-position manual selector valve</li> <li>• Valve shaft has hex socket which mates with manual turning tool</li> </ul>
Valve Ports	<ul style="list-style-type: none"> <li>• Inlet</li> <li>• Normal (outlet)</li> <li>• Bypass (outlet)</li> </ul>

Valve Positions	
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BYPASS	Water-glycol flows from inlet to bypass port
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NORMAL	Water-glycol flows from inlet to normal port
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Valve Rotation	90 deg clockwise from BYPASS to NORMAL
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Water-Glycol Inlet Pressure	0 to 60 psig
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Water-Glycol Inlet Temperature	40 to 150F
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$\Delta P$	0.30 psi max with 200 lb/hr water-glycol at 70F in BYPASS or NORMAL position
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External Leakage	$3.9 \times 10^{-4}$ cc/hr water-glycol max at 0 to 60 psig and 70F in BYPASS or NORMAL position
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Internal Leakage	2 cc/hr water-glycol max at 0 to 60 psi $\Delta P$ (inlet to normal in BYPASS position or inlet to bypass in NORMAL position)
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BACKPRESSURE CONTROL VALVE	829170-1	2.39
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Design and Operation	<ul style="list-style-type: none"> <li>• Electrically actuated pinch valve (flexible liner constricted by damper and anvil)</li> </ul>
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	<ul style="list-style-type: none"> <li>• Modulated to control steam backpressure in glycol evaporator</li> <li>• Water-glycol heats steam restriction to prevent freezing</li> </ul>
Ports	<ul style="list-style-type: none"> <li>• Steam inlet (duct flange)</li> <li>• Steam outlet (duct flange)</li> <li>• Glycol inlet (fitting end)</li> <li>• Glycol outlet (fitting end)</li> </ul>
Actuator Inputs	
Open Signal (Retract Damper)	<ul style="list-style-type: none"> <li>• Pulsed or continuous 115 v ac, 1 <math>\phi</math>, 400 cps</li> <li>• Signal drives valve towards open position, decreasing steam backpressure</li> </ul>
Close Signal (Extend Damper)	<ul style="list-style-type: none"> <li>• Pulsed or continuous 115 v ac, 1 <math>\phi</math>, 400 cps</li> <li>• Signal drives valve towards closed position, increasing steam backpressure</li> </ul>
Output (Limit Switch Contact Transfer)	<ul style="list-style-type: none"> <li>• Switch closed when valve fully closed</li> <li>• Switch open when valve fully open or modulated</li> </ul>
Operating Pressure Range (Steam Side)	0 to 14.7 psia (0 to 760 mm Hg abs)
$\Delta P$	
Steam	2 mm Hg max with 7.5 lb/hr dry steam flow at 4 mm Hg abs and 40F inlet (valve in full open position)
Water-Glycol	0.15 psi max with 200 lb/hr at 70F
Actuation Time	58 sec max full closed to full open or reverse with continuous power applied
External Leakage	
Steam	<ul style="list-style-type: none"> <li>□ Leakage from housing external surface (cabin) to steam side</li> <li>• <math>6 \times 10^{-6}</math> lb/hr <math>N_2</math> (test fluid) max at 15 psig</li> </ul>
Water-Glycol	$10.4 \times 10^{-4}$ cc/hr water-glycol max at 60 psig and 70F

Internal Leakage (Steam Side)	$3 \times 10^{-5}$ lb/minute $N_2$ (test fluid) max at 0.1 psi (5.17 mm Hg) $\Delta P$
Power Requirement	0.07 a (8 va) max at 115 v, 1 $\phi$ , 400 cps

# GLYCOL EVAPORATOR TEMPERATURE CONTROL\*

820956-2

2.40

## Configuration

Two circuits (backpressure control section and water control section) with separate inputs and outputs

## BACKPRESSURE CONTROL SECTION

### Function

Controls glycol evaporator (2.6 or 2.7) water-glycol outlet temperature to  $41.5 \pm 1.5F$  by modulating position of backpressure control valve (2.39)

### Inputs

#### Mode Control

Resistance of radiator water-glycol outlet temperature sensor (2.47)

#### Minimum Pressure Control

Closure of steam pressure switch (8.24)

#### Temperature Control

Resistance of evaporator water-glycol outlet temperature sensor (2.23)

### Output

- Pulsed or continuous 115 v ac, 400 cps ac
- Modulation variable from 0 (no output) to 100 percent (continuous ac)
- Pin M ac opens 2.39, decreasing steam pressure and increasing cooling
- Pin L ac closes 2.39, increasing steam pressure and decreasing cooling

\*Refer to primary glycol temperature control block diagram and secondary glycol temperature control block diagram

## Operation

## Mode Control

- Switches from standby (2.39 closed) to evaporative mode (2.39 modulated by 2.23 signal) in response to 2.47 when radiator water-glycol outlet temperature is excessive
- Switches from evaporative to standby mode in response to 2.47 when radiator cooling is sufficient

## Minimum Pressure Control

- Maintains steam pan pressure above freezing by closing 2.39 in response to 8.24
- Maintains 2.39 closed until minimum steam pan pressure is restored

## Temperature Control

- Modulates position of 2.39 in response to 2.23 to adjust steam pressure (and, therefore, steam saturation temperature) to maintain 2.6 water-glycol outlet temperature within control band when 2.40 is in evaporative mode
- 2.23 input has no effect on 2.39 position if 2.40 is in standby mode (in response to 2.47) or is in minimum pressure state (in response to 8.24)

## Mode Control, Standby Mode

## Output

- This output obtained with listed inputs
- 50  $\pm$  10 percent modulation of close-valve pulses
- 17 ms min pulse width

## Inputs

- 48.5F or less (7622  $\pm$  1 ohms or greater) at 2.47
- Any temperature (resistance) at 2.23
- 8.24 open

# Mode Control, Evaporative Mode

- One typical case for evaporative mode shown; compare with Deadband Center under Temperature Control; all control points listed under Temperature Control are for evaporative mode

## Output

No close-valve pulses (with listed inputs)

## Inputs

- 50F (7355  $\pm$ 1 ohms) at 2.47
- 41.5F (4701  $\pm$ 4 ohms) at 2.23
- 8.24 open
- Continuous a-c to close 2.39 when 8.24 is closed (steam pressure near freezing condition); 8.24 closure overrides other inputs
- Output controlled by 2.23 and 2.47 when 8.24 is open (steam pressure above freezing condition)

# Minimum Pressure Control

## Temperature Control

### Fixed Conditions for Listed Control Points and Deadband

- 50.5F (7269  $\pm$ 4 ohms) at 2.47
- 8.24 open

### Control Points

- Listed control points show outputs produced as result of 2.23 temperatures and resistances during evaporative mode
- 77.8F (2050 ohms): continuous ac to open 2.39
- 66.1F (2650 ohms): pulsed or continuous ac to open 2.39
- 58.8F (3000  $\pm$ 1 ohms): 50  $\pm$ 15 percent modulation of pulses to open 2.39; width = 17 ms min
- 42.4F (4602 ohms): pulses to open 2.39 (width = 17 to 35 ms; period = 500 to 3000 ms)
- 41.6F (4690  $\pm$ 1 ohms): no pulses
- 41.5F (4701 ohms): deadband center (no pulses)
- 41.4F (4710  $\pm$ 1 ohms): no pulses



	<ul style="list-style-type: none"> <li>• 40.6F (4802 <math>\pm</math>1 ohms): pulses to close 2.39 (width = 17 to 35 ms; period = 500 to 3000 ms)</li> <li>• 23.9F (7000 <math>\pm</math>1 ohms): 50 <math>\pm</math>15 percent modulation of pulses to close 2.39; width = 17 ms min</li> <li>• 20.3F (8000 ohms): pulses or continuous ac to close 2.39</li> <li>• 5.1F (12,000 ohms): continuous ac to close 2.39</li> </ul>
Deadband	<ul style="list-style-type: none"> <li>□ Deadband as 2.23 temperature is varied; listed requirements are summary of preceding control points</li> </ul>
Deadband Center	41.5F (actual water-glycol temperature = desired temperature)
Minimum Deadband	<ul style="list-style-type: none"> <li>□ Required temperature range producing no output</li> <li>• 41.4 to 41.6F</li> </ul>
Maximum Deadband	<ul style="list-style-type: none"> <li>□ Allowable temperature range producing no output</li> <li>• Down to (but not including) 40.6F</li> <li>• Up to (but not including) 42.4F</li> </ul>

## WATER CONTROL SECTION

Function	Controls glycol evaporator water control valve (5.29) to supply water to glycol evaporator (2.6) for cooling without water carryover into steam duct
Inputs	
Mode Control	Contact transfer of backpressure control valve (2.39) limit switch
Wetness Control	Resistance of wick temperature sensor (2.49)
Reference	Resistance of evaporator water-glycol inlet temperature sensor (2.50)

## Output Circuits

## Configuration

- D-c power supply provides voltage for 5.29
- Positive side of supply connected directly to 5.29 solenoid
- Negative (return) side of supply connected to 5.29 solenoid through transistor switch which is closed to energize valve

## Rating

- 28 +6, -3 v dc at 8 w max between pins P (+) and R (-) for energized 5.29
- 0 +0.1, -0 v dc between pins P and R for deenergized 5.29

## Operation

## Mode Control

- Standby mode: maintains 5.29 closed when 2.39 is closed (2.39 limit switch closed)
- Evaporative mode: permits 2.49 and 2.50 to control 5.29 when 2.39 is modulated (2.39 limit switch open)

## Water Control

- Control (2.49) and reference (2.50) inputs are compared to maintain wicks wet without water carryover
- Temperature of 2.49 can vary between 2.6 water-glycol inlet temperature and saturation temperature of steam; when wicks are wet, 2.49 temperature decreases toward steam saturation temperature; 2.49 resistance increases and turns off water to 2.6; when wicks are dry, 2.49 temperature increases, resistance decreases, and water is turned on
- 2.50 provides variable reference for 2.49 to compensate for variations in heat load to 2.6; when 2.6 water-glycol inlet temperature increases, correct wick wetting occurs at a higher temperature; decreased 2.50 resistance is used to compensate for this effect

## Water Control

Fixed Condition  
for Listed  
Control Points

2.39 limit switch open

Control Points

- Listed control points show 5.29 position as result of 2.49 and 2.50 temperatures and resistances during evaporative mode

	2.50 Resistance (ohms)		2.49 Resistance* (ohms)	
	5.29 Open		5.29 Closed	
8094 (46F)	≤8250	(≥45.21F)	≥8416	(≤44.39F)
7355 (50F)	≤7895	(≥47.03F)	≥8088	(≤46.03F)
5833 (60F)	≤7086	(≥51.58F)	≥7412	(≤49.68F)
4661 (70F)	≤6470	(≥55.50F)	≥6890	(≤52.78F)
3752 (80F)	≤5993	(≥58.82F)	≥6486	(≤55.39F)
3041 (90F)	≤5620	(≥61.63F)	≥6170	(≤57.56F)
2690 (96F)	≤5435	(≥63.11F)	≥6014	(≤58.67F)

## COMBINED CIRCUIT REQUIREMENTS

Power

- 115 v, 1  $\phi$ , 400 cps
- 8 va max with backpressure control section and water control section unactivated
- 25 va max with 100 percent modulation from backpressure control section and water control section activated

---

GLYCOL TEMPERATURE CONTROL VALVE	828540-3	2.42
Flow Capacity	200 to 250 lb/hr water-glycol at 70F and 5.75 psi $\Delta P$	
Flow Metering	Linear within 10 percent from zero to full flow with 5.75 psi $\Delta P$	
External Leakage	5.2 x 10 <sup>-4</sup> cc/hr water-glycol max at 60 psig and 70F	

\*5.29 may be either open or closed between resistances listed

Internal Leakage	10 cc/min water-glycol max at 5.75 psi $\Delta P$
Power Requirement	8 va max, 115 v, 1 $\emptyset$ , 400 cps

GLYCOL TEMPERATURE SENSOR	820980-2-1	2.45
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Configuration	<ul style="list-style-type: none"> <li>• Two identical sensing elements (one for back-up)</li> <li>• Each element consists of single negative temperature coefficient thermistor</li> <li>• Each thermistor is enclosed in glass probe</li> </ul>
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Sensing Element Resistance	3296 $\pm$ 280 ohms at 20F 2614 $\pm$ 139 ohms at 30F 2084 $\pm$ 51 ohms at 40F 1860 $\pm$ 28 ohms at 45F 1663 $\pm$ 42 ohms at 50F 1336 $\pm$ 58 ohms at 60F 1082 $\pm$ 66 ohms at 70F
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External Leakage	1.3 x 10 <sup>-4</sup> cc/hr water-glycol max at 60 psig and 70F
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GLYCOL SHUTOFF VALVE	828490-2	2.46
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Operating Pressure	<ul style="list-style-type: none"> <li>• 0 to 60 psig inlet</li> <li>• 0 to 60 psi <math>\Delta P</math> (valve closed)</li> </ul>
--------------------	--

Inlet Temperature	0 to 150F
-------------------	-----------

Flow Capacity	200 lb/hr water-glycol at 70F and 1 psi $\Delta P$ max
---------------	--

Power Requirement	5 amp max, 28 vdc
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External Leakage	2.6 x 10 <sup>-4</sup> cc/hr water-glycol max at 0 to 60 psig and 70F
------------------	---

Internal Leakage	<ul style="list-style-type: none"> <li>• 3.2 x 10<sup>-2</sup> cc/hr water glycol max at 0 to 40 psig and 70F</li> <li>• 1 cc/hr water-glycol max at 40 to 60 psig and 70F</li> </ul>
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GLYCOL TEMPERATURE SENSOR	820980-4	2.47 2.50
---------------------------	----------	--------------

Configuration	<ul style="list-style-type: none"> <li>• Two identical sensing elements (one for backup)</li> </ul>
---------------	---

Sensing Element Resistance	<ul style="list-style-type: none"> <li>Each element has two matched negative temperature coefficient thermistors in series</li> <li>Each thermistor is enclosed in glass probe</li> </ul>
	9356 $\pm$ 117 ohms at 40F 7355 $\pm$ 92 ohms at 50F 5833 $\pm$ 73 ohms at 60F 4661 $\pm$ 58 ohms at 70F 3752 $\pm$ 47 ohms at 80F 3041 $\pm$ 38 ohms at 90F 2482 $\pm$ 31 ohms at 100F
External Leakage	$1.3 \times 10^{-4}$ cc/hr water-glycol max at 60 psig and 70F

GLYCOL PUMP	825070-2	2.48
Type and Function	Motor-driven centrifugal pumps which circulate water-glycol in two separate circuits (primary and secondary)	
Ports	<input type="checkbox"/> All ports are fitting ends except cabin reference ports	
Primary Circuit	<ul style="list-style-type: none"> <li>PRIM INLET</li> <li>PRIM OUTLET</li> <li>Pump outlet pressure sensing</li> <li>Accumulator water-glycol pressure sensing (for quantity instrumentation)</li> <li>Accumulator cabin reference (screened opening to cabin)</li> </ul>	
Secondary Circuit	<ul style="list-style-type: none"> <li>SEC INLET</li> <li>SEC OUTLET</li> <li>Pump outlet pressure sensing</li> <li>Accumulator water-glycol pressure sensing (for quantity instrumentation)</li> <li>Accumulator cabin reference (screened opening to cabin)</li> </ul>	
Primary Accumulator Isolation Valve Positions		
Counterclockwise	Open	
Clockwise	Closed	

# Operation (Primary Circuit)

- Inlet filter traps contaminants
- Metal-bellows fluid accumulator stores water-glycol and references pump inlet pressure to cabin pressure; accumulator provides make-up water-glycol for entire primary glycol circuit and accepts water-glycol due to thermal expansion
- Normally open accumulator isolation valve can be closed if accumulator leakage is excessive; valve is hex-driven (by manual turning tool)
- Either of two parallel (redundant) motor-driven centrifugal pumps can be selected by external manually operated switches; swing check valve in discharge line of each pump prevents fluid recirculation through unused pump
- 3- $\phi$ , 400-cps induction motor drives impeller of each centrifugal pump; magnet on impeller shaft is coupled to magnet on motor shaft through plastic static seal

# Operation (Secondary Circuit)

Same as primary circuit except secondary circuit has single pump and no accumulator isolation valve

# Water-Glycol Inlet Pressure

7.5 psig nom (accumulator partially full) at 70F avg water-glycol temperature (avg temperature for entire water-glycol circuit)

# Water-Glycol Inlet Temperature

96F max

# Filtration (Each Inlet Filter)

- 50 microns nom
- 70 microns abs

# Accumulator Displacement (Storage Capacity)

## Primary

60 cu in. (2.34 lb water-glycol at 70F) min with pressure change from 2 psig to 24 psig

Secondary	35 cu in. (1.37 lb water-glycol at 70F) min with pressure change from 2 psig to 24 psig
Centrifugal Pumps	
Design Flow Rate	200 lb/hr water-glycol nom
Pressure Rise	36 psid min with 200 lb/hr water-glycol flow
External Leakage	
Primary Circuit	$4.2 \times 10^{-3}$ cc/hr water-glycol max at 60 psig and 70F
Secondary Circuit	$4.2 \times 10^{-3}$ cc/hr water-glycol max at 60 psig and 70F
Check Valve Check Leakage (Each Primary Circuit Check Valve)	5 cc/hr water-glycol max at 36 psi $\Delta P$ and 70F
Isolation Valve Internal Leakage	$2.5 \times 10^{-3}$ cc/hr water-glycol max at 60 psi inlet-to-accumulator $\Delta P$
Power Requirement (Each Motor)	<ul style="list-style-type: none"> <li>• 115 v ac, 3 <math>\phi</math>, 400 cps</li> <li>• 52 w max with 200 lb/hr water-glycol flow and 36 psid pressure rise</li> </ul>

## WICK TEMPERATURE SENSOR

820972-2

2.49

## Configuration

- Two temperature-sensing elements and single electrical connector
- Sensing elements are identical (one for backup)
- Each element has two matched negative-temperature-coefficient thermistors in series
- Each thermistor is sealed in glass cylinder which is protected by metal cap; capped cylinder extends from molded probe
- Four probes are attached to wicks in glycol evaporator (2.6); electrical connector mounts in mating boss in 2.6 housing; electrical wires connect wick-mounted probes to housing-mounted connector

Function	Senses temperature of 2.6 wicks; sensed temperature used to control wick wetness
Sensing Element Resistances	<ul style="list-style-type: none"> <li>• 8495 <math>\pm</math>41 ohms at 44F</li> <li>• 7355 <math>\pm</math>37 ohms at 50F</li> <li>• 5833 <math>\pm</math>31 ohms at 60F</li> <li>• 4661 <math>\pm</math>26 ohms at 70F</li> <li>• 3752 <math>\pm</math>22 ohms at 80F</li> <li>• 3041 <math>\pm</math>19 ohms at 90F</li> <li>• 2482 <math>\pm</math>16 ohms at 100F</li> </ul>
External Leakage	<ul style="list-style-type: none"> <li>□ Electrical connector installed in mating boss and test pressure applied from pin side to solder-pot side</li> <li>• <math>6 \times 10^{-6}</math> lb/hr <math>O_2</math> max at 6 psig and 70F</li> </ul>

GLYCOL TEMPERATURE SENSOR	820980-4	2.50
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Same as Item 2.47

PRESSURE CAP	829140-1	2.51
Function and Operation	<ul style="list-style-type: none"> <li>• Quick-disconnect pressure cap; mates with quick-disconnect nipple and forms pressure seal when connected</li> <li>• Pressure cap collar is retracted to connect cap to nipple; when collar is released, cap locks to nipple</li> <li>• Collar is also retracted to disconnect cap from nipple</li> </ul>	
Water-Glycol Pressure	0 to 60 psig	
Water-Glycol Temperature	-65 to +150F	
External Leakage		
Prelaunch	$3.2 \times 10^{-2}$ cc/hr water-glycol max at 0 to 60 psig and 70F	
Post Launch	<ul style="list-style-type: none"> <li>• <math>3.2 \times 10^{-2}</math> cc/hr water-glycol max at 0 to 60 psig and 0 to 150F</li> <li>• 1 cc/hr water-glycol max at 0 to 60 psig and -240 to +240F</li> </ul>	



GLYCOL DIVERTER VALVE  
[ SUIT HT EXCH SECONDARY  
GLYCOL]\*

829190-1

2.52

Valve Type

- One-inlet, two-outlet, two-position manual selector valve
- Valve shaft has hex socket which mates with manual turning tool

Valve Ports

- Inlet
- Normal (outlet)
- Bypass (outlet)

Valve Positions

BYPASS [BYPASS]

Water-glycol flows from inlet to bypass port

NORMAL [FLOW]

Water-glycol flows from inlet to normal port

Valve Rotation

90 deg clockwise from BYPASS to NORMAL

Water-Glycol Inlet Pressure

0 to 60 psig

Water-Glycol Inlet Temperature

40 to 150F

$\Delta P$

0.30 psi max with 200 lb/hr water-glycol at 70F in BYPASS or NORMAL position

External Leakage

$3.9 \times 10^{-4}$  cc/hr water-glycol max at 0 to 60 psig and 70F in BYPASS or NORMAL position

Internal Leakage

2 cc/hr water-glycol max at 0 to 60 psi  $\Delta P$  (inlet to normal in BYPASS position or inlet to bypass in NORMAL position)

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\*Names in brackets are ECU coolant control panel markings

## GROUP 3. CABIN PRESSURE AND TEMPERATURE CONTROL

CABIN PRESSURE RELIEF VALVE 810450-3

3.1

### Configuration

- Two independent pressure relief valve sections with manual overrides
- Either section will outflow to limit cabin-to-ambient  $\Delta P$  (positive pressure relief)
- Either section will inflow to limit ambient-to-cabin  $\Delta P$  (negative pressure relief)

### Manual Override Positions (One Section Does Not Have Dump Position)

Closed

Will not open automatically

Normal

Automatic with limited flow

Boost & Reentry

Automatic with full flow

Dump

Manually open with full flow

### Operating Ambient Pressure Range

0 to 25 psia

### Positive Pressure Relief

6.0  $\pm$  0.2, -0.4 psi cabin-to-ambient  $\Delta P$

### Negative Pressure Relief

25 in. H<sub>2</sub>O ambient-to-cabin  $\Delta P$  max

### Effective Flow Area (CA) for Each Section

Outflow

- 1.50 sq in. min (boost & reentry and dump positions)
- 0.039 to 0.130 sq in. (normal position)

Inflow

0.75 sq in. min (boost & reentry and dump positions)

### Positive Pressure Leakage

$6 \times 10^{-4}$  lb/minute O<sub>2</sub> max with 5.5 psia cabin and 0.5 psia ambient

### Negative Pressure Leakage

215 scc/minute O<sub>2</sub> max with 8 in. H<sub>2</sub>O ambient-to-cabin  $\Delta P$

## CABIN HEAT EXCHANGER

812150-1

3.2

## Type

- Plate-fin, sandwich-construction, cabin-gas-to-water-glycol heat exchanger
- Two separate coolant circuits (primary and secondary water-glycol)
- Single-pass on gas side, two-pass on each water-glycol side
- Water-glycol flow is counter-cross to cabin-gas flow

## Ports

- PRIMARY INLET (boss)
- PRIMARY OUTLET (boss)
- SECONDARY INLET (boss)
- SECONDARY OUTLET (boss)
- Cabin gas inlet (protective screen over core inflow face)
- Cabin gas outlet (core outflow face)

## Primary Full-Cooling Mode

## Heat Transfer Rate

- Heat transfer rate with listed gas-side and water-glycol-side parameters
- 892 Btu/hr min

## Gas-Side Parameters

- 297 lb/hr O<sub>2</sub> flow
- 76.5F inlet temperature
- 5 psia inlet pressure

## Water-Glycol-Side Parameters

- 167 lb/hr flow
- 58.9F inlet temperature
- 60 psig max inlet pressure

## Primary Full-Heating Mode

## Heat Transfer Rate

- Heat transfer rate with listed gas-side and water-glycol-side parameters
- 236 Btu/hr min

## Gas-Side Parameters

- 297 lb/hr O<sub>2</sub> flow
- 76.5F inlet temperature
- 5 psia inlet pressure

## Water-Glycol-Side Parameters

- 200 lb/hr flow
- 85F inlet temperature
- 60 psig max inlet pressure

Secondary Cooling Mode	
Heat Transfer Rate	<ul style="list-style-type: none"> <li>□ Heat transfer rate with listed gas-side and water-glycol-side parameters</li> <li>• 1132 Btu/hr min</li> </ul>
Gas-Side Parameters	<ul style="list-style-type: none"> <li>• 297 lb/hr O<sub>2</sub> flow</li> <li>• 76.5F inlet temperature</li> <li>• 5 psia inlet pressure</li> </ul>
Water-Glycol-Side Parameters	<ul style="list-style-type: none"> <li>• 167 lb/hr flow*</li> <li>• 55F inlet temperature</li> <li>• 60 psig max inlet pressure</li> </ul>
Gas-Side $\rho\Delta P$	<ul style="list-style-type: none"> <li>• 0.0042 lb/ft<sup>3</sup>-in. H<sub>2</sub>O@ 200 phr</li> <li>• 0.0059 lb/ft<sup>3</sup>-in. H<sub>2</sub>O@ 250 phr</li> <li>• 0.0076 lb/ft<sup>3</sup>-in. H<sub>2</sub>O@ 300 phr</li> <li>• 0.0095 lb/ft<sup>3</sup>-in. H<sub>2</sub>O@ 350 phr</li> <li>• 0.0115 lb/ft<sup>3</sup>-in. H<sub>2</sub>O@ 400 phr</li> </ul>
Typical Gas-Side $\Delta P$	
Conditions	<ul style="list-style-type: none"> <li>□ Typical conditions for 5-psia cabin</li> <li>• 300 lb/hr cabin gas weight flow</li> <li>• 0.0285 lb/cu ft cabin gas density (<math>\rho</math>)</li> </ul>
$\Delta P$	0.267 in. H <sub>2</sub> O
Water-Glycol-Side $\Delta P$ (Primary or Secondary)	1 psi max with 200 lb/hr water-glycol at 70F
External Leakage (Primary or Secondary)	6.8 x 10 <sup>-4</sup> cc/hr water-glycol max at 60 psig and 70F

---

**CABIN TEMPERATURE  
ANTICIPATOR**

820110-3

3.6

**Configuration**

- Two electrically identical sensing elements
- One element is thermally lagged, the other is unlagged
- Each element has two matched negative temperature coefficient thermistors in series
- Each thermistor is enclosed in glass probe

\*Secondary cooling flow in system variable from 0 to 200 lb/hr

	<ul style="list-style-type: none"> <li>• Thermistors for unlagged element are exposed directly to cabin heat exchanger (3.2) outlet</li> <li>• Thermistors for lagged element are sealed in thermal insulation</li> </ul>
Sensing Element Resistance	2330 $\pm$ 58 ohms at 70F 2089 $\pm$ 51 ohms at 75F 1876 $\pm$ 47 ohms at 80F
Time Constant of Lagged Element	4.0 $\pm$ 1.0 minutes for 63.2 percent of applied step in 3-in. dia duct with 20 cfm O <sub>2</sub> flow at 14.7 psia
Time Constant of Unlagged Element	6 sec max for 63.2 percent of applied step in 3-in. dia duct with 20 cfm O <sub>2</sub> flow at 14.7 psia

---

**CABIN TEMPERATURE CONTROL\***

820010-4\*\*

3.7

**Type and Function**

- Solid-state electronic control
- Controls a-c power to cabin temperature control valve (2.13)
- Modulates position of 2.13 to adjust glycol flow through cabin heat exchanger (3.2) until selected cabin temperature is obtained

**Inputs****Temperature**

- Selected cabin temperature: resistance of NAA cabin temperature selector
- Actual cabin temperature: resistance of cabin temperature sensor (3.8)

\*Refer to cabin temperature and glycol pump control block diagram

\*\*Part number for this item same as 2.22; differences in external connections account for differences in requirements

# Rate-of-Change (Overshoot) Control

Cabin temperature rate-of-change: resistance ratio of lagged and unlagged elements of cabin temperature anticipator (3.6)

## Outputs

### Valve Rotation Output

- Pulsed or continuous 115 v ac, 400 cps ac
- Modulation variable from 0 percent (no output) to 100 percent (continuous ac)
- Pin D ac rotates 2.13 to decrease cabin air temperature
- Pin E ac rotates 2.13 to increase cabin air temperature

### Valve Braking Output

32  $\pm$  6 v dc across pins D (-) and E (+) if no ac (valve rotation output) is present

## Operation

### Temperature Control

- Compares selected cabin temperature (NAA selector) and actual cabin temperature (3.8)
- Comparison produces difference or error signal, which is amplified and applied to 2.13; 2.13 is driven in direction to reduce sensed error towards zero

### Temperature Rate-of-Change Control

- Compensates for control-loop time lag (time interval between temperature correction and correction sensing); because of lag, use of temperature error signal only would result in overcorrection
- 3.6 provides rate-of-change signal, which anticipates new temperature at temperature-sensing point (3.8)
- Signal from 3.6 is combined with error signal; this introduces time-lead component into total signal; this lead component compensates for control-loop time lag

## Temperature Control

Fixed Conditions  
for Listed Control  
Points and Deadband

- 77F (2000  $\pm$ 1 ohms) at both lagged and unlagged 3.6 elements (temperature rate of change = 0)
- 75F (229 ohms) at cabin temperature selector

## Control Points

- Listed control points show outputs produced as result of 3.8 temperatures and resistances
- 89.1F (1550  $\pm$ 1 ohms): 30  $\pm$ 20 percent modulation of pulses which decrease cabin air temperature
- 77.0F (2001 ohms): sustained 15 to 35 ms pulses which decrease cabin air temperature
- 75.3F (2076 ohms): no pulses
- 75.0F (2089 ohms): deadband center (no pulses)
- 74.7F (2100 ohms): no pulses
- 73.0F (2182 ohms): sustained 15 to 35 ms pulses which increase cabin air temperature
- 59.9F (2920  $\pm$ 1 ohms): 30  $\pm$ 20 percent modulation of pulses which increase cabin air temperature

## Deadband

- Deadband as 3.8 temperature is varied; listed requirements are summary of preceding control points

Deadband  
Center

75.0F (actual cabin temperature = selected cabin temperature)

Minimum  
Deadband

- Required temperature range producing no output
- 74.7 to 75.3F

Maximum  
Deadband

- Allowable temperature range producing no output
- Down to (but not including) 73F
- Up to (but not including) 77F

## Rate-of-Change Control

- Rate-of-change requirement is stated as ratio of two cabin-temperature-control-valve actuation times
- Ratio obtained by dividing rate-of-change actuation time by reference actuation time

## Reference Actuation Time

- Rotation time of 2.13 from full "C" to full "H" with below inputs
  - 0 ohms at cabin temperature selector
  - $2600 \pm 1$  ohms at 3.8
  - Open circuits at both lagged and unlagged elements of 3.6

## Rate-of-Change Actuation Time

- Rotation time of 2.13 from full "C" to full "H" with below inputs
- Listed inputs represent condition of no cabin-temperature error and negative temperature rate of change
  - 75F (229 ohms) at cabin temperature selector
  - 75F ( $2089 \pm 1$  ohms) at 3.8
  - 77F ( $2000 \pm 5$  ohms) at lagged 3.6 element
  - 50F ( $3678 \pm 1$  ohms) at unlagged 3.6 element

Actuation Time Ratio  
(Rate-of-Change/  
Reference)0.22  $\pm$  0.15

## Power Requirement

- 115 v, 1  $\phi$ , 400 cps
- 2.5 va max with no ac output

## CABIN TEMPERATURE SENSOR

820964-1

3.8

## Configuration

- One sensing element consisting of two matched negative-temperature-coefficient bead thermistors in series
- Each thermistor is enclosed in glass probe
- Thermistors mounted at end of post, which is inserted into cabin heat exchanger (3.2) inlet duct



Sensing Element Resistance	<ul style="list-style-type: none"> <li>• 2330 <math>\pm</math>58 ohms at 70F</li> <li>• 2230 <math>\pm</math>56 ohms at 72F</li> <li>• 2135 <math>\pm</math>53 ohms at 74F</li> <li>• 2089 <math>\pm</math>51 ohms at 75F</li> <li>• 2045 <math>\pm</math>51 ohms at 76F</li> <li>• 1959 <math>\pm</math>49 ohms at 78F</li> <li>• 1876 <math>\pm</math>47 ohms at 80F</li> </ul>	
Response Time		
Conditions	<ul style="list-style-type: none"> <li>• 35 cfm cabin gas min at 14.7 psia (flow past sensor)</li> <li>• Temperature step change applied to cabin gas</li> </ul>	
Requirement	8 sec max for resistance change equal to 63.2 percent of total change for applied step	
<hr/>		
CABIN FAN	826010-2	3.18
Normal Operation	86 cfm O <sub>2</sub> at 5 psia inlet and 0.0285 lb/cu ft density with 0.39 in. H <sub>2</sub> O pressure rise	
Power Requirement	115/200 v, 3 $\phi$ , 400 cps, 19 w max normal operation	
<hr/>		
CABIN PRESSURE REGULATOR	810230-1	3.28
Configuration and Operation	<ul style="list-style-type: none"> <li>• Two flow-limited, absolute-pressure, demand regulators operating in parallel and inflowing to cabin</li> <li>• Regulators maintain cabin at normal pressure (nonemergency) and shutoff during depressurized cabin (emergency)</li> <li>• Manual repressurization valve [CABIN REPRESS.]* bypasses regulators to repressurize cabin after emergency</li> <li>• Manual control knob has hex socket which mates with manual turning tool</li> </ul>	

\*Names in brackets indicate oxygen control panel markings

## Ports

- Inlet (fitting end)
- Regulator No. 1 outlet [GSE CALIB. PORT]; boss\*
- Regulator No. 2 outlet [GSE CALIB. PORT]; boss\*
- Manual repressurization valve outlet [GSE REPRESS. PORT]; boss\*

## Repressurization Valve

## Positions

- Closed
- [OPEN]

## Rotation

270 deg clockwise from closed to fully open

## Oxygen Inlet Pressure

85 to 115 psia

## Oxygen Inlet Temperature

0 to +160F

## Pressure Regulation

- Regulator performance as function of cabin pressure ( $P_C$ )
- All requirements are with inlet at 85 to 115 psia and -40 to +160F unless indicated otherwise

$$P_C > 5.2 \text{ psia}$$

- High-pressure lockup (sea level to normal cabin pressure range)
- No regulator flow

$$5.2 \geq P_C \geq 4.8 \text{ psia}$$

- Nominal control range (normal cabin)
- Cabin pressure regulated to  $5.0 \pm 0.2$  psia with flow demands up to 0.6 lb/hr  $O_2$  per regulator with 85 psia and 70F inlet

$$5.2 \geq P_C > 3.5 \text{ psia}$$

- Total cabin-pressure range producing demand flows (normal to depressurized cabin transition)

\*Bosses are fitted with vented plugs on oxygen control panel; regulator outflows to cabin through plugs which serve as flow deflectors; plugs removed and GSE equipment connected for ground test; GSE CALIB. PORT's permit ground test of aneroid calibration

$$P_C \leq 3.5 \text{ psia}$$

- Demand flow limited to 0.65 lb/hr O<sub>2</sub> per regulator (1.30 lb/hr total) with 85 psia inlet
- Low-pressure shutoff (depressurized cabin)
- No regulator flow

## Repressurization Valve

Flow

0.10 lb/minute (6 lb/hr) O<sub>2</sub> min with 85 psia inlet

Repressurization Time

1 hr max to repressurize cabin volume from 10<sup>-6</sup> torr (10<sup>-6</sup> mm Hg) to 5 psia with above flow

Leakage

- Total leakage for both regulators and repressurization valve

High-Pressure Lockup

46 std cc/minute (8.22 x 10<sup>-3</sup> lb/hr) O<sub>2</sub> max with 115 psia and 70F inlet and 5.5 psia cabin

Low-Pressure Shutoff

27 std cc/minute (4.83 x 10<sup>-3</sup> lb/hr) O<sub>2</sub> max with 115 psia and 70F inlet and 3.5 psia cabin

## LEM PRESSURE VALVE

828920-1

3.30

Valve Type

- Four-port, four-position manual selector valve
- Valve shaft has hex socket which mates with manual turning tool

Valve Ports

- LEM (fitting end)
- CM tunnel (boss)
- Vent (boss)
- Command module (screened opening)

Valve Positions

1

Off position: no flow

2

Tun/LEM position: pressurizes CM tunnel and LEM from command module

3	Lunar orbit docking position: pressurizes CM tunnel from LEM
4	Tun/vent position: vents CM tunnel to ambient
Valve Rotation	<ul style="list-style-type: none"> <li>• 45 deg between positions</li> <li>• 135 deg total clockwise rotation from position 1 to position 4</li> </ul>
O <sub>2</sub> Pressure Range	0 to 6.2 psid
O <sub>2</sub> Temperature	0 to 150F
Flow Capacity	
Position 2	1.90 lb/minute O <sub>2</sub> min command module-to-CM tunnel + LEM flow with 5 psig and 70F command module and 5 psi ΔP
Position 3	0.51 lb/minute O <sub>2</sub> min LEM-to- CM tunnel flow with 5 psig and 70F LEM and 5 psi ΔP
Position 4	0.45 lb/minute O <sub>2</sub> min CM tunnel-to-vent flow with 5 psig and 70F CM tunnel and 5 psi ΔP
Total Leakage	15 std cc/hr ( $4.47 \times 10^{-5}$ lb/hr) O <sub>2</sub> max in all positions with external surfaces and cabin port at 5 psig and all other ports at 0 psig

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**TUNNEL PRESSURE  
EQUALIZATION VALVE**

828930-1

3.31

Valve Type	<ul style="list-style-type: none"> <li>• Manual shutoff valve with integral pressure indicating device</li> </ul>
Valve Function	<ul style="list-style-type: none"> <li>• Valve mounts on door between command module cabin and com- mand module tunnel and is opened to eliminate pressure differential across door prior to opening</li> <li>• Valve may be operated from tunnel or cabin side; valve shaft has hex socket on both tunnel and cabin sides</li> </ul>

	<ul style="list-style-type: none"> <li>• Indicating device is visible from tunnel side and shows when door differential pressure has reduced to safe level for opening (3.32 is used to indicate door differential pressure on cabin side of door)</li> </ul>
Valve Ports	<ul style="list-style-type: none"> <li>• Command module (direct opening to cabin)</li> <li>• CM tunnel (direct opening to tunnel)</li> </ul>
Valve Positions	<ul style="list-style-type: none"> <li>• CLOSED</li> <li>• OPEN</li> </ul>
Valve Rotation	
Command Module	60 deg clockwise from CLOSED to OPEN
Tunnel Side	60 deg counterclockwise from CLOSED to OPEN
Pressure Indications	
White (Safe)	<ul style="list-style-type: none"> <li>• Valve CLOSED</li> <li>• Valve OPEN and tunnel-to-cabin <math>\Delta P</math> near zero</li> <li>• Valve OPEN and cabin pressure higher than tunnel (pressure differential in direction to maintain door closed)</li> </ul>
Red (Unsafe)	Valve OPEN and tunnel pressure higher than cabin (pressure differential in direction to blow door)
O <sub>2</sub> Pressure Range	0 to 6.2 psid
O <sub>2</sub> Temperature Range	0 to 150F
Effective Flow Aperture	0.38-in. dia min
$\Delta P$ for Indicator Response	0.10 $\pm$ 0.05 psi tunnel-to-cabin $\Delta P$
Total Leakage	15 std cc/hr ( $4.47 \times 10^{-5}$ lb/hr) O <sub>2</sub> max at 5 psid

# TUNNEL PRESSURE GAUGE

828940-1

3.32

Type

Bourdon-tube gauge

Function

Indicates cabin-to-CM-tunnel differential pressure

Ports

- Pressure sensing port (fitting end)
- Ambient sensing ports (ports in case; ports have sintered-metal filtering plugs)

Dial Calibrations

- Negative readings indicate tunnel pressure higher than cabin; positive readings indicate cabin pressure higher than tunnel

Counterclockwise

-1 psi

Clockwise

+4 psi

O<sub>2</sub> Operating Pressure Range

-1.0 to +4.0 psid, ambient sensing ports to pressure sensing port

O<sub>2</sub> Temperature Range

0 to 200F

Accuracy

- ±0.1 psi at -1.0 to +1.0 psid and 70F
- ±0.2 psi at +1.0 to +4.0 psid and 70F

External Leakage

$2.98 \times 10^{-5}$  lb/hr O<sub>2</sub> max at +4.0 psid ambient sensing ports to pressure sensing port

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## GROUP 4. OXYGEN SUPPLY

### DEMAND PRESSURE REGULATOR

828730-5

4.16

#### Inlet Selector Valve Positions

1	Flow to regulator 1 only
2	Flow to regulator 2 only
1 & 2	Flow to both regulators
OFF	No flow to either regulator

#### SUIT TEST Selector Valve Positions

PRESS	Suit circuit pressurized at controlled test rate
DEPRESS	Suit depressurized (from pressurized test condition) at controlled test rate
OFF	Regulator functions normally

Inlet Pressure

85 to 115 psia

Inlet Temperature

40 to 160F

Normal Regulation  
(4 to 14.7 psia Cabin)

Regulator Lockup

No demand flow with cabin-to-suit  $\Delta P$  less than 2.5 in. H<sub>2</sub>O

Control Range

Cabin-to-suit  $\Delta P$  maintained at 2.5 to 3.5 in. H<sub>2</sub>O with O<sub>2</sub> demand flow of 0.007 lb/minute (each regulator) or 0.014 lb/minute (both regulators)

Maximum Demand Flow

Cabin-to-suit  $\Delta P$  limited to 5.5 in. H<sub>2</sub>O with O<sub>2</sub> demand flow of 0.30 lb/minute

Emergency Regulation  
(0 to 4 psia Cabin)

Regulator Lockup

No demand flow at 4.0 psia and higher suit pressures

Control Range

Suit pressure maintained at 3.5 to 4.0 psia

Maximum Demand Flow

0.66 lb/minute O<sub>2</sub> demand flow at 3.5 psia and lower suit pressures

Normal Venting (4 to 14.7 psia cabin)	Suit pressure limited to 9 in. H <sub>2</sub> O max above cabin with vent flows up to 0.66 lb/minute
Emergency Venting (0 to 4 psia cabin)	Suit pressure limited to 9 in. H <sub>2</sub> O max above 4.0 psia
SUIT TEST Valve	
PRESS Position	0.075 lb/minute O <sub>2</sub> max suit inflow with 114.7 psia inlet and inlet selector not OFF
DEPRESS Position	0.068 lb/minute O <sub>2</sub> max suit-to-cabin flow with 18.7 psia suit pressure and sea-level cabin
Reference Chamber Pressure Relief Valve	Cracks and reseats within 4.1 to 4.5 psig
Regulator Leakage and Controlled Bleed	<ul style="list-style-type: none"> <li>• 210 scc/minute O<sub>2</sub> max in 1 &amp; 2 position</li> <li>• 110 scc/minute O<sub>2</sub> max in 1 or 2 position</li> </ul>
Normal Vent Valve Leakage (4 to 14.7 psia cabin)	<ul style="list-style-type: none"> <li>• 10 scc/minute max with suit-to-cabin <math>\Delta P</math> of 1.0 in. H<sub>2</sub>O</li> <li>• 1000 scc/minute max with suit-to-cabin <math>\Delta P</math> of 2.0 in. H<sub>2</sub>O</li> </ul>
Emergency Vent Valve Leakage (0 to 4 psia cabin)	10 scc/minute max

---

MANUAL OXYGEN METERING VALVE	828560-1	4.17
Inlet Pressure	140 psig max	
Inlet Temperature	0 to 200F	
Flow Capacity	0.67 lb/minute O <sub>2</sub> min with 100 psia and 70F inlet	
External Leakage	$5.8 \times 10^{-6}$ lb/hr O <sub>2</sub> max at 140 psig	
Internal Leakage	1.0 scc/minute O <sub>2</sub> max at 140 psi $\Delta P$	

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EMERGENCY OXYGEN INFLOW  
CONTROL VALVE  
[EMERGENCY CABIN PRESSURE]\*

828510-4

4.22

Function

Provides emergency inflow of oxygen into cabin to prevent rapid decompression if cabin wall is punctured

Ports

- Inlet (fitting end)
- Outlet [GSE TEST PORT]; boss open to cabin; vented plug (flow deflector) installed in boss; plug removed and GSE equipment connected for ground tests
- Controlled bleed outlet [PRESS TO TEST]; sleeve with end open to cabin; vented press-to-test button installed on sleeve; button removed and GSE equipment connected for ground tests
- Cabin sense port (direct opening to cabin)
- Reference chamber 1 pressure relief valve cabin-sense-and-relief-outlet port (direct opening to cabin)
- Reference chamber 2 pressure relief valve cabin-sense-and-relief-outlet port (direct opening to cabin)

Inlet Selector Valve  
Positions

1

Inlet flow to regulator 1 only

NORMAL

Inlet flow to both regulators

2

Inlet flow to regulator 2 only

OFF

No inlet flow to either regulator

Press-to-Test Valve  
[PRESS TO TEST]  
Positions

Pressed

- Closes controlled-bleed outlet and causes reference-chamber pressure relief valve(s) to flow

\*Names in brackets indicate oxygen control panel markings

Released

Configuration and  
Operation

- Increased reference chamber pressure deflects sensing diaphragm which opens demand supply valve(s)
- One or both regulators, depending on inlet selector position, flows at maximum rate
- Opens controlled-bleed outlet
- Regulators function normally
- Two parallel (redundant) absolute pressure regulators with common inlet port (controlled by inlet selector valve) and common outlet port
- Inlet selector valve permits exclusion of failed regulator and permits shutoff of both regulators during emergency (cabin leak) repair or prior to planned cabin dump
- Each regulator responds to differential between cabin pressure and an internal reference-chamber pressure
- With normal cabin, reference-chamber pressure equals cabin pressure and regulator does not flow; as cabin becomes depressurized, aneroid traps controlled bleed and limits reference chamber pressure; regulator responds to differential and flows
- Relief valve limits reference chamber pressure by venting bleed if aneroid fails or closed press-to-test button blocks bleed
- Closed press-to-test button causes increase of reference chamber pressure; this causes regulator to flow, testing operation when no emergency exists

Oxygen Inlet Pressure

- 85 to 115 psia (nom)
- 155 psia max

Oxygen Inlet Temperature

0 to +160F

Regulator Flows  
(Each Regulator)Fixed Conditions for  
Listed Flows $P_C \geq 4.6$  psia $4.6 > P_C \geq 4.2$  psia $P_C < 4.2$  psiaReference Chamber Pressure  
Relief Valve (Each Valve)Regulator Leakage and  
Controlled BleedNORMAL Selector  
Position1 or 2 Selector  
Position

OFF Selector Position

- Regulator performance as function of cabin pressure ( $P_C$ )

- 85 to 115 psia  $O_2$  inlet pressure
- 70F  $O_2$  inlet temperature

- Regulator lockup (sea level to normal cabin)

- No flow

- Zero to full flow (depressurizing cabin)

- Flow increases from zero to 0.66 lb/minute  $O_2$  min as cabin pressure reduces from 4.6 to 4.2 psia

- Full flow (depressurized cabin)

- 0.66 lb/minute  $O_2$  min

- Reference chamber pressure with loss of vacuum in aneroid or press-to-test valve closed

- Valve cracks and reseats within 4.1 to 5.1 psig range

- Total leakage from inlet port to cabin with 115 psia inlet

210 std cc/minute ( $3.76 \times 10^{-2}$  lb/hr)  $O_2$  max110 std cc/minute ( $1.97 \times 10^{-2}$  lb/hr)  $O_2$  max10 std cc/minute ( $1.79 \times 10^{-3}$  lb/hr)  $O_2$  maxOXYGEN PRESSURE REGULATOR  
[MAIN REGULATOR]\*

829150-2

4.24

## Function

Reduces pressure level of oxygen from service module oxygen storage system to value suitable for use in ECS; provides nearly constant outlet pressure with wide inlet pressure variations and wide range of flow demands

\*Names in brackets indicate oxygen control panel markings

## Ports

- Inlet (fitting end)
- Outlet (fitting end)
- Relief valve No. 1 test port [GSE TEST PORT]; boss\*
- Relief valve No. 2 test port [GSE TEST PORT]; boss\*

## Inlet Selector Valve Positions

1

Inlet flow to regulator 1 only

OFF

No inlet flow to either regulator

2

Inlet flow to regulator 2 only

NORMAL

Inlet flow to both regulators

## Configuration and Operation

- Two parallel (redundant) regulator sections with common inlet port (controlled by inlet selector valve) and common outlet port
- Inlet selector valve permits exclusion of failed regulator section(s)
- Each section includes gauge-pressure regulator, relief valve, and check valve
- Relief valve limits regulator outlet pressure if associated regulator fails open
- Check valve prevents back flow from operating (selected) regulator into opposite (excluded) regulator that has failed-open relief valve
- Relief valve test ports permit test operation of relief valves

O<sub>2</sub> Inlet Pressure

150 to 1000 psig

O<sub>2</sub> Temperature

-40 to +160F

Regulated Pressure  
(Each Regulator)

- Outlet port pressure with 150 to 1000 psig inlet
- 90 to 110 psig with demands from 400 std cc/minute ( $7.15 \times 10^{-2}$  lb/hr) to 0.67 lb/minute

\*Bosses are fitted with plugs on oxygen control panel; plugs removed and GSE equipment connected for ground test

# Relief Pressure (Each Relief Valve)

Outlet Port Pressure Range	<ul style="list-style-type: none"> <li>□ Outlet port pressure with failed-open regulator</li> <li>• 120 to 140 psig with inlet pressures of 150 to 1000 psig</li> </ul>
Pressure at Reseat	<ul style="list-style-type: none"> <li>□ Outlet port pressure with relief flow from relief valve test port to ambient</li> <li>• 120 psig min at 10 std cc/minute <math>O_2</math> (<math>1.79 \times 10^{-3}</math> lb/hr)</li> </ul>
Pressure at Full Flow	<ul style="list-style-type: none"> <li>□ Outlet port pressure with relief flow from relief valve test port to ambient</li> <li>• 140 psig max at 4.5 lb/minute <math>O_2</math></li> </ul>
External Leakage	$6 \times 10^{-6}$ lb/minute ( $3.6 \times 10^{-4}$ lb/hr) $O_2$ max at 1000 psig inlet and 110 psig outlet
Internal Leakages	
Check Valve Check Leakage	<ul style="list-style-type: none"> <li>□ Total leakage flow from outlet port to both relief valve test ports</li> <li>• 5 std cc/minute (<math>8.94 \times 10^{-4}</math> lb/hr) <math>O_2</math> max at 140 psig and 70F outlet</li> </ul>
Selector Valve Internal Leakage	10 std cc/minute ( $1.79 \times 10^{-3}$ lb/hr) $O_2$ max at 1000 psig and 70F inlet and inlet selector in OFF position

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# HIGH PRESSURE OXYGEN CHECK VALVE

828260-1

4.25

Inlet Pressure	1000 psig max $O_2$
Inlet Temperature	-40 to 150F
Flow Capacity	0.75 lb/minute $O_2$ at 150 psig and 70F inlet and 5 psi $\Delta P$ max
Internal Leakage	2 scc/hr $O_2$ max with check $\Delta P$ of 5 to 1000 psi
External Leakage	$6 \times 10^{-6}$ lb/hr $O_2$ max at 1000 psig and 70F

---

## MANUAL SHUTOFF VALVE

828740-2

4.26

## Type

- Manual high-pressure oxygen shutoff valve
- Hex socket in shaft mates with turning tool

## Valve Positions

ON

Open

OFF

Closed

## Valve Rotation

80 to 100 deg clockwise from OFF to ON

O<sub>2</sub> Inlet Pressure

0 to 1000 psig

O<sub>2</sub> Temperature

-40 to +150F

 $\Delta P$ 

- $\Delta P$  with emergency cabin or emergency suit flowrate
- 10 psi max with 0.66 lb/minute O<sub>2</sub> at 160 psig and 70F inlet

## External Leakage

- External leakage with valve in ON or OFF position
- $3 \times 10^{-5}$  lb/hr O<sub>2</sub> max at 1000 psig

## Internal Leakage

- $3 \times 10^{-6}$  lb/minute ( $1.8 \times 10^{-4}$  lb/hr) O<sub>2</sub> max at 0 to 1000 psi  $\Delta P$

## RELIEF VALVE

828650-2

4.27

## Valve Type and Function

- High-pressure oxygen pressure relief valve with integral inlet shutoff valve
- Limits surge-tank pressure to safe level by relieving oxygen to cabin

## Valve Ports

- Inlet (connection to surge tank); fitting end
- Relief outlet; direct opening to cabin

## Inlet Shutoff Valve Positions

AUTO

Inlet port connected to relief valve

OFF

Inlet-to-relief-valve flow blocked

## Inlet Shutoff Valve Rotation

90 deg clockwise from OFF to AUTO

O <sub>2</sub> Temperature Range	0 to 150F
Relief Pressure Range	<input type="checkbox"/> Relief valve limits inlet port pressure by relieving within following pressure range <ul style="list-style-type: none"><li>• 1020 psig (reseat) to 1070 psig (full flow)</li></ul>
Relief Flow Range	<input type="checkbox"/> Range of relief flows for preceding relief pressure range
Full Flow	3.4 lb/hr O <sub>2</sub> min with 1070 psig inlet
Reseat Leakage	5 std cc/minute ( $8.94 \times 10^{-4}$ lb/hr) O <sub>2</sub> max with 1020 psig inlet
Total Leakage	<input type="checkbox"/> Total inlet-port-to-cabin leakage
OFF Position	$3 \times 10^{-5}$ lb/hr O <sub>2</sub> max with 1000 psig and 70F inlet
AUTO Position	$3 \times 10^{-6}$ lb/minute ( $1.8 \times 10^{-4}$ lb/hr) O <sub>2</sub> max with 1000 psig and 70F inlet

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CABIN DEPRESSURIZATION SHUTOFF VALVE [OXYGEN SUPPLY]*	828960-1	4.28
Valve Type	Electrically actuated shutoff valve with provision for manual operation	
Valve Positions		
Closed	Manual control knob fully counterclockwise	
Open [OPEN]	Manual control knob fully clockwise	
Actuator Inputs	<ul style="list-style-type: none"><li>• Continuous 115 v ac, 1 <math>\phi</math>, 400 cps</li><li>• Ac applied to pin A closes valve</li><li>• Ac applied to pin B opens valve</li></ul>	

\*Names in brackets indicate oxygen control panel markings

Function	<ul style="list-style-type: none"> <li>• Allows remote shutoff of oxygen supply to emergency oxygen inflow control valve (4.22)</li> <li>• Switch controlling actuator is located outside command module pressurized area</li> <li>• Astronauts entering through command module main hatch use switch prior to extra-vehicular cabin dump</li> <li>• Valve operated manually in command module; hex socket in manual control knob mates with manual turning tool</li> </ul>
O <sub>2</sub> Inlet Pressure	0 to 140 psig
O <sub>2</sub> Temperature Range	0 to +150F
ΔP	<ul style="list-style-type: none"> <li>□ ΔP with emergency cabin or emergency suit O<sub>2</sub> flowrate</li> <li>• 0.25 psi max with 0.67 lb/minute O<sub>2</sub> at 85 psia and 70F inlet</li> </ul>
Actuation Time	10 to 25 sec for full rotational stroke in either direction with continuous power applied
External Leakage	5.0 std cc/hr ( $1.49 \times 10^{-5}$ lb/hr) O <sub>2</sub> max at 140 psig inlet in open or closed position
Power Consumption	8 va max at 115 v, 1 φ, 400 cps

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THREE-POSITION SELECTOR VALVE	828860-2	4.34
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Valve Type and Operation	<ul style="list-style-type: none"> <li>• Two-port, three-position, high-pressure-oxygen manual selector valve</li> <li>• PLSS (Portable Life Support System) connected to valve for filling prior to extra-vehicular activity or prior to SM (service module) jettison; PLSS functions as a back-up oxygen supply after SM jettison</li> </ul>
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## Valve Ports

IN

Port connected to oxygen control panel

Out

Port connected to PLSS prior to SM jettison

## Valve Positions

BYPASS (Counter-clockwise Position)

- IN port connected directly to out port (internal check valve bypassed)
- Oxygen from oxygen control panel flows from IN port to out port, filling PLSS
- Flow blocked

CLOSE (Center Position)

OPEN (Clockwise Position)

- Out port connected to IN port through internal check valve
- Check valve blocks flow from IN port to out port, preventing flow when surge tank pressure is higher than PLSS pressure
- Check valve permits flow from out port to IN port, permitting PLSS to supply oxygen when its pressure is higher than surge tank pressure

## Valve Rotation

O<sub>2</sub> Pressure

- 45 deg nom between positions
- 90 deg nom clockwise from BYPASS to OPEN

O<sub>2</sub> Temperature

0 to 1000 psig

 $\Delta P$ 

-40 to +150F

BYPASS Position

- $\Delta P$  with flow from IN port to out port
- 10 psi max with 0.66 lb/minute O<sub>2</sub> and IN port at 160 psig and 70F

OPEN Position	<ul style="list-style-type: none"><li>□ <math>\Delta P</math> with flow from out port to IN port at emergency cabin or emergency suit flowrate</li><li>• 20 psi max with 0.66 lb/minute <math>O_2</math> and out port at 160 psig and 70F</li></ul>	
External Leakage	<ul style="list-style-type: none"><li>□ External leakage in any valve position</li><li>• <math>3 \times 10^{-5}</math> lb/hr <math>O_2</math> max at 1000 psig</li></ul>	
Internal Leakage		
Selector Valve	<ul style="list-style-type: none"><li>□ Leakage flow from out port to IN port with selector valve in CLOSE position</li><li>• <math>3 \times 10^{-6}</math> lb/minute (<math>1.8 \times 10^{-4}</math> lb/hr) <math>O_2</math> max with 0 to 1000 psi out-port-to-IN-port <math>\Delta P</math></li></ul>	
Check Valve	<ul style="list-style-type: none"><li>□ Leakage flow from IN port to out port with selector valve in OPEN position</li><li>• 1 std cc/minute (<math>1.79 \times 10^{-4}</math> lb/hr) <math>O_2</math> max with 5 to 1000 psi IN-port-to-out-port <math>\Delta P</math></li></ul>	
<hr/>		
OXYGEN FILTER	848353-2	4.35
Operating Pressure	140 psig nom	
Filtration	10 microns nom, 25 microns max	
Flow Capacity	0.67 lb/minute $O_2$ at 85 psia and 70F inlet with 3.0 psi $\Delta P$ max	
External Leakage	$6 \times 10^{-6}$ lb/hr $O_2$ max at 140 psig and 70F	
<hr/>		

## GROUP 5. WATER SUPPLY

WATER CHECK VALVE	827360-2	5.2
Operating Pressure	<ul style="list-style-type: none"> <li>• 60 psig max inlet</li> <li>• 40 psig max checking <math>\Delta P</math></li> </ul>	
Flow Capacity	0.5 gpm (4.17 lb/minute) at 30 psig and 70F inlet and 2 psi $\Delta P$ max	
External Leakage	$4.8 \times 10^{-3}$ cc/hr H <sub>2</sub> O max at 40 psig and 70F inlet	
Internal Leakage	0.5 cc/hr H <sub>2</sub> O max with check $\Delta P$ of 2 to 40 psi	

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POTABLE WATER TANK	812370-1	5.10
Configuration and Operation	<ul style="list-style-type: none"> <li>• Cylindrical tank with pressurized bladder for water expulsion at 0 g</li> <li>• Water collection channels prevent trapping of water by bladder (tank empty); flow passages through bladder supporting frame prevent trapping of oxygen by bladder (tank full)</li> <li>• Potentiometer driven by cable attached to bladder provides water-quantity signal</li> </ul>	
Ports	<ul style="list-style-type: none"> <li>• OXYGEN (expulsion gas inlet-outlet)</li> <li>• WATER (water inlet-outlet)</li> <li>• GSE SERVICE (water-side servicing)</li> </ul>	
Storage Capacity	36 +3, -0 lb H <sub>2</sub> O at 150F	
Expulsion Gas Pressure	18 to 27 psig	
Water Side Pressure		
Capability	0 to 40 psig	
Normal Range	Equal to expulsion gas pressure (tank neither full nor empty)	
Supply (Inflow) Water		
Inflow Rate	2.2 lb/hr nom	
Temperature	40 to 150F	

Water Delivery Rate	5 lb/minute min at 18 psig expulsion pressure (5 lb/ minute = 300 lb/hr = 1.27 fl oz/sec at 60F)
Quantity Gauging System	
Output Signal	<input type="checkbox"/> Signal characteristics with 18 to 27 psig expulsion pres- sure <ul style="list-style-type: none"> <li>• D-c voltage proportional to quantity H<sub>2</sub>O</li> <li>• 0 v dc = empty tank</li> <li>• 5 v dc = 36 lb H<sub>2</sub>O min</li> <li>• 6.5 v dc = max output for mechanism overtravel</li> </ul>
Signal Accuracy	±0.5 v dc (±10 percent of full scale) max error
Signal Ripple Component	10 mv rms max
Load Resistance	30,000 ohms
Supply Voltage	28 ±2, -3 v dc
External Leakage	
Expulsion Side	$1 \times 10^{-6}$ lb/hr O <sub>2</sub> max at 25 psig
Water Side	$5.6 \times 10^{-2}$ cc/hr H <sub>2</sub> O max at 40 psig
Bladder Leakage	$3 \times 10^{-6}$ lb/hr N <sub>2</sub> (test fluid) max at 25 psi expulsion-to- water side $\Delta P$

WATER CHILLER	812400-3	5.14
Water-Glycol Inlet Conditions		
Flow	167 lb/hr	
Temperature	45F	
Pressure	60 psig max	
Water Inlet Conditions		
Temperature	150F max	
Pressure	40 psig max	

Water Outlet Temperature	55F max with above inlet conditions and 6 fl oz H <sub>2</sub> O withdrawn in 10 sec max at 24-minute intervals
Water-Glycol Pressure Loss	0.5 psi max at above water-glycol inlet conditions
Water Pressure Loss	1.0 psi max at 1.0 ±0.2 fl oz/sec flow and above inlet conditions
Water Capacity	0.5 lb min at 60F
Water Side Total Leakage	3.2 x 10 <sup>-3</sup> cc/hr H <sub>2</sub> O max at 40 psig and 70F
Water-Glycol Side Leakage	<ul style="list-style-type: none"> <li>• 2.6 x 10<sup>-4</sup> cc/hr water-glycol max external at 60 psig and 70F</li> <li>• No internal leakage with above inlet conditions</li> </ul>

## WASTE WATER TANK

812260-1

5.15

## Configuration

- Cylindrical tank with pressurized bladder for water expulsion at 0 g
- Water collection channels prevent trapping of water port by bladder (tank empty); flow passages through bladder supporting frame prevent trapping of oxygen by bladder (tank full)
- Potentiometer driven by cable attached to bladder provides water-quantity signal

## Ports

- OXYGEN (expulsion gas inlet-outlet)
- WATER (water inlet-outlet)

## Storage Capacity

56 +3, -0 lb H<sub>2</sub>O at 150F

## Expulsion Gas Pressure

18 to 27 psig

## Water Side Pressure

## Capability

0 to 40 psig

## Normal Range

Equal to expulsion gas pressure (tank neither full nor empty)

Water Temperature	40 to 150F
Water Delivery Rate	11 lb/hr min at 18 psig expulsion pressure
Quantity Gauging System	
Output Signal	<ul style="list-style-type: none"> <li>□ Signal characteristics with 18 to 27 psig expulsion pressure</li> <li>• D-c voltage proportional to quantity H<sub>2</sub>O</li> <li>• 0 v dc = empty tank</li> <li>• 5 v dc = 56 lb H<sub>2</sub>O min</li> <li>• 6.5 v dc = max output for mechanism overtravel</li> </ul>
Accuracy	±0.5 v dc (±10 percent of full scale) max error
Signal Ripple Component	10 mv rms max
Load Resistance	30,000 ohms
Supply Voltage	28 +2, -3 v dc
External Leakage	7.2 std cc/hr N <sub>2</sub> (test fluid) max at 40 psig water side and 27 psig gas side
Bladder Leakage	3 x 10 <sup>-6</sup> lb/hr N <sub>2</sub> (test fluid) max at 25 psi expulsion-to-water side ΔP

WATER SHUTOFF VALVE	827410-1 828660-2	5.18
Configuration	<ul style="list-style-type: none"> <li>• 1/4-turn manual shutoff valve</li> <li>• Poppet type with bellows shaft seal</li> <li>• 827410-1 has shaft handle</li> <li>• 828660-2 has hex socket in shaft which mates with turning tool</li> </ul>	
Valve Positions		
ON	Open	
OFF	Closed	
Valve Rotation	90 deg clockwise from ON to OFF	
H <sub>2</sub> O Inlet Pressure	0 to 40 psig	

H <sub>2</sub> O Inlet Temperature	35 to 150F
ΔP	0.5 psi max at 0.25 gpm (125 lb/hr) H <sub>2</sub> O with 70F inlet
External Leakage	$4.8 \times 10^{-3}$ cc/hr H <sub>2</sub> O max at 0 to 40 psig and 70F
Internal Leakage	2 cc/hr H <sub>2</sub> O max at 0 to 40 psi ΔP

WATER TANK PRESSURE RELIEF VALVE	828760-1	5.19
Inlet Pressure	40 psig max	
Inlet Temperature	40 to 200F	
Flow Capacity	12 lb/hr H <sub>2</sub> O min at 70F inlet and 6.5 psi ΔP	
Crack and Reseat	Crack, full flow, and reseat with 4.5 to 6.5 psi ΔP range	
External Leakage	$6.4 \times 10^{-3}$ cc/hr H <sub>2</sub> O max at 40 psig and 70F	
Internal Leakage	<ul style="list-style-type: none"> <li>• 5 cc/minute H<sub>2</sub>O max with 4.5 psi ΔP and valve ON</li> <li>• 1 cc/minute H<sub>2</sub>O max with 4.0 psi ΔP and valve ON</li> <li>• 0.5 cc/minute H<sub>2</sub>O max with 40 psi ΔP and valve OFF</li> </ul>	

POTABLE WATER SUPPLY ASSEMBLY	812950-2	5.22
Function	Supplies hot or cold water in deliveries of fixed volume into dehydrated food packages	
Operation	<ul style="list-style-type: none"> <li>• Cold water dispensing valve dispenses water from water chiller (5.14) into water delivery probe</li> <li>• Electrically heated, thermo- statically controlled, hot water reservoir heats water from potable water tank (5.10)</li> <li>• Hot water dispensing valve dispenses water from reservoir into water delivery probe</li> </ul>	

## Ports

- HOT WATER IN (fitting end); inlet to hot water reservoir
- COLD WATER IN (fitting end); inlet to cold water dispensing valve
- Outlet (water delivery probe); outlet for both dispensing valves; snap-on probe cover seals probe when not in use
- DRAIN (boss with plug installed); drain for hot water reservoir

## FOOD PREPARATION WATER

## Valves

COLD

Cold-water dispensing valve

HOT

Hot-water dispensing valve

Valve Type  
(Both Valves)

- Manually triggered, automatically reset, water dispensing valve
- Valve delivers fixed volume of water each time it is triggered

Valve Positions  
(Both Valves)

Triggered

- Finger trigger is pulled to actuate valve
- Valve inflows into metering chamber without outflowing
- When chamber is full, valve automatically returns finger trigger to off position

Off (Reset)

- Valve dispenses (outflows) metered volume of water (inflow blocked)
- When metered volume is dispensed, outflow terminates until valve is again triggered

Water Delivery  
(Either Valve)

Delivered Volume

$1 \pm 0.05$  fl oz H<sub>2</sub>O per  
actuation

Delivery Flow

1.2 fl oz/sec H<sub>2</sub>O max flow  
from water delivery probe  
during dispense portion of  
cycle



## Hot Water Reservoir

Water Temperature

154  $\pm$ 4F after recovery

Recovery Time

2 hr max to heat reservoir,  
water from 60 to 154FHot Water Delivery  
RequirementsDelivery  
Temperature

- Temperature of indicated  
volumes of water delivered  
during listed cycles

- 154  $\pm$ 4F

Delivery Cycles

- 10 fl oz H<sub>2</sub>O at T = 0
- 10 fl oz H<sub>2</sub>O at T = 30 minutes
- 14 fl oz H<sub>2</sub>O at T = 60 minutes
- 10 fl oz H<sub>2</sub>O at T = 120 minutes
- Above four cycles repeated at  
T = 150 minutes

Water Inflow

- HOT WATER IN or COLD WATER IN  
inflow

- 1  $\pm$ 0.05 fl oz per actuation  
(1 fl oz = 0.065 lb H<sub>2</sub>O at  
60F)

External Leakage

8 x 10<sup>-3</sup> cc/hr H<sub>2</sub>O max with  
both HOT WATER IN and COLD  
WATER IN ports at 40 psig  
and 70F

Power Consumption

45 w max at 28 +2, -3 v dc  
during reservoir heatingWATER PRESSURE RELIEF VALVE  
[PRESSURE RELIEF]\*

827830-3

5.23

Valve Type and Function

- Two parallel (redundant) water  
pressure relief valves con-  
trolled by inlet selector  
valve
- Limits potable and waste water  
system pressures by relieving  
excessive water overboard

Valve Ports

- Inlet
- Relief valve 1 outlet
- Relief valve 2 outlet

\*Names in brackets indicate water control panel markings

# Inlet Selector Valve Positions

1 [1]	Inlet water flow to relief valve 1 only
1 & 2 [BOTH]	Inlet water flow to both relief valves
2 [2]	Inlet water flow to relief valve 2 only
OFF [OFF]	No flow to either relief valve
H <sub>2</sub> O Temperature Range	40 to 200F
Pressures	<input type="checkbox"/> Inlet to outlet port (overboard discharge line) ΔP's with inlet selector valve in any position except OFF
ΔP at Full Flow	48 psi with 0.3 gal/minute H <sub>2</sub> O min (150 lb/hr H <sub>2</sub> O min at 70F)
ΔP at Reseat	40 psi min
External Leakage	8 x 10 <sup>-3</sup> cc/hr H <sub>2</sub> O max at 48 psig and 70F
Internal Leakage	
Relief Valve Reseat Leakage (Each Valve)	2 cc/hr H <sub>2</sub> O max at 40 psi ΔP
Selector Valve	4 cc/hr H <sub>2</sub> O max through any closed port at 48 psig inlet

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TANK PRESSURE REGULATOR	810340-2	5.24
Inlet Pressure	85 to 115 psia	
Inlet Temperature	0 to 160F	
Regulated Pressure	20 ±2 psig	
Flow Capacity	0.075 lb/minute O <sub>2</sub> min per regulator	
External Leakage	• 4 scc/hr O <sub>2</sub> max with 100 psig and 70F inlet and outlet chamber at 22 psig (inlet and outlet selectors in positions 1, 2, or OFF)	

	<ul style="list-style-type: none"><li>8 scc/hr O<sub>2</sub> max (inlet and outlet selectors in BOTH position)</li></ul>	
Internal Leakage (Regulators)	20 scc/minute O <sub>2</sub> max for both regulators with 115 psia inlet and 23 psig outlet	
Pressure Relief Valve	25 ±2 psig with failed-open regulator	
<hr/>		
GLYCOL EVAPORATOR WATER CONTROL VALVE	829130-X -2	5.29
Configuration	Normally closed solenoid valve in series with two-way selector valve	
Selector Valve Positions		
AUTO	Flow path open to solenoid valve	
OFF	Flow blocked (used if solenoid valve leaks)	
Inlet Pressure	0 to 40 psig	
Flow Capacity	8.5 to 10.0 lb/hr H <sub>2</sub> O at 0.5 psi ΔP and 70F	
External Leakage	4.8 x 10 <sup>-3</sup> cc/hr H <sub>2</sub> O max at 40 psig and 70F	
Internal Leakage		
Selector at OFF	1.0 cc/hr H <sub>2</sub> O max with inlet at 0 to 40 psig and 70F	
Selector at AUTO	1.0 cc/hr H <sub>2</sub> O max with inlet at 0 to 40 psig and 70F and with ΔP of 0 to 40 psi	
Power Requirement	6 va max at 28 vdc and 70F	
<hr/>		
WATER FILTER	812870-5	5.33
Configuration	Filter cartridge plus ΔP-operated bypass valve that opens for clogged cartridge	
Ports	<ul style="list-style-type: none"><li>• IN</li><li>• OUT</li></ul>	
Operating Pressure	18 to 32 psig	
Filtration	10 microns abs	

$\Delta P$	<ul style="list-style-type: none"><li><input type="checkbox"/> <math>\Delta P</math> with unclogged filter</li><li><input checked="" type="checkbox"/> 1 psi max with 30 lb/hr <math>H_2O</math> at 70F inlet</li></ul>
Bypass Valve	<ul style="list-style-type: none"><li><input type="checkbox"/> Bypass valve characteristics with clogged filter</li></ul>
$\Delta P$ at Full Flow	3 psi max at 10 lb/hr $H_2O$
$\Delta P$ at Reseat	2 psi min
External Leakage	0.0096 cc/hr $H_2O$ max at 40 psig and 70F
Bypass Valve Reseat Leakage	1 cc/minute (60 cc/hr) $H_2O$ max at 2 psi $\Delta P$

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## GROUP 6. VENTILATION

POST LANDING VENTILATION FAN		826070-4	6.1
Function	Fan ventilates cabin during 48-hr post-landing period		
Type	<ul style="list-style-type: none"><li>• Single-stage vane-axial fan driven by two-speed brushless d-c motor</li><li>• Motor incorporates solid-state electronic commutator which replaces conventional brush-type commutator; brushless d-c motor has higher efficiency, is less susceptible to salt-water immersion, and generates less radio interference than conventional motor</li></ul>		
Flow Rate			
Condition	0.0727 lb/cu ft gas density (air density at 14.7 psia and 85F)		
High-Vent Requirement	150 cfm airflow with 0.37 in. H <sub>2</sub> O pressure rise		
Low-Vent Requirement	100 cfm airflow with 0.16 in. H <sub>2</sub> O pressure rise		
Power Consumption			
High Vent	17 w max at 28 +2, -3 v dc		
Low Vent	8 w max at 28 +2, -3 v dc		
Total Power	520 w-hr max for 48-hr period with equal time at high and low flows		
<hr/>			
POST-LANDING VENTILATION GATE VALVE		816032-1	6.7
Valve Type	Electrically actuated, two-position, port-sealing gate valve		
Function	<ul style="list-style-type: none"><li>• Operated by electrical switches on command module main display console</li></ul>		

- Seals 5-1/4-in. ventilation port in cabin wall during flight; opens port after landing for fan ventilation of cabin; seals port if command module overturns in water
- Two valves are used: one for cabin inflow port, one for cabin outflow port

## Valve Positions

Closed

Port-sealing disc over port and seated on port

Open

Port-sealing disc moved away from port

## Actuator Inputs

- Continuous 28 v dc
- Dc applied to pin A opens valve
- Dc applied to pin B closes valve

## Operation

- Reversible, 28 v dc actuator drives cam and axial screw shaft; cam and axial screw shaft drives disc actuating arm; port-sealing disc is attached to end of disc actuating arm
- During opening sequence, 28-v d-c open voltage is applied to actuator; d-c power releases motor brake and rotates motor
- Actuator output shaft turns cam and axial screw shaft; disc actuating arm first moves axially on cam and axial screw shaft; disc actuating arm moves port-sealing disc away from port, unseating disc; disc actuating arm then rotates with cam and axial screw shaft; disc actuating arm slides disc away from port as it rotates; when port is uncovered, actuator limit switch removes power from motor, and motor brake is applied

- Closing sequence is reverse of opening; disc actuating arm rotates, sliding disc over port; arm then moves axially and seats disc on port; limit switch removes motor power when disc seats

Actuation Time

1.5 sec max from full closed to full open or reverse

Closed Position  
Leakage

Outward (Flight)

$1.5 \times 10^{-5}$  lb/hr  $O_2$  max at  
5 psi cabin-to-ambient  $\Delta P$   
and  $80 \pm 40^\circ F$

Inward (Post Landing)

12 cc/hr sea water max at  
4 psig

Power Requirement

Start and Shutoff

5 a max peak at 28 v dc

Running

2.2 a max at 28 v dc

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## GROUP 7. SUIT CIRCUIT INSTRUMENTATION

### SUIT SUPPLY INLET PRESSURE TRANSDUCER

837044-4

7.6

Type	Absolute pressure transducer
Function	Senses suit circuit absolute pressure and produces electrical signal for visual read-out and telemetering
Port	Pressure sensing port (fitting end)
Sensed Fluid Temperature	0 to 150F
Load Resistance	30,000 ohms
Output	□ Output signal with above load resistance
Output Signal	<ul style="list-style-type: none"> <li>• D-c voltage proportional to sensed pressure</li> <li>• 0 v dc at 0 psia</li> <li>• 5 v dc at 17 psia</li> <li>• 6.5 v dc max at pressures greater than 17 psia</li> </ul>
Accuracy	±0.125 v dc (±0.425 psia) max error
Signal Ripple Component	10 mv rms max
Output Impedance	500 ohms max
Power Consumption	25 ma max at 28 +2, -3 v dc
External Leakage	$6 \times 10^{-6}$ lb/hr $O_2$ max pressure-sensing-port-to-ambient leakage at 4 psig and 70F

### SUIT COMPRESSOR DIFFERENTIAL PRESSURE TRANSDUCER

837054-1

7.12

Operating $\Delta P$ Range	0 to 25 in. $H_2O$
Output Signal	<ul style="list-style-type: none"> <li>• 0 to 5 vdc proportional to operating <math>\Delta P</math></li> <li>• 6.5 vdc max on over-pressurization</li> </ul>
Output Load	30,000 ohms
Output Impedance	500 ohms max



Output Ripple	10 mv rms max
Power Requirement	40 ma max, 28 +2, -3 vdc
External Leakage	$6 \times 10^{-6}$ lb/hr $O_2$ max at 4 psig and 70F

# SUIT SUPPLY INLET TEMPERATURE SENSOR

836950-1

7.17

Function	<ul style="list-style-type: none"> <li>• Mounts on suit supply duct and senses temperature of gas supplied to suits</li> <li>• Provides temperature signal for visual read-out and telemetering</li> </ul>
Type and Operation	<ul style="list-style-type: none"> <li>• Wheatstone bridge with sensing element as one arm of bridge</li> <li>• Sensing element is coil of coated 40-gauge platinum wire enclosed within wall of 14K-gold tubular probe; probe is mounted so that it is concentric to suit supply duct</li> <li>• Square-wave excitation voltage is applied to bridge</li> <li>• Bridge is balanced at 20F and produces no output signal; sensing element resistance increases with temperature increases, unbalancing bridge; unbalanced bridge produces square-wave temperature signal</li> <li>• Temperature signal is applied to temperature sensor amplifier (13.1) for conditioning</li> <li>• Bridge is also unbalanced at temperatures below 20F, but phase of output signal is reversed and 13.1 rejects signal</li> </ul>
Bridge Excitation Voltage	2.70 $\pm$ 0.02 v rms, 300 cps, square-type wave
Output Load	270 $\pm$ 2.7 ohms

Output	□ Output signal with above excitation voltage and output load
Output Signal	<ul style="list-style-type: none"><li>• 300-cps square-type wave with magnitude directly proportional to sensed temperature</li><li>• 0 mv rms at 20F</li><li>• 29.5 mv rms at 95F</li></ul>
Accuracy	±0.59 mv rms (±1.5F) max error
Response Time	
Condition	Temperature step applied to sensed fluid
Requirement	6 sec max for output voltage change equal to 63 percent of total change for applied step
Output Impedance	500 ohms max
Current Consumption	140 ma effective max
Sensing Element Power Dissipation	5 mw max
External Leakage	$6 \times 10^{-6}$ lb/hr $O_2$ max duct-to-cabin leakage at 4 psig and 70F

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## GROUP 8. COOLANT CIRCUIT INSTRUMENTATION

### GLYCOL PUMP OUTLET PRESSURE TRANSDUCER

836130-1

8.1

Type	Gauge pressure transducer
Function	Senses pump discharge pressure and produces electrical signal for visual read-out and telemetering
Ports	<ul style="list-style-type: none"> <li>• Pressure sensing port (fitting end)</li> <li>• Ambient (cabin) reference port (boss fitted with vented plug)</li> </ul>
Sensed Fluid Temperature	35 to 160F
Load Resistance	30,000 ohms
Output	<input type="checkbox"/> Output signal with above load resistance
Output Signal	<ul style="list-style-type: none"> <li>• D-c voltage proportional to sensed pressure</li> <li>• 0 v dc at 0 psig</li> <li>• 5 v dc at 60 psig</li> <li>• 6.5 v dc max at pressures greater than 60 psig</li> </ul>
Accuracy	±0.125 v dc (1.5 psig) max error
Signal Ripple Component	10 mv rms max
Output Impedance	500 ohms max
Power Consumption	25 ma max at 28 +2, -3 v dc
External Leakage	$1.3 \times 10^{-4}$ cc/hr water-glycol max pressure-sensing-port-to-ambient leakage at 60 psig and 70F

### GLYCOL ACCUMULATOR QUANTITY TRANSDUCER

837026-4

8.16

Type	Gauge pressure transducer
Function	<ul style="list-style-type: none"> <li>• Senses glycol accumulator-to-cabin <math>\Delta P</math> (accumulator gauge pressure)</li> </ul>

	<ul style="list-style-type: none"> <li>• Indicates glycol quantity since quantity is nearly proportional to accumulator glycol pressure due to spring characteristics of accumulator bellows</li> <li>• Produces electrical signal for visual read-out and telemetering</li> </ul>
Ports	<ul style="list-style-type: none"> <li>• Pressure sensing port (fitting end)</li> <li>• Ambient (cabin) reference port (boss fitted with filtering plug)</li> </ul>
Accumulator Quantity Range	<ul style="list-style-type: none"> <li>□ Storage capacity requirements for glycol pump (2.48) accumulators, listed here for reference</li> </ul>
Primary	<ul style="list-style-type: none"> <li>• 0 cu in. at 0 psig</li> <li>• 60 cu in. (2.34 lb water-glycol at 70F) min at 24 psig</li> </ul>
Secondary	<ul style="list-style-type: none"> <li>• 0 cu in. at 0 psig</li> <li>• 35 cu in. (1.37 lb water-glycol at 70F) min at 24 psig</li> </ul>
Sensed Fluid Temperature	
Oxygen (Ambient Reference Port)	0 to 150F
Water-Glycol (Pressure Sensing Port)	35 to 160F
Load Resistance	30,000 ohms
Output	<ul style="list-style-type: none"> <li>□ Output signal with above load resistance</li> </ul>
Output Signal	<ul style="list-style-type: none"> <li>• D-c voltage proportional to sensed pressure</li> <li>• 0 v dc = 0 psig (accumulator empty)</li> <li>• 5 v dc = 25 psig (accumulator full)</li> <li>• 6.5 v dc max at pressures greater than 25 psig</li> </ul>
Accuracy	±0.125 v dc (±0.625 psig) max error

Signal Ripple Component	10 mv rms max
Output Impedance	500 ohms max
Ambient Reference Port Filtration	0.3 micron
Power Consumption	25 ma max at 28 +2, -3 v dc
External Leakage	$1.3 \times 10^{-4}$ cc/hr water-glycol max with 60 psig and 70F at pressure sensing port

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EVAPORATOR STEAM DUCT PRESSURE TRANSDUCER	837036-1	8.17
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Output Signal	<ul style="list-style-type: none"> <li>• 0 to 5 vdc proportional to pressure</li> <li>• 0 vdc = 0.05 psia</li> <li>• 5 vdc = 0.25 psia</li> <li>• <math>\pm 0.2</math> vdc max error</li> <li>• 6.5 vdc max on over-pressurization</li> </ul>
Output Load	30,000 ohms
Output Impedance	500 ohms max
Output Ripple	10 mv rms max
Steam Temperature Range	20 to 95F
Power Requirement	40 ma max, 28 +2, -3 vdc
External Leakage	$6 \times 10^{-6}$ lb/hr $O_2$ max from cabin to steam sense port at 6 psi $\Delta P$

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STEAM DUCT TEMPERATURE SENSOR	836950-2	8.22
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Function	<ul style="list-style-type: none"> <li>• Mounts on steam duct and senses temperature of steam and free water exhausted to space</li> <li>• Used to sense presence of ice in steam duct</li> <li>• Provides temperature signal for telemetering</li> </ul>
Type and Operation	<ul style="list-style-type: none"> <li>• Wheatstone bridge with sensing element as one arm of bridge</li> </ul>

	<ul style="list-style-type: none"> <li>• Sensing element is coil of coated 40-gauge platinum wire enclosed within wall of 14K-gold tubular probe; probe is mounted so that it is concentric to steam duct</li> <li>• Square-wave excitation voltage applied to bridge</li> <li>• Bridge is balanced at 20F and produces no output signal; sensing element resistance increases with temperature increases, unbalancing bridge; unbalanced bridge produces square-wave temperature signal</li> <li>• Temperature signal is applied to temperature sensor amplifier (13.1) for conditioning</li> <li>• Bridge is also unbalanced at temperatures below 20F, but phase of output signal is reversed and 13.1 rejects signal</li> </ul>
Bridge Excitation Voltage	2.70 $\pm$ 0.02 v rms, 300 cps, square-type wave
Load Resistance	270 $\pm$ 2.7 ohms
Output (Test Conditions)	<ul style="list-style-type: none"> <li>□ Output signal with above excitation voltage and load resistance</li> <li>□ Sensing element submerged in liquid temperature bath</li> </ul>
Output Signal	<ul style="list-style-type: none"> <li>• 300-cps square-type wave with magnitude directly proportional to bath temperature</li> <li>• 0 mv rms at 20F</li> <li>• 29.5 mv rms at 95F</li> </ul>
Accuracy	<ul style="list-style-type: none"> <li>• <math>\pm</math>2.0 percent of full scale output (<math>\pm</math>0.59 mv) at 20 to 35F</li> <li>• <math>\pm</math>3.5 percent of full scale output (<math>\pm</math>1.03 mv) at 35 to 95F</li> </ul>
Output (Operating Conditions)	<ul style="list-style-type: none"> <li>□ Output with 20 percent minimum free water in exhaust steam and 0.085 psia (4.4 mm Hg abs) max steam duct pressure</li> <li>• 5.9 mv rms max (35F max indicated temperature)</li> </ul>

Response Time	<ul style="list-style-type: none"> <li>□ Response time with temperature step applied to sensed fluid with sensing element submerged in quiescent water</li> <li>• 6 sec max for output voltage change equal to 63 percent of total change for applied step</li> </ul>
Output Impedance	500 ohms max
Current Consumption	140 ma effective max
Sensing Element Power Dissipation	5 mw max
External Leakage	$6 \times 10^{-6}$ lb/hr $O_2$ max cabin-to-duct leakage at 6 psig and 70F

# RADIATOR OUTLET TEMPERATURE SENSOR

836058-1

8.23

Operating Temperature Range	-50 to 100F
Output Signal	0 at -50F to 29.5 mv rms at 100F with load impedance of 270 ohms; 300 cps sq-type wave with rms magnitude proportional to temperature
Output Impedance	1300 ohms max
Bridge Excitation Voltage	2.70 $\pm$ 0.02 v rms, 300 cps sq-type wave
Operating Current	140 ma max (effective)
External Leakage	$2.6 \times 10^{-4}$ cc/hr water-glycol max at 60 psig and 70F
Pressure Loss	0.50 in. $H_2O$ $\Delta P$ max with 200 lb/hr water-glycol at 60 psig and 45F

# STEAM PRESSURE SWITCH

836114-1

8.24

Type and Configuration	<ul style="list-style-type: none"> <li>• Absolute-pressure actuated switch</li> <li>• Diaphragm-actuated variable-reluctance pickup produces signal conditioned by solid-state signal conditioner; signal conditioner drives output transistor switch</li> </ul>
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	<ul style="list-style-type: none"> <li>• Glycol evaporator (2.6 or 2.7) steam pan pressure applied to sense side of diaphragm; hard vacuum (sealed internal plenum) applied to reference side of diaphragm</li> </ul>
Port	Pressure sensing port (fitting end)
Operation	<ul style="list-style-type: none"> <li>• Switch (output transistor switch) connected to glycol evaporator temperature control (2.40)</li> <li>• When steam pressure is normal, switch is open and 2.40 controls backpressure control valve (2.39) in normal manner</li> <li>• When steam pressure decreases to near freezing condition, switch closes and 2.40 initiates closure of 2.39</li> <li>• When diaphragm is unstroked (steam pressure zero or diaphragm ruptured), switch is open and 2.40 controls 2.39 in normal manner; this is a fail-safe feature which prevents closure of 2.39 if diaphragm is ruptured</li> </ul>
Switching Points	
Steam Pressures for Open Switch	<ul style="list-style-type: none"> <li>• &gt; 5 mm Hg abs (steam saturation temperature at 5 mm Hg abs = 34.1F)</li> <li>• &lt; 3.5 mm Hg abs (steam saturation temperature at 3.5 mm Hg abs = 26.2F)</li> </ul>
Steam Pressures for Closed Switch	3.5 to 5.0 mm Hg abs
Switching Point Accuracy	<ul style="list-style-type: none"> <li>• <math>\pm 0.2</math> mm Hg with case ambient (cabin) temperatures of 0 to 150F</li> <li>• <math>\pm 0.3</math> mm Hg with case ambient temperatures of 150 to 200F</li> </ul>
Switch Rating	<ul style="list-style-type: none"> <li>• 10 ua max leakage current with 5 v dc across open switch</li> <li>• 0.2-v d-c voltage drop max with 5 ma through closed switch</li> </ul>



Sensed Fluid Temperature  
Range

0 to 200F

Power Requirement

50 ma max at 28 +2, -3 v dc

External Leakage

$6 \times 10^{-6}$  lb/hr  $O_2$  max cabin-  
to-sensing-port leakage with  
6-psig cabin and 0-psig  
sensing port pressure

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# GROUPS 9 AND 10. OXYGEN SUPPLY AND CABIN INSTRUMENTATION

## OXYGEN FLOW TRANSDUCER

836112-2

9.2

### Flow Measuring Circuit

#### Output Signal

- 0 to 5 vdc proportional to  $O_2$  Flow
- 0 vdc = 0.2 lb/hr
- 5 vdc = 1.0 lb/hr
- $\pm 0.5$  vdc ( $\pm 0.08$  lb/hr) max error at 0 to 150F  $O_2$  and ambient temperatures
- 6.5 vdc max on overflow

#### Output Load

30,000 ohms

#### Output Impedance

500 ohms max

#### Output Ripple

10 mv rms max

### Overflow Warning Circuit

#### Configuration

Switch connects return side of external indicator light to -28 vdc

#### Rating

120 ma steady state, 800 ma peak surge at 28 vdc

#### Increasing $O_2$ Flows

- <1.00 lb/hr: switch open
- 1.00 to 1.25 lb/hr: switch closes
- >1.25 lb/hr: switch closed

#### Decreasing $O_2$ Flows

- >1.25 lb/hr: switch closed
- 1.25 to 0.96 lb/hr: switch opens
- <0.96 lb/hr: switch open

#### $O_2$ Pressure Range

85 to 140 psig

#### $O_2$ Temperature Range

-40 to 165F

#### Maximum Flow

0.7 lb/minute  $O_2$  without damage

#### Pressure Loss

- 1 psi max at 1.0 lb/hr  $O_2$  and 100 psig inlet
- 8.0 psi max at 0.7 lb/minute  $O_2$  and 100 psig inlet

#### Power Requirement

120 ma max, 28 +2, -3 vdc

#### External Leakage

$6 \times 10^{-6}$  lb/hr  $O_2$  max at 140 psig and 70F

OXYGEN PRESSURE TRANSDUCER	837016-2	9.8
Type	Gauge pressure transducer	
Function	Senses regulated-oxygen-supply pressure and produces electrical signal for telemetering	
Ports	<ul style="list-style-type: none"> <li>• Pressure sensing port (fitting end)</li> <li>• Ambient (cabin) reference port (boss fitted with filtering plug)</li> </ul>	
Sensed Fluid Temperature	0 to 150F	
Load Resistance	30,000 ohms	
Output	□ Output signal with above load resistance	
Output Signal	<ul style="list-style-type: none"> <li>• D-c voltage proportional to sensed pressure</li> <li>• 0 v dc at 0 psig</li> <li>• 5 v dc at 150 psig</li> <li>• 6.5 v dc max at pressures greater than 150 psig</li> </ul>	
Accuracy	±0.125 v dc (±3.75 psig) max error	
Signal Ripple Component	10 mv rms max	
Output Impedance	500 ohms max	
Ambient Reference Port Filtration	0.3 micron	
Power Consumption	25 ma max at 28 +2, -3 v dc	
External Leakage	6 x 10 <sup>-6</sup> lb/hr O <sub>2</sub> max pressure-sensing-port-to-ambient leakage at 150 psig and 70F	

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CABIN TEMPERATURE TRANSDUCER	836930-1	9.11
Type and Function	<ul style="list-style-type: none"> <li>• Solid-state temperature transducer</li> <li>• Provides temperature signal for visual read-out and telemetering</li> </ul>	
Configuration and Operation	<ul style="list-style-type: none"> <li>• Unit includes power supply, temperature sensing element, and signal conditioner</li> </ul>	

	<ul style="list-style-type: none"> <li>• Two series bead thermistors form sensing element; sensing element mounted at tip of probe which is inserted into inlet duct of cabin heat exchanger (3.2)</li> <li>• Power supply provides necessary operating voltages and isolates unit from 28-v d-c spacecraft power</li> <li>• Signal conditioner converts sensing element current changes (due to resistance changes) into output voltages</li> </ul>
Operating Pressure Range	0 to 24 psia
Load Resistance	30,000 $\pm$ 6,000 ohms
Output	<ul style="list-style-type: none"> <li>□ Output signal with above load resistance</li> </ul>
Output Signal	<ul style="list-style-type: none"> <li>• D-c voltage proportional to sensed temperature</li> <li>• 0 v dc at 40F</li> <li>• 5 v dc at 125F</li> </ul>
Accuracy	<ul style="list-style-type: none"> <li>• <math>\pm</math>2.5 percent of full scale output (<math>\pm</math>0.125 v dc) at 60 to 80F</li> <li>• <math>\pm</math>5 percent of full scale output (<math>\pm</math>0.25 v dc) at 40 to 60F and at 80 to 125F</li> </ul>
Response Time	
Conditions	<ul style="list-style-type: none"> <li>• Sensing probe mounted in 3-in.-diameter duct</li> <li>• Probe exposed to 20-cfm air-flow at 14.7 psia</li> <li>• Temperature step applied to sensed air</li> </ul>
Requirement	10 sec max for output voltage change equal to 63 percent of total change for applied step
Output Impedance	500 ohms max
Power Consumption	80 ma max at 28 $\pm$ 2, -3 v dc

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CABIN PRESSURE TRANSDUCER	836132-1	10.5
Type	Absolute-pressure transducer	
Function	Senses cabin absolute pressure and produces electrical signal for visual read-out and telemetering	
Port	Pressure sensing port (boss open to cabin)	
Sensed Fluid Temperature	0 to 150F	
Load Resistance	30,000 ohms	
Output	<input type="checkbox"/> Output signal with above load resistance	
Output Signal	<ul style="list-style-type: none"> <li>• D-c voltage proportional to sensed pressure</li> <li>• 0 v dc at 0 psia</li> <li>• 5 v dc at 17 psia</li> <li>• 6.5 v dc max at pressures greater than 17 psia</li> </ul>	
Accuracy	±0.125 v dc (±0.425 psia) max error	
Signal Ripple Component	10 mv rms max	
Output Impedance	500 ohms max	
Power Consumption	25 ma max at 28 +2, -3 v dc	
External Leakage	<input type="checkbox"/> Leakage from sensing port to ambient with test pressure applied to sensing port <ul style="list-style-type: none"> <li>• <math>6 \times 10^{-6}</math> lb/hr O<sub>2</sub> max at 4 psig and 70F</li> </ul>	

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## GROUP 12. INSTRUMENTATION POWER SUPPLIES

### TEMPERATURE TRANSDUCER POWER SUPPLY

836066-3

12.1

#### Type and Function

- Two separate and identical solid-state electronic power supplies (normal and standby); standby supply is used when normal supply fails
- Provides a-c excitation voltage for bridge-type temperature sensors and d-c voltages for temperature sensor amplifiers

#### Power Supply Outputs (Each Power Supply)

##### Bridge Excitation

- 300  $\pm$ 30, -100 cps square-type wave
- 2.7  $\pm$ 0.02 v rms amplitude
- 700 ma normal load current

##### Temperature Sensor Amplifier Supply Voltage

- 18  $\pm$ 1 v dc
- 165 ma normal load current

##### Temperature Sensor Amplifier Bias

- -0.5  $\pm$ 0.2 v dc
- 30 ma normal load current

#### Power Consumption (Each Power Supply)

10.7 w max at 28  $\pm$ 2, -3 v dc

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# GROUP 13. INSTRUMENTATION AMPLIFIERS

## TEMPERATURE SENSOR AMPLIFIER

836056-2

13.1

Input Signal	0 to 29.5 mv rms, 300 cps sq-type wave
Input Impedance	270 $\pm$ 2.7 ohms
Output Load	30,000 ohms
Output Signal	Output voltage (0 to 5 vdc) proportional to input signal voltage of 0 to 29.5 mv rms, 300 sq-type wave
Output Ripple	10 mv rms max
Output Impedance	400 ohms max
Excitation Voltage Output	2.70 $\pm$ 0.02 v rms, 300 cps sq-type wave
Power Requirements	<ul style="list-style-type: none"><li>• 140 ma max, 2.70 <math>\pm</math>0.02 v rms, 300 cps sq-type wave when used in inflight tem- perature transducer subsystem</li><li>• 1 ma max, 2.70 <math>\pm</math>0.02 v rms, 300 cps sq-type wave when not used in subsystem</li><li>• 33 ma max, 18 <math>\pm</math>1.0 vdc</li><li>• 6 ma max, -0.5 <math>\pm</math>0.2 vdc</li></ul>

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## GROUP 15. ELECTRICAL FILTERS

### CAPACITOR ASSEMBLY

836995-1  
836995-2

15.1

#### Configuration and Operation

- Signal wires from all glycol temperature control system temperature sensors are routed through 15.1
- Series-connected r-f filter capacitors reduce noise level on signal lines connected between glycol temperature sensor (2.23) and glycol evaporator temperature control (2.40)
- Assembly includes electrical connectors to facilitate hook-up to ECU cabling
- Temperature sensors used for glycol temperature control contain normal and standby sensing elements; 15.1 hook-up is changed to switch elements in use
- 836995-1 and 836995-2 are identical except for connector reference designators

#### Capacitor Assembly 836995-1

- ☐ Used on primary glycol temperature control system
- ☐ Connectors designated J52A, P52A, and P53A

#### Hook-up for Normal Sensors

- J52A on 15.1 connected to P52 on ECU
- P52A connected to J52
- P53A capped

#### Hook-up for Standby Sensors

- J52A connected to P52
- P52A capped
- P53A connected to J53

#### Capacitor Assembly 836995-2

- ☐ Used on secondary glycol temperature control system
- ☐ Connectors designated J57A, P57A, and P58A

#### Hook-up for Normal Sensors

- J57A connected to P57
- P57A connected to J57
- P58A capped

#### Hook-up for Standby Sensors

- J57A connected to P57
- P57A capped
- P58A connected to J58



Capacitance

Each Capacitor

4.7 uf  $\pm 10$  percent

Total Series  
Capacitance

- Capacitance between pins A and P of P53A on 836995-1 or pins A and P of P58A on 836995-2
  - 2.35 uf  $\pm 10$  percent
-

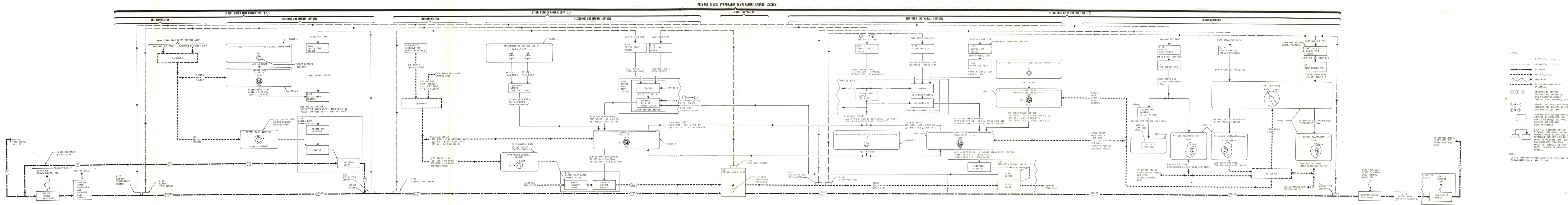


FIG 1 PRIMARY GLYCOL TEMPERATURE CONTROL BLOCK DIAGRAM

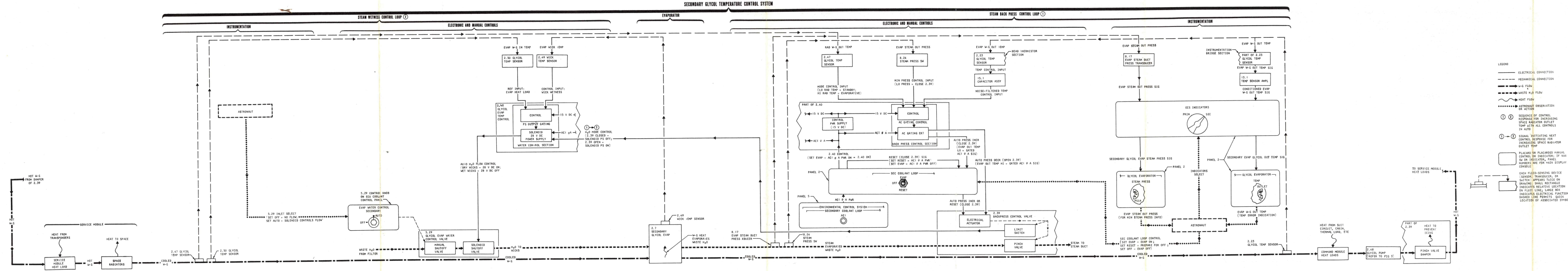


FIG 2 SECONDARY GLYCOL TEMPERATURE CONTROL BLOCK DIAGRAM



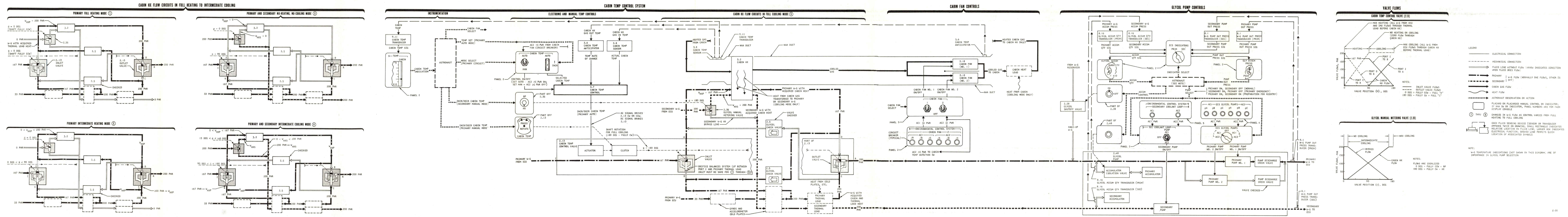
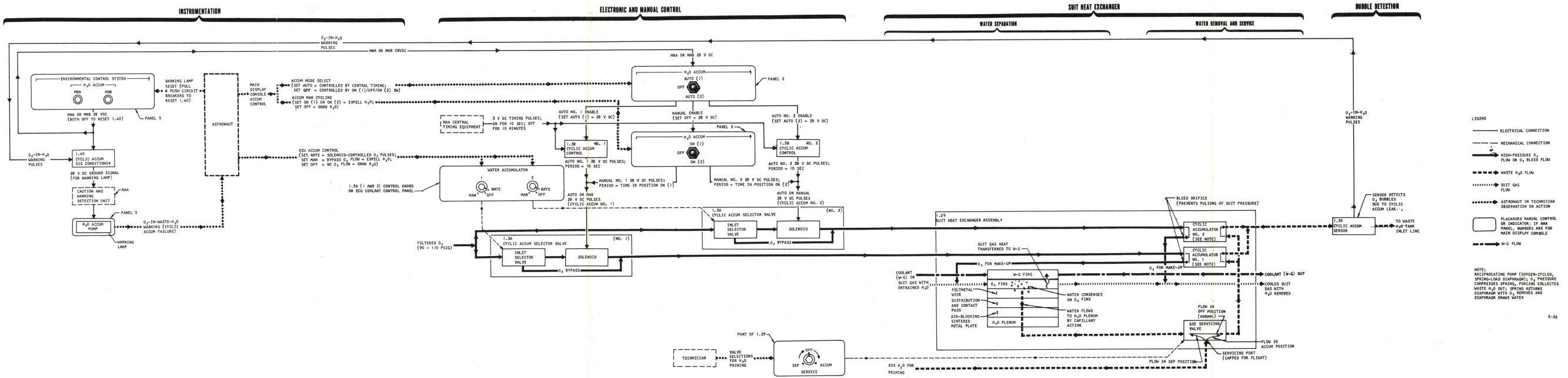


FIG 3 CABIN TEMPERATURE AND GLYCOL PUMP CONTROL BLOCK DIAGRAM

FIG 4 CYCLIC ACCUMULATOR  
CONTROL BLOCK DIAGRAM





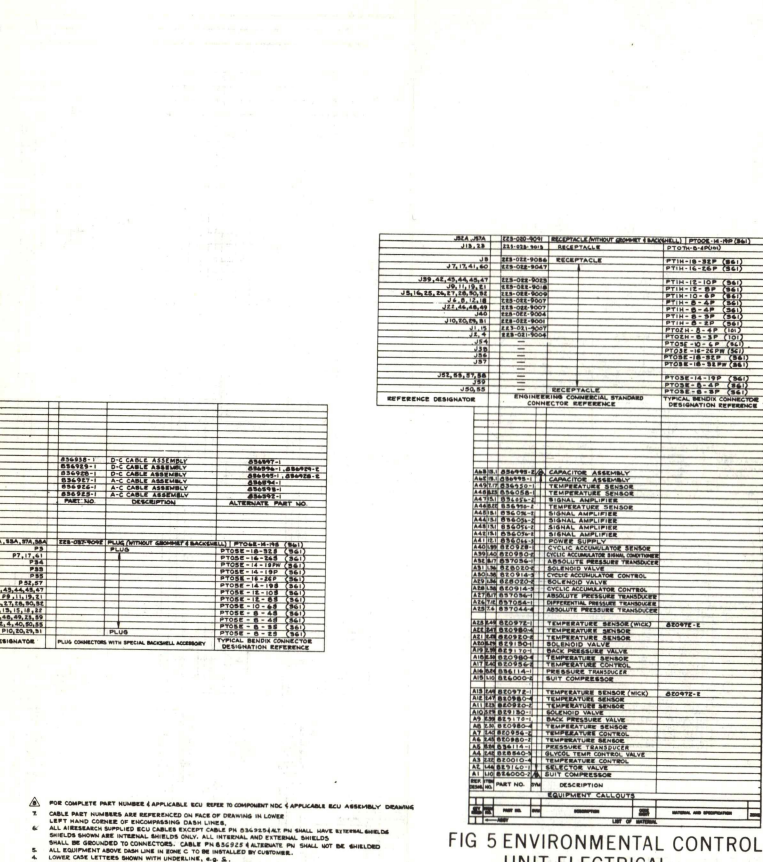


FIG 5 ENVIRONMENTAL CONTROL  
UNIT ELECTRICAL  
SCHEMATIC





SERVICE  
MODULE



NOTES

NOTES