CRWMS/M&O

Non-Q Design Analysis Cover Sheet

Complete only applicable items.

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QA: N/A

Page: 1 Of: 5

2. DESIGN ANALYSIS TITLE			
NORTH PORTAL - WATER HEATER CALCULATION - SHOP BUILDING #5006 (SCP8: N/A)			
3. DOCUMENT IDENTIFIER (Including Rev. No.)		4. REV. NO.	5. TOTAL PAGES
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6. TOTAL ATTACHMENTS	7. ATTACHMENT NUMBERS - NO. OF PAGES IN EACH		8. SYSTEM ELEMENT
1	I-4		MGDS
	Print Name	Signature	Date
9. Originator	R. Blackstone	R. E. Flye FOR R. BLACKSTONE	1-24-96
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13. Remarks			

Design Analysis Revision Record

Complete only applicable items.

1.

Page: 2

Of: 5

2. DESIGN ANALYSIS TITLE

NORTH PORTAL - WATER HEATER CALCULATION - SHOP BUILDING #5006

3. DOCUMENT IDENTIFIER (Including Rev. No.)

BABBAD000-01717-0200-00140 REV 01

4. Revision No.	5. Description of Revision
00	Initial Issue
01	Reformatted to conform to NAP-MG-013, Rev. 0
	Revised Title
	Removed TBV-122
	Changed QA Classification from TBV-122 to QA: N/A
	Editorial Changes

1. PURPOSE

The purpose of this design analysis and calculation is to determine the demand for hot and the selection of a water heater of appropriate size, in accordance with the Uniform Plumbing Code (Section 4.4.1) and U.S. Department of Energy Order 6430.1A-1540 (Section 4.4.2).

2. QUALITY ASSURANCE

This analysis is non-Q because it is for a temporary item. The Determination of Importance Evaluation (Reference 5.1) of the shop building has determined that no quality assurance (QA) controls are applicable within the context of this analysis.

3. METHOD

The method used for the calculation is based on Reference 5.2 that provides estimates for the hot water demand per fixture for various types of buildings. The hot water demand is then totalled and multiplied by two factors from Reference 5.2 representing demand and storage capacity. A water heater with a storage capacity to the calculated value is then selected from manufacturer's equipment catalogs (Reference 5.4).

4. DESIGN INPUTS

4.1 DESIGN PARAMETERS

Hot Water Demand (Reference 5.2)

- A. Lavatory - 12 gallons per hour (gph)
- B. Service Sink - 20 gph
- C. Mop Sink - 20 gph
- D. Kitchen Sink - 20 gph

Demand Factor = 0.40 (Reference 5.2)

Storage Capacity Factor = 1.00 (Reference 5.2)

4.2 CRITERIA

The Plumbing Design for the shop building will be designed in accordance with DOE Order 6430.1A (Section 4.4.2) and appropriate state and local codes (ESFDR Sections 3.2.1Q, 3.2.1R, and 3.2.1S, Reference 5.3).

4.3 ASSUMPTIONS

Not used.

4.4 CODES AND STANDARDS

4.4.1 International Association of Plumbing and Mechanical Officials:

UPC 1991

Uniform Plumbing Code (UPC)

4.4.2 U.S. Department of Energy (DOE):

DOE Order 6430.1A - 89

General Design Criteria

5. REFERENCES

- 5.1 BABBA0000-01717-2200-00007 Rev 00 Determination of Importance Evaluation for ESF Change House Facility and Shop Building.
- 5.2 1991 American Society of Heating, Refrigeration, and Air Conditioning Engineers Handbook, HVAC Application I-P Edition.
- 5.3 Yucca Mountain Site Characterization Project Exploratory Studies Facility Design Requirements, YMP/CM-0019, REV. 1, ICN 3
- 5.4 A.O. Smith Water Products Bulletin A202, August 1988.
- 5.5 Drawings:
 - 5.5.1 BABBAD000-01717-2100-27400 Rev. 00 Shop-Building 5006 Plumbing and Piping First Floor Plan
 - 5.5.1 BABBAD000-01717-2100-27401 Rev. 00 Shop-Building 5006 Plumbing and Piping Second Floor Plan
 - 5.5.3 BABBAD000-01717-2100-27400 Rev. 00 Shop-Building 5006 Plumbing Isometrics and Details

6. USE OF COMPUTER SOFTWARE

Not used.

7. DESIGN ANALYSIS

The possible maximum hot water demand shown in Attachment I is 180 gph based on the number of plumbing fixtures as required by the UPC (Section 4.4.1) for the type of occupancy and the hot water demand from Section 4.1. The probable demand equals the product of the possible maximum demand multiplied by the demand factor which equals 72 gph. The storage capacity is the probable demand (72 gph) multiplied by the storage capacity factor (1.0) which equals 72 gallons.

8. CONCLUSIONS

For the Shop Building, an A.O. Smith Model DSE was selected. This water heater has a storage capacity of 80 gallons with a recovery rate of 70 gph.

9. ATTACHMENTS

ATTACHMENT

TITLE

I

A.O. Smith Data Sheets

A.O. SMITH DATA SHEETS (REFERENCE 5.4)

A.O. SMITH

Designed for use as a recovery heater having its own storage tank or booster for supplying sanitizing rinse water for dishwashing.

FEATURES

- ▶ **ASME TANK CONSTRUCTION** — 125 psi working pressure (65 thru 120 gallons), 150 psi working pressure (5 thru 50 gallons).

R-16 FOAM INSULATED - To meet rigorous state codes.

- ▶ **GLASS-LINED TANK** - Ten tank sizes available; 5 to 120 gallon capacity. Tank interior is coated with glass specifically developed for water heater use. Tank cabinet has bonderized undercoat with baked enamel finish.

- ▶ **INCOLOY IMMERSION HEATERS** — Heavy-duty medium watt density elements (three/immersion heater) have incoloy sheathing and prewired leads; provide excellent protection against oxidation and scaling. Input ranges from 6KW to 54KW available (see accompanying chart).

STANDARD VOLTAGES — 208, 240 and 480 volt single and three phase. Single phase 208 and 240 volt are convertible to three phase, 208 and 240 volt at 24KW and below are phase convertible (three to single and vice versa). 277 volt single phase also available.

MEETS OR EXCEEDS THE REQUIREMENTS OF ASHRAE 90A-1980 STANDARD FOR ENERGY EFFICIENCIES

ASME

Dura-Power[®] SUPREME COMMERCIAL ELECTRIC WATER HEATERS DSE-5 thru 120

OTHER STANDARD FEATURES

- Simplified circuitry, color coded for ease of service
- Anode rod for corrosion protection
- Manual reset high limit
- Brass drain valve
- Hinged control compartment door
- ASME T & P relief valve.

TERMINAL BLOCK — To accept copper or aluminum conduit.

IMMERSION THERMOSTAT — Close differential immersion type thermostat provides the accurate temperature control required for commercial applications (adjustable through a range of 95° to 180°F).

120 VOLT CONTROL CIRCUIT — 120 volt control circuit powered by fused transformer.

MAGNETIC CONTACTORS — Heavy-duty UL rated for 100,000 cycles.

POWER CIRCUIT FUSING (120 amp current draw and above) — Meets National Electric Code and UL requirements that ASME tanks must have internal fusing when current draw exceeds 120 amps.

LIMITED WARRANTY OUTLINE

If the tank should leak any time during the first three years, under the terms of the warranty, A. O. Smith will repair or replace the heater; installation, labor, handling and local delivery extra. **THIS OUTLINE IS NOT A WARRANTY.** For complete information, consult the written warranty or A. O. Smith Water Products Company.

A.O. SMITH DATA SHEETS (Continued)

STANDARD KW INPUTS

Standard KW Ratings	Immersion Heaters **		Number of 50A Connectors			Full Load Current in Amperes								
	No. of	Wattage	208V	240V	480V	Single Phase				Three Phase				
						208V	240V	277V	480V	208V	240V	480V		
3	1	3,000	1	1	1	14.4	12.5	10.8	6.3	8.3	7.2	3.6		
6	1	6,000				28.8	25.0	21.2	12.5	16.7	14.4	7.2		
9	1	9,000				43.3	37.5	32.5	18.8	25.0	21.7	10.8		
12	1	12,000				57.7	50.0	43.3	25.0	33.3	28.9	14.4		
15	1	15,000				72.1	62.5	54.2	31.3	41.8	36.1	18.0		
18	1	18,000	2	2	2	86.5	75.0	65.0	37.5	50.0	43.3	21.7		
24	2	12,000				115.4	100.0	86.6	50.0	66.8	57.7	28.9		
30	2	15,000				144.2	125.0	108.3	62.5	83.3	72.2	36.1		
36	2	18,000	3	3	2	173.1	150.0	130.0	75.0	99.9	86.6	43.3		
45	3	15,000				216.3	187.5	162.5	93.8	124.9	108.3	54.1		
54	3	18,000				N/A	225.0	194.9	112.5	149.9	129.9	65.0		

*208V models use one additional immersion heater.

**Each immersion heater contains three electric elements.

piping diagrams

A.O. SMITH DATA SHEETS (Continued)

ALL DIMENSIONS IN INCHES

A. O. Smith Model	Nominal Gallon Capacity	Maximum KW Input	Maximum Number of * Immersion Heaters	Height A	Width (Dia.) B	Depth C	D	Inspection Opening	Inlet Outlet Opening	Relief Opening	Approx. Ship. Wt. (Lbs.)
DSE-5	5	3	1	20 1/2	16 1/4	21 1/2	5 1/4	Optional 4" x 6"			82
DSE-10	10	6		26 1/4	18 3/4	24	5 1/4				106
DSE-20	20	18		27 1/4	20 1/2	27	5 3/4				130
DSE-30	30	24		35 3/4	20 1/2	27	5 3/4				150
DSE-40	40	36	2	45 3/4	20 1/2	27	5 3/4		3/4	3/4	190
DSE-50	50	45		54 3/4	20 1/2	27	5 3/4				221
DSE-65	65	54		50 1/2	24 1/2	30 1/4	7				267
DSE-80	80	54		49 1/4	26 1/2	32 1/4	7				285
DSE-100	100	54	3	58 1/4	26 1/2	32 1/4	7		1 1/4		354
DSE-120	119	54		63 1/4	28	33 3/4	7 1/2				420

* Each immersion heater contains three electric elements.

RECOVERY RATE IN GALLONS PER HOUR* - Temperature Rise °F

STANDARD KW INPUT	BTU/HOUR	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°	130°	140°
3	10,239	41	31	24	20	17	15	13	12	11	10	10	9
6	20,478	82	62	49	41	35	31	27	25	22	21	19	18
9	30,717	123	92	74	62	53	46	41	37	34	31	28	26
12	40,956	164	123	98	82	70	61	55	49	45	41	38	35
15	51,195	205	154	123	102	88	77	68	61	56	51	47	44
18	61,434	246	184	148	123	105	92	82	74	67	62	57	53
24	81,912	328	246	197	164	140	123	109	98	90	82	76	70
30	102,390	410	308	246	205	176	154	137	123	112	103	95	88
36	122,868	492	369	295	246	211	184	164	148	134	123	113	105
45	153,585	615	461	369	307	263	230	205	184	168	154	142	132
54	184,302	738	554	443	359	316	277	246	221	201	185	170	158

* Figured at 1 KW (3413 Btu) = 4.1 Gallons at 100°F temperature rise.

To determine recovery rate per minute, divide recovery rate per hour by 60.

NSF ratings may be obtained by multiplying above figures by 0.98.

A.O. SMITH DATA SHEETS (Continued)

OPTIONAL EQUIPMENT & CONSTRUCTION:

SILICON BRONZE TANK — Available for special applications or very corrosive water conditions.

STAINLESS STEEL TANK — Available for special applications or unique water conditions.

150 OR 160 PSI WORKING PRESSURE — Available when required. Must be specified at time of order.

HANDHOLE CLEANOUT — 4" x 6" size.

COMBINATION TEMPERATURE/PRESSURE GAUGE — Dial type combination gauge (shipped loose).

CONTROL OPTIONS:

LOW WATER CUTOFF — Probe type electric low water cutoff prevents energizing of elements in the event of low water condition.

OVERRIDE SWITCHES — A simple form of load control allows all or part of unit input to be controlled manually. Up to one override switch per contactor is available.

INDICATING/PILOT LIGHTS — For indicating element operation and/or switch closure. Up to one indicating light available for each switch and/or contactor is available.

THERMOSTAT STEP — The simplest form of modulation. Allows elements to be stepped on in groups or individually by specifying additional thermostats (up to 1 per contactor).

SEQUENCER — Two or three step time delay sequencer provides for stepping of elements in groups or individually (maximum of 1 step per contactor).

MODULATING STEP — Solid state electronic control device that modulates input to match load through progressive sequencing of steps (up to 3 steps with maximum of 1 per contactor). Contact factory for availability.

TIME CLOCK — Seven day clock may be programmed for up to 14 on/off operations per week. Skip a day feature allows for weekend shutdown.

IMMERSION RESET HIGH LIMITS — Adjustable automatic or manual reset type. Provides additional protection against high temperature conditions. Specify type and operating range.

SAFETY DOOR INTERLOCK — Prevents opening of control panel door when heater power supply is energized. NOTE: Once door is open, the heater may be energized if necessary for service diagnosis.

PRESSURE LIMIT SWITCHES — Both high and low pressure limit switches available.

POWER CIRCUIT FUSING — Sub-divides internal circuitry with maximum of 60 amp fuses. Supplied as standard when required by NEC and UL.

ALARM HORN — Horns may be furnished to warn of any condition in the heater for which sensors have been specified.

SUGGESTED SPECIFICATION

The heater shall be a glass-lined dura-power supreme commercial electric model No. _____ as manufactured by A. O. Smith Corporation. Heater should be rated at _____ KW _____ volts _____ phase, 50/60 cycle AC and constructed in accordance with ASME code shall bear appropriate symbol and listed with the National Board as required. Heater shall be listed with Underwriters' Laboratories and approved by National Sanitation Foundation. All internal surfaces of the tank shall be glass-lined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature of 1600°F. Tank shall be cathodically protected with adequate extruded magnesium anode. The entire vessel is to be enclosed in a round steel enclosure with baked enamel finish. Control compartment to be hinged and shall house 120 volt control circuit transformer, transformer fusing, magnetic contactor(s), immersion style operating thermostat(s), element fusing per N.E.C., and commercial grade incoloy sheathed flange mounted elements with prewired terminal leads. Temperature controls include limiting switch which will require resetting manually in the event the temperature reaches 190°F. Foam insulation, (R-16), shall exceed latest requirements of ASHRAE, (currently 90A-1980) for heat loss efficiency. Heater shall include ASME T & P relief valve and drain valve.

A. O. Smith
Water Products Company
Irving, TX

A Division of A. O. Smith Corporation

A. O. Smith Corporation reserves the right to make product changes or improvements at any time without notice.