

SHEET NOTES:

- WATER USED TO DILUTE DOWFROST GLYCOL IN THE PIPING TO HEAT REJECTION SYSTEM MUST BE EITHER DISTILLED OR DI (DEIONIZED) WATER. IMPURITIES IN DILUTION WATER CAN INCREASE METAL CORROSION, REDUCE EFFECTIVENESS OF CORROSION INHIBITORS, INCREASE INHIBITOR DEPLETION RATE, CAUSE FORMATION OF SCALE AND OTHER DEPOSITS ON HEAT TRANSFER SURFACES, AND CAUSE CLOGGING OF SYSTEM COMPONENTS.
- GAS COCK - APOLLO GAS BALL VALVE 80-100-27 UP TO 3", HOMESTEAD #612-LSD LUBRICATED PLUG VALVE OVER 3", OR APPROVED EQUAL. VALVE MUST BE LOCKABLE.
- A MAKE UP WATER QUALITY ANALYSIS IS REQUIRED. USE UTC POWER DOCUMENT "STANDARD WORK FOR MAKE-UP WATER ANALYSIS" TO DETERMINE IF ADDITIONAL WATER TREATMENT BOTTLES, OR A REVERSE OSMOSIS SYSTEM (RO), IS REQUIRED. PIPING FROM AN RO UNIT TO THE FUEL CELL IS REQUIRED TO BE PVC OR SS. IF CUSTOMER HAS A DEIONIZED (DI) WATER SOURCE, THAT CAN BE USED.
- LIQUID VOLUMES: POWER MODULE LG HEX - 7 GALLONS (CUSTOMER SIDE)
POWER MODULE HG HEX - 4 GALLONS (CUSTOMER SIDE)
- COOLING LOOP PIPE SIZING (BASED ON TOTAL LINEAR FEET OF SUPPLY AND RETURN PIPING FROM CELL FLANGE TO COOLING MODULE CONNECTION):
2" UP TO 120 LINEAR FEET
2 1/2" FOR 120 TO 320 LINEAR FEET
3" FOR 320 TO 420 LINEAR FEET
- COOLING MODULE RELIEF VALVE IS INTERNAL TO FUEL CELL.
- HIGH GRADE LOOP PRESSURE RELIEF VALVE, EQUAL TO WATTS MODEL 174A. SET HG RELIEF PRESSURE APPROPRIATE TO APPLICATION, BUT NOT TO EXCEED 150 PSIG. PIPE FULL OUTLET SIZE TO SAFE LOCATION. SIZED FOR 1.1 MMBTH.
- LOW GRADE LOOP PRESSURE RELIEF VALVE, EQUAL TO WATTS MODEL 174A. SET LG RELIEF PRESSURE APPROPRIATE TO APPLICATION, BUT NOT TO EXCEED 136 PSIG. PIPE FULL OUTLET SIZE TO SAFE LOCATION. SIZED FOR 2.2 MMBTH.
- THE FUEL CELL DRAIN (DEIONIZED WATER) AND AC UNIT DRAIN ARE REQUIRED TO BE PIPED TO A DRYWELL OR SANITARY DRAIN (STORM DRAIN ONLY WITH LOCAL APPROVAL). THE DRAIN LINE SHOULD BE SIZED FOR 2 GPM GRAVITY FLOW.
- NITROGEN PURGE MANIFOLD AND FRAME ASSEMBLY: AS MANUFACTURED BY AIRGAS ENGINEERING SOLUTIONS GROUP, PART #V89 ES1464 (FREE STANDING), OR PART #V89 ES1465 (WALL MOUNTED).
- FLEXIBLE CONNECTORS WILL BE INSTALLED AT THE FUEL CELL TO ALLOW FOR PIPE MOVEMENT DUE TO PIPE EXPANSION AND SEISMIC MOVEMENTS.
- GAS FLOW RATE IS BASED ON HIGH HEATING VALUE OF 1,030 BTU/SCF. REQUIRED GAS PRESSURE AT THE FUEL CELL INLET IS 10 TO 14 INCHES WC AT MAXIMUM GAS FLOW RATE OF 4,500 SCFH. CONSULT UTC POWER IF OPERATION BELOW 10 IN. WC IS REQUIRED.
- NATURAL GAS AND NITROGEN PIPING SHALL BE CLEARED OF FOREIGN MATERIAL USING COMPRESSED AIR, NITROGEN, OR OTHER NONFLAMMABLE GAS PRIOR TO CONNECTING TO FUEL CELL. (PER NFPA 54)
- PROVIDE A 20 MESH SCREEN Y-TYPE STRAINER WITH BLOW DOWN VALVE, IN THE LG AND HG PIPING LOOPS. PERFORM INITIAL PIPE FLUSHING WITH A FINE STARTUP STRAINER.
- PROVIDE AIR SEPARATOR AND EXPANSION TANK AT PUMP SUCTION.
- FOR PURE WATER SYSTEMS, PROVIDE A MAKE UP WATER CONNECTION WITH CODE COMPLIANT BACKFLOW PREVENTION. FOR GLYCOL SYSTEMS, PROVIDE A PACKAGED GLYCOL MAKE UP WATER SYSTEM.
- IF THE HEAT RECOVERY PUMPS ARE CONTROLLED BY VARIABLE FREQUENCY DRIVES, THE VFD'S SHALL BE PROGRAMMABLE FOR AUTOMATIC RESET AFTER A MOMENTARY OR SHORT TERM POWER LOSS.

GAS PIPING PRESSURE DROP CALCULATION

The following calculation is based on ASHRAE 1993 Fundamentals Handbook, Chapter 33 Gas Pipe Sizing formula (16) and the equipment manufacturer's printed data (total gas consumption = 13,500 SCFH (4,500 SCFM ea. unit))

$$Q = 2313 \cdot d^{2.623} \cdot (DP/C)^{0.541}$$

Where:

- Q = flow rate at 60 degrees F and 30 in. Hg., (cf/hr)
- d = inside diameter of pipe, (in.)
- DP = pressure drop, (in. H₂O)
- C = factor of viscosity, density, and temperature = 0.00354 (t + 460) s^{0.848} u^{0.152}
- t = temperature, (degree F)
- s = ratio of density of gas to density of air at 60 degree F and 30 in Hg
- u = viscosity of gas, centipoise (0.012 for natural gas, 0.008 for propane)
- L = pipe length, (ft)

(METER TO FC-3)

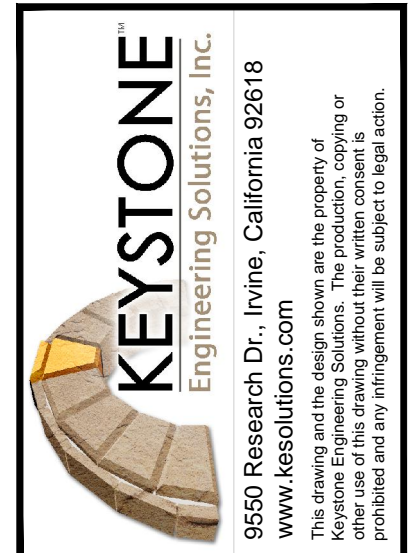
Piping Pressure Drop Calculation: Gas Type: **natural gas**

Section	Q (cf/hr)	const 2313	d (in)	d ^{2.623}	C	L (ft)	DP (in H ₂ O)	density gas	density air	s	u
To New Fuel Cell Plant											
a - b	13,500	2313	2.5	11.061	0.598	3	0.5504	0.044	0.075	0.5867	0.012
b - c	13,500	2313	2.5	11.061	0.598	4	0.7339	0.044	0.075	0.5867	0.012
c - d	13,500	2313	2.5	11.061	0.598	1	0.1835	0.044	0.075	0.5867	0.012
d - e	13,500	2313	2.5	11.061	0.598	16	2.9355	0.044	0.075	0.5867	0.012
e - j	9,000	2313	2.5	11.061	0.598	4	0.3469	0.044	0.075	0.5867	0.012
j - k	4,500	2313	2.0	6.160	0.598	17	1.2079	0.044	0.075	0.5867	0.012
k - l	4,500	2313	2.0	6.160	0.598	31	2.2027	0.044	0.075	0.5867	0.012
l - m	4,500	2313	2.0	6.160	0.598	2	0.1421	0.044	0.075	0.5867	0.012
m - n	4,500	2313	2.0	6.160	0.598	4	0.2842	0.044	0.075	0.5867	0.012
n - o	4,500	2313	2.0	6.160	0.598	2	0.1421	0.044	0.075	0.5867	0.012
o - p	4,500	2313	2.0	6.160	0.598	0.5	0.0355	0.044	0.075	0.5867	0.012
Fittings (assume fitting loss equals 110% of line losses)							9.6412				
							18.4060				

Starting Pressure: 1.10 PSI ** OR 30.45 in WC
 Pressure Drop: 0.67 PSI 18.41 in WC
 Final Pressure: 0.43 PSI ** 12.04 in WC

* Refer to KAP sketch dated 7/30/12 for gas piping diagram
 **Regulator delivery at 5 PSIG per R. Stanton; Step down to 10-14 in WC at Fuel Cell per UTC 1 IN WC = 0.036126 PSI

(TYPICAL) FUEL CELL PIPING AND INSTRUMENTATION DIAGRAM
 NOT TO SCALE



CBS TELEVISION CITY FUEL CELL INSTALLATION PROJECT

7800 BEVERLY BLVD.
 LOS ANGELES, CALIFORNIA 90036

FUEL CELL PIPING AND INSTRUMENTATION DIAGRAM

ID	DATE	REVISIONS	REMARKS
1	7/02/12	PRELIMINARY DESIGN REVIEW	
2	8/20/12	PLAN CHECK	
3	9/14/12	BD CHECK	
4	9/19/12	UTC RECOMMENDED CORRECTIONS	
5	9/25/12	UTC COMMENTS/REVISIONS	

ENGR: WTB
 DRWN BY: KAP
 CHECK'D BY: WTB
 DATE: 9/19/12
 JOB NO.: 12-010
 SCALE: AS NOTED

