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BEFORE THE ARIZONA CORPORATION COMMISSION

COMMISSIONERS

GARY PIERCE, Chairman
BOB STUMP
SANDRA D. KENNEDY
PAUL NEWMAN
BRENDA BURNS

Arizona Corporation Commission
DOCKETED
FEB 4 2011
DOCKETED BY

LYNN A. WHEELER,

Complainant,

v.

ARIZONA PUBLIC SERVICE COMPANY,

Respondent.

DOCKET NO. E-01345A-10-0201

NOTICE OF FILING TESTIMONY

Respondent, Arizona Public Service Company, hereby gives notice that it is filing the following witness direct testimony: Luis Abril-Herrera; Angela Allison; Donald R. Lamontagne; Gregory Teslevich; and Kenneth Wolf.

RESPECTFULLY SUBMITTED this 4th day of February 2011.

By: Linda J. Arnold
Linda J. Arnold
Thomas L. Mumaw
Attorneys for Arizona Public Service Company

ORIGINAL and thirteen (13) copies of the foregoing filed this 4th day of February, 2011, with:

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Kim Cosme

DIRECT TESTIMONY OF LUIS ABRIL-HERRERA

On Behalf of Arizona Public Service Company

Docket No. E-01345A-10-0201

February 4, 2011

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DIRECT TESTIMONY OF LUIS ABRIL-HERRERA
ON BEHALF OF ARIZONA PUBLIC SERVICE COMPANY
(Docket No. E-01345A-10-0201)

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. Luis Abril-Herrera, 2121 West Cheryl Drive, Phoenix, Arizona 85072.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am the Manager for West Valley Customer Construction at Arizona Public Service Company ("APS" or "Company").

Q. WHAT ARE YOUR PROFESSIONAL QUALIFICATIONS?

A. I received my Bachelor of Science in Mechanical Engineering from Universidad Autonoma de Baja California (Mexico), and my Master of Science in Mechanical Engineering from Arizona State University. I have worked at APS since June 1999 as an engineer in the Underground Transmission, the Underground Construction, and the Distribution Planning departments. Recently, I held a leadership position in the Distribution Asset Management department where I was responsible for planning and operations engineering, which included forecasting APS's distribution system capacity needs and optimal operation of the distribution system. Currently, I am the Manager for the West Valley Customer Construction Department responsible for all new construction and home builder activities for the west part of Metro Phoenix, Buckeye, Gila Bend, Ajo and the surrounding areas.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to discuss the routine studies that APS conducted on Gila Bend feeder ("GB22 Feeder") -- the feeder that provides electric service to America's Choice Inn and Suites Hotel ("Hotel").

II. SUMMARY OF TESTIMONY

Q. PLEASE SUMMARIZE YOUR TESTIMONY.

A. APS continuously monitors its distribution feeders by assessing load data, identifying system weaknesses, and implementing measures to address the anticipated issues before the situations actually arise. The routine studies that APS conducted on the GB22 Feeder did not signal any low voltage issues on that feeder.

Q. WOULD YOU EXPLAIN WHY APS ROUTINELY MONITORS THE COMPANY'S DISTRIBUTION FEEDERS?

A. The Company continuously monitors the distribution feeder backbone (from which services are tapped) to ensure the following: (1) that there is sufficient capacity on the distribution system; (2) the feeders or equipment are not overloaded and are operating within established guidelines; and (3) that voltage at the substation buss is within the established limits.

Q. WOULD YOU PLEASE DESCRIBE HOW APS MONITORS ITS DISTRIBUTION FEEDERS?

A. Throughout the year, APS analyzes loads, anticipates any degradation in service, i.e., overload or system weaknesses, and implements measures that addresses the anticipated issues before they actually occur. At the beginning of each year, APS will forecast each feeder's predicted load and voltage to identify overload situations, and whether the feeder will be approaching its operational and planning guideline limits. APS uses the feeder's previous year's peak loads as a starting point for its forecast. Based on that forecast, APS will prioritize the feeders in order of issue criticality from most critical to less critical, i.e., feeder predicted to exceed its rating limit, feeder will be approaching its rating limit. Finally, after the system peak for the year has passed (usually in the fall), APS will review information and identify system weaknesses, feeder overloads, low voltage situations and a feeder's capacity limitations for the subsequent three-year period. APS will then propose solutions to mitigate the identified issues. If APS determines that system upgrades, i.e., new feeder, new feeder tie, new

substation, upgrade to feeder, are necessary to mitigate the issues, APS will recommend the system improvements. This same cycle starts over at the beginning of every year.

Q. WOULD YOU PLEASE DESCRIBE THE CAPACITY OF THE GB22 FEEDER?

A. The Hotel is served from GB22 Feeder out of the APS Gila Bend Substation as illustrated on Attachment LAH-1, attached hereto. Currently, the GB22 Feeder has load capacity for 9.4 megawatts ("MW") and the maximum load forecast for 2011 is approximately 5 MW. Using an analogy of transportation, the GB22 Feeder would be analogous to a freeway with several lanes that has the capacity of nine vehicles. APS currently forecasts that no more than five vehicles will use the freeway (GB22 Feeder). Based on analysis made on the freeway (GB22 Feeder) utilization during the previous year by counting the actual cars that used the freeway and accounting for an expected increase in vehicle usage (actual peak loads of the previous year and new predicted load growth), the GB22 Feeder has not exceeded 6 MW since its installation.

The feeder has taps that spread out to serve customers and, at times, tie into other feeders. Continuing the transportation analogy, the tap would be analogous to a freeway off ramp used by drivers to exit the freeway that allows vehicles to take different routes through different streets.

Q. DID THE STUDY SHOW THAT GB22 FEEDER HAD INSUFFICIENT CAPACITY TO SERVE CUSTOMERS?

A. No, the routine studies performed by APS have not shown or indicated that GB22 Feeder has ever had insufficient capacity. Since the GB22 Feeder has been in service, load has not exceeded 6 MW on the GB22 Feeder, which has a rating of 9.4 MW. The actual demand on GB22 Feeder for the time period 1996-2008 is as follows:

1996	3.9MW	2003	4.2MW
1997	3.4MW	2004	4.6MW
1998	3.4MW	2005	4.3MW
1999	3.1MW	2006	4.7MW
2000	4.3MW	2007	5.4MW
2001	4.8MW	2008	5.7MW
2002	4.3MW		

Q. DID ANY OF THE STUDIES SHOW THAT GB22 FEEDER HAD EVER EXCEEDED ITS RATED CAPACITY?

A. No, the routine studies performed by APS for the Buckeye District, the District in which GB22 Feeder is situated, have not shown that GB22 Feeder has ever experienced an overload situation.

Q. DID ANY OF THE STUDIES SHOW THAT GB22 FEEDER DEVIATED FROM ESTABLISHED OPERATING GUIDELINES?

A. No, the routine studies performed by APS have not shown that GB22 Feeder deviated from the established operating guidelines. In fact, APS has not identified any overloads, low voltage situations or capacity limitations on GB22 Feeder that required system upgrades, i.e., new feeder, new feeder tie, new substation, upgrade to feeder, since it was constructed.

Q. DID ANY OF THE STUDIES SHOW THAT VOLTAGE AT THE GILA BEND SUBSTATION BUSS SHOW THAT THE VOLTAGE AT THE SUBSTATION BUSS WAS OUTSIDE THE ESTABLISHED LIMITS?

A. No, the routine studies performed by APS did not show any voltage problems at the Gila Bend Substation Buss.

III. CONCLUSION

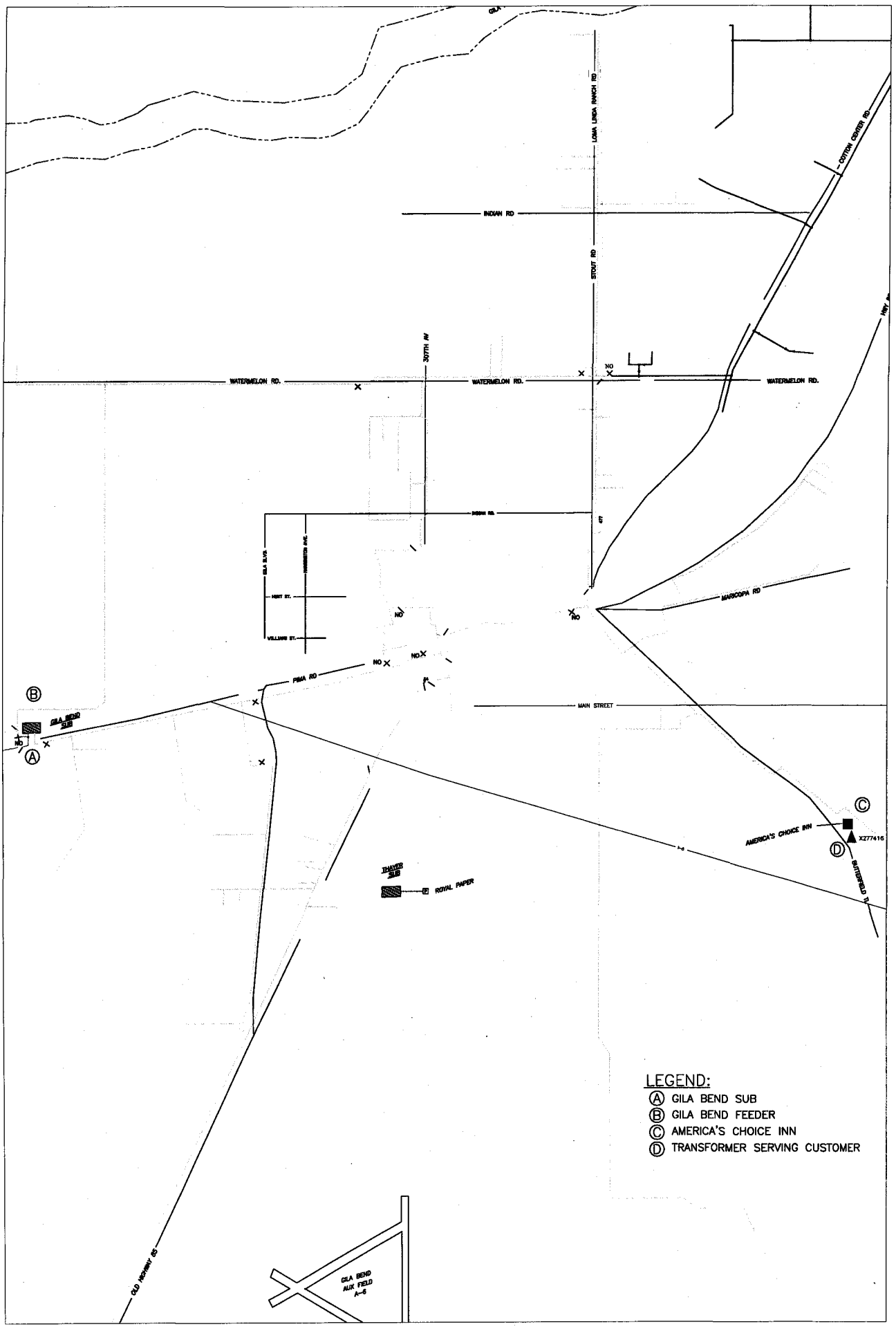
Q. WOULD YOU PLEASE SUMMARIZE YOUR CONCLUSIONS?

A. APS continuously models the distribution feeders using electronic load data to identify and circumvent system weaknesses. Throughout the year, APS analyzes loads, and if APS identifies any overload or system weaknesses, APS will implement system improvement projects before the overload or low voltage situation occurs. None of these studies indicated any voltage issues on GB22 Feeder.

Q. DOES THAT CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes it does.

ATTACHMENT LAH-1


LOMA LINDA RANCH RD
COTTON CENTER RD
INDIAN RD
STOUT RD
307TH AV
WATERMELON RD.
WATERMELON RD.
WATERMELON RD.
MARICOPA RD
MAIN STREET
PIMA RD
GILA BEND SUB
AMERICA'S CHOICE INN
X277416
BUTTERFIELD TR
ROYAL PAPER
OLD HIGHWAY 85
GILA BEND AUX FIELD A-6
LEGEND:
Ⓐ GILA BEND SUB
Ⓑ GILA BEND FEEDER
Ⓒ AMERICA'S CHOICE INN
Ⓓ TRANSFORMER SERVING CUSTOMER

DIRECT TESTIMONY OF ANGELA J. ALLISON

On Behalf of Arizona Public Service Company

Docket No. E-01345A-10-0201

February 4, 2011

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DIRECT TESTIMONY OF ANGELA J. ALLISON
ON BEHALF OF ARIZONA PUBLIC SERVICE COMPANY
(Docket No. E-01345A-10-0201)

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. Angela J. Allison, 400 North Fifth Street, Phoenix, Arizona 85012.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am a Senior Consumer Advocate for Arizona Public Service Company ("APS" or "Company").

Q. WHAT IS THE PURPOSE OF YOUR DIRECT TESTIMONY IN THIS PROCEEDING?

A. I will discuss the Company's involvement with the Complainant, Mr. Lynn Wheeler, since he first alleged that APS was responsible for the damage to air-conditioning equipment at America's Choice Inn & Suites Hotel ("Hotel").

II. HISTORY OF DISPUTE

Q. WHEN DID THIS DISPUTE BETWEEN COMPLAINANT AND THE COMPANY FIRST ARISE?

A. Mr. Wheeler filed his first informal complaint with the Arizona Corporation Commission ("Commission") on March 15, 2006. The complaint stated the following: "there have been quite a few power surges in his area in Gila Bend." He then alleged that these surges had caused damage to his appliances. Additionally, Mr. Wheeler contended that on March 11, 2006, the Hotel was without service for seven (7) hours.

Q. DID APS INVESTIGATE THIS COMPLAINT?

A. Yes. Jessica Hobbick, APS Consumer Advocate, contacted Mr. Wheeler on March 17, 2006 to address the complaint. Ms. Hobbick explained to Mr. Wheeler that while repairs had been made by APS to three breakers and a transformer at the APS Gila Bend substation, there had been no reports of power surges in the area and no outages recorded. Mr. Wheeler then agreed with Ms.

Hobbick that the Hotel had not been out of service. Mr. Wheeler also contended that his real complaint was regarding the City of Gila Bend ("Gila Bend"), and its failure to acquire APS facilities within Gila Bend similar to what had been done in the City of Williams ("Williams"). Mr. Wheeler was aware that Williams had acquired its own electric distribution system and wanted Gila Bend to do the same. Mr. Wheeler's complaint was then considered closed by both APS and the Commission.

Q. WAS THAT THE END OF THIS MATTER?

A. No. On May 22, 2006, Mr. Wheeler contacted the APS Customer Care Center reporting that the Hotel was receiving low voltage. APS responded that same day and found no evidence of inadequate voltage. Nevertheless, on June 9, 2006, Mr. Wheeler filed a second informal complaint with the Commission alleging the voltage to his Hotel was inadequate and requesting a recording volt meter ("RVM") be installed that would record and print voltage readings on a regular basis.

Q. DID APS RESPOND TO THIS NEW COMPLAINT?

A. Yes. APS returned to the Hotel property on June 12, 2006 to specifically test the voltage being delivered to the Hotel. There was no evidence of inadequate voltage, but APS chose to place a capacitor bank on-line. This could have raised the voltage level and could have improved the power factor of the feeder. Although no voltage problem had been found, Mr. Wheeler insisted on the installation of a RVM. APS complied with his request on June 13, 2006, and installed two (2) RVMs. One was placed on the Hotel's Service Entrance Section ("SES"), and a second was installed on the APS transformer serving the Hotel.

Q. IS THIS DIFFERENT THAN WHAT WAS REPORTED TO THE COMMISSION?

A. Yes. Ms. Hobbick contacted Mr. Wheeler and informed him that APS had previously been in the area of the Hotel on May 22, 2006 to replace a capacitor bank. However, APS later discovered the capacitor bank was not replaced on May 22nd as previously indicated.

Q. WHAT DID THE RVM'S INDICATE?

A. The first RVMs failed to record amperage; thus, the results were inconclusive either way. APS removed the RVMs and installed new RVMs on June 21, 2006. On June 30, 2006, APS sent Mr. Wheeler the RVM results of the voltage measurements from June 21 to June 27, 2006. Although other APS witnesses are the experts in this area, I was informed that the RVMs indicated that voltage at the SES and the transformer were at all times within the limits established by A.A.C. R14-2-208(F)(2).

I resent the results from the second set of RVMs to both Mr. Wheeler and Mr. John LaPorta (Commission Staff) on July 10, 2006. At Mr. Wheeler's request, I also faxed him and Mr. LaPorta the readings from the first set of RVMs on July 13, 2006. Although APS offered to meet with Mr. Wheeler and his engineer to go over the results of the RVMs, Mr. Wheeler did not request such a meeting.

Q. WHAT WAS MR. WHEELER'S RESPONSE?

A. As early as June 14, 2006, Mr. Wheeler asked APS to increase the voltage at his Hotel to a higher than standard level of voltage. APS explained that too high of a voltage could damage other equipment at the Hotel and might even constitute a safety hazard. Mr. Wheeler later asked that his service be upgraded from 208/120 to 240/120 volts. This could not be done unless Mr. Wheeler upgraded his SES to accommodate this higher voltage service. In addition, certain upgrades would have been necessary on APS's side as well as approval from local building code authorities.

Q. DID THE COMMISSION CLOSE MR. WHEELER'S SECOND COMPLAINT?

A. Yes.

Q. WAS MR. WHEELER SATISFIED?

A. No. On June 18, 2007, Complainant filed a third informal complaint again alleging low voltage. The next day, APS had a conference call with Mr. Prem Bahl of the Commission Staff. APS informed Mr. Bahl that a serviceman had been to the Hotel on June 18, 2007, and found the voltage at 118.7, 116.8, and 117.4 phase to ground and 302.6, 205.7, and 200.9 phase to phase — below the designed level of 208/120V, but still well within Commission limits. The serviceman nevertheless increased the voltage to 208/120 by raising the voltage in the capacitor bank. Mr. Bahl agreed that the voltage being provided was within the limits prescribed by the Commission both before and after the June 18, 2007 adjustment, but asked if APS could raise it another two (2) volts. APS resisted this further increase due to concerns about the impact on other equipment at the Hotel.

This third complaint went to informal mediation on August 22, 2007, with Mr. LaPorta as the Commission Staff mediator. As a result of the mediation, APS agreed it would further raise the voltage to the Hotel by up to five percent (5%) if Mr. Wheeler would execute a release holding APS harmless from any damages as a result of increasing the voltage above the 208/120 design. Mr. Wheeler executed such a release, and on August 30, 2007, APS increased the voltage at the point of delivery to the Hotel by five percent (5%).

Q. DID THE COMMISSION THEN CLOSE MR. WHEELER'S THIRD COMPLAINT?

A. Yes.

III. <u>CONCLUSION</u>

Q. DO YOU HAVE ANY CONCLUDING REMARKS TO YOUR TESTIMONY?

A. APS has at all times attempted to work with Mr. Wheeler to resolve his problems. Unfortunately, these efforts were not sufficient to avoid the filing of this, Mr. Wheeler's fourth, complaint.

Q. DOES THAT CONCLUDE YOUR TESTIMONY?

A. Yes.

DIRECT TESTIMONY OF DONALD R. LAMONTAGNE

On Behalf of Arizona Public Service Company

Docket No. E-01345A-10-0201

February 4, 2011

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DIRECT TESTIMONY OF DONALD R. LAMONTAGNE
ON BEHALF OF ARIZONA PUBLIC SERVICE COMPANY
(Docket No. E-01345A-10-0201)

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. Donald R. Lamontagne, 2121 West Cheryl Drive, Phoenix, Arizona 85021.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am Engineering Manager for Reliability Analysis and Standards for Arizona Public Service Company ("APS" or "Company").

Q. WHAT ARE YOUR PROFESSIONAL QUALIFICATIONS?

A. I received my Bachelor of Science degree in Electrical Engineering from Rensselaer Polytechnic Institute in Troy, New York. I am the inventor of APS's Transformer Oil Analysis and Notification (TOAN) system, winner of the Edison Electric Institute's 2008 *Edison Award*, which is given annually for outstanding contributions to the advancement of the power industry. For the last ten years, I have been responsible for transmission, substation and distribution outage collection and analysis, root cause of failure analysis, failure data trending, and management and monitoring of all transmission, substation, and distribution reliability programs for APS. In the past year, I have assumed the additional responsibility for all engineering standards for transmission, substation and distribution construction. I am the author of two patents for the TOAN system: one for its exception-based notification system; and one for the development of piecewise linear approximation and harmonic regression algorithms to accurately calculate gassing rates from online dissolved gas monitors. I have received root cause training and am the lead root cause investigator for equipment failures for APS's Energy Delivery organization. In addition, I have more than seventeen years of experience in nuclear and fossil power plant construction and operation.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to discuss the failure of Mr. Wheeler's air-conditioning units and provide my opinion as to the likely cause of such failure.

II. SUMMARY OF TESTIMONY

Q. PLEASE SUMMARIZE YOUR TESTIMONY.

A. In my testimony, I support APS's position that the Company provided adequate electric service to the America's Choice Inn and Suites ("Hotel"), and that the likely cause of the air-conditioning units' failure resulted from the units' inadequate minimum voltage rating when being served with the required[1] 208 volts ANSI Class A voltage range provided by APS. My analysis indicates that the replacement air conditioning units were likely not like-for-like replacements for the original air-conditioning units in that they were likely not rated for a minimum voltage of 187 volts.

III. ANALYSIS OF AIR CONDITIONING UNITS' FAILURE

Q. IN AN EQUIPMENT FAILURE INVESTIGATION, SUCH AS THIS, WHAT WOULD BE THE FIRST STEP IN THE INVESTIGATION?

A. An investigation of this type would typically try to determine what changes may have been made to the equipment to cause the increased failure rate. For that, an investigator will typically compare the specifications of the original and replacement devices. Since the original equipment is no longer manufactured, and product literature is not available, I had to determine the voltage ratings of the original equipment and the current air-conditioning units from other evidence.

Q. IS IT LIKELY THAT THE NEW AIR-CONDITIONING UNITS THAT MR. WHEELER HAS INSTALLED WERE LIKE-FOR-LIKE REPLACEMENTS FOR THE ORIGINAL AIR CONDITIONING UNITS?

A. No, it is unlikely. Mr. Wheeler stated that for about 11 years the original air-conditioning units worked properly.[2] After replacing the air-conditioning units, Mr. Wheeler reported that the replacement air-conditioning units were failing

[1] Arizona Administrative Code R14-2-208(F)(2).
[2] Wheeler direct testimony, 3:17-19.

prematurely.[3] The replacement air-conditioning units are likely not a like-for-like replacement for the original Sears air-conditioning units.[4] If the replacement units were like-for-like, one would expect to see similar service life from the replacement units.

Q. WHAT IS THE CONSEQUENCE OF NOT BEING A LIKE-FOR-LIKE REPLACEMENT?

A. In order to operate properly, the air conditioning units need to be properly matched to the voltage source and the amount of voltage drop between the voltage source and the farthest air-conditioning unit in the Hotel. If not properly matched, the air-conditioning units could receive lower voltage than what the manufacturer specifies. This would likely result in a shortened service life.

Q. WHAT WOULD BE THE FIRST STEP IN DETERMINING IF THE NEW UNITS ARE AN ADEQUATE REPLACEMENT?

A. The first thing we need to do is understand the way the industry rates and labels these types of units. Mr. Wheeler claims that the replacement air-conditioning units require voltage in a range of 208 volts to 230 volts.[5] The equipment rating of "208-230V" is not an Underwriting Laboratory ("UL") standard voltage range for heating, ventilation and air-conditioning equipment. The UL Marking Guide, "Electrical Heating and Cooling Equipment," (January 2010)[6] defines equipment marked as "208-230V" as equipment rated for voltages between 208 volts and 230 volts. The UL Marking Guide is attached hereto as Attachment DRL-1. It also defines equipment marked as "208/230V" as dual rated equipment rated for 208 volts and 230 volts. It also lists the available standard voltage ranges as "110 - 120, 200 - 208, 220 - 240, 254 - 277, 440 - 480 and 550 -600." The Air-

[3] Wheeler direct testimony, 3:31-4:2.
[4] Mr. Wheeler's Response to First Set of Data Requests from APS, A.1-2.
[5] Wheeler direct testimony, 4:10-11.
[6] *See* Attachment DRL-1, p. 8, Section 10. Reprinted from the White Book with permission from Underwriters Laboratories Inc.®

Conditioning & Refrigeration Institute Standard 110[7] has similar content describing how to mark a nameplate for a voltage range and for dual voltage ratings. The Air-Conditioning & Refrigeration Institute Standard 110 is attached hereto as Attachment DRL-2

Q. ARE THERE ANY APPROVED ALTERNATE VOLTAGES IN THE 208/230 VOLT CATEGORY?

A. In response to APS's suggestion that the replacement units purchased should have had 200 volt motors,[8] it should be noted that Mr. Wheeler claimed that "through the wall PTAC units are not manufactured with 200 volt motors."[9] However, the Air-Conditioning & Refrigeration Institute Standard 110[10] does show 200 volts as an approved alternate to 208 volts.

Q. ARE THERE ANY OTHER STANDARDS THAT APPLY TO THE EQUIPMENT IN QUESTION?

A. Yes. Motors are manufactured pursuant to the National Electrical Manufacturers Association ("NEMA") Standards Publication No. MG-1, Motors and Generators. NEMA Standards Publication No. MG-1, 1998, Section II, Small (Fractional) and Medium (Integral) Machines, Part 10, Ratings-AC Small and Medium Motors, paragraph 10.30.b.1 identifies that standard voltages for single-phase, 60 HA motors are 115, 200 and 230 volts.

Q. THROUGHOUT APS'S INTERACTION WITH MR. WHEELER, THERE HAVE BEEN NUMEROUS "RATINGS" USED IN DISCUSSIONS AND CORRESPONDENCE. CAN YOU SUMMARIZE THE DIFFERENT RATINGS AND THEIR USES?

A. Yes. The air-conditioning units themselves are manufactured to the Air-Conditioning & Refrigeration Institute Standard. And, as the units are UL Listed,[11] they will also conform to the UL Marking Guide. The air-conditioner is

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[7] 2002 Standard for Air-Conditioning and Refrigerating Equipment Nameplate Voltages, p. 2 Table 1, Note 3.
[8] Wheeler direct testimony, 8:22-23.
[9] Wheeler direct testimony, 8:23-24.
[10] 2002 Standard for Air-Conditioning and Refrigerating Equipment Nameplate Voltages, p. 2 Table 1.
[11] *See* Amana 26" Built-In Air Conditioners, p. 2, attached hereto as Attachment DRL-3.

made up of multiple components, many with their own individual rating from their respective standards setting organization. The air-conditioner manufacturer must consider the individual ratings of the components when publishing a combined rating for the air-conditioner. However, the motor within the air-conditioner will have a NEMA rating.

Q. ARE MR. WHEELER'S REPLACEMENT AIR-CONDITIONING UNITS INDUSTRY STANDARD?

A. If Mr. Wheeler's air-conditioning units are indeed "208-230V" rated equipment, rather than "208/230V" rated equipment, then Mr. Wheeler purchased non-standard air-conditioning equipment. However, it is much more likely that Mr. Wheeler purchased standard air-conditioning units rated "208/230V", and Mr. Wheeler is misinterpreting the nameplate designation.[12] In researching some Amana[13] air-conditioning unit's installation manuals and specification sheets, these documents indicate that the air-conditioning units are rated "208/230V" with a minimum voltage rating of 197 volts.[14] Amana Product Specifications is attached hereto as Attachment DRL-4. Other manufacturers[15] had units also rated at "208/230V" but stated a minimum voltage of 187 volts.

Q. COULD THE ORIGINAL AIR-CONDITIONING UNITS HAVE BEEN RATED AT "208-230V"?

No, it is not likely. If we assume that a voltage range of "208-230V" was required by the original equipment and it performed adequately for over a decade, as Mr. Wheeler testified,[16] then APS would had to have been providing service with a minimum voltage of 208 volts plus whatever the voltage drop is through the Hotel (from the meter to the farthest room). The voltage drop to the air-conditioning units through 250 feet[17] of #10AWG wire[18] between where APS

[12] Wheeler direct testimony, 2:17-20.
[13] Mr. Wheeler's Response to Second Set of Data Requests from APS, A.2-1.
[14] *See* Attachment DRL-4, p. 6, Note 3.
[15] APS Response to Allegation No. 7 of Formal Complaint, p. 7:4-18.
[16] Wheeler direct testimony, 3:17-19.
[17] Mr. Wheeler's Response to Second Set of Data Requests from APS, A.2-3.

provides power to the Hotel to the farthest air-conditioning unit within the Hotel is ten volts, assuming a current of 20 amps (typical nameplate value for a 12,000 BTU PTAC). Therefore, APS's minimum delivery voltage would have to be adjusted upward to 218 volts, nominal voltage would then become 229.5 volts and maximum delivery voltage would become 240.9 volts (to preserve the +/- 5% around nominal).

So in order for Mr. Wheeler to maintain that APS delivered adequate voltage to 208-230 volt air-conditioning units for over a decade to the Hotel,[19] APS would have had to serve the remaining customers on the Gila Bend #22 feeder with a minimum voltage that matched the ANSI C84.1, Class A maximum voltage, thereby violating Arizona Administrative Code R14-2-208(F)(2) ("Rule 208").[20] Equipment on the feeder, such as capacitor banks, were set to operate within ANSI C84.1, Class A voltage and are checked annually for proper operation. Therefore, the original air-conditioning units likely were not rated to operate between 208 volts and 230 volts (208-230V). Rather, they were more likely dual rated, and rated to operate at 208 volts or 230 volts (208/230V) and with a minimum voltage of 187 volts.

Q. OTHER MANUFACTURERS HAVE A MINIMUM VOLTAGE RATING OF 187 VOLTS. IS A MINIMUM VOLTAGE OF 187 VOLTS RATHER THAN 197 VOLTS IMPORTANT?

A. Yes. APS can supply voltage at a minimum of 197 volts to maintain compliance with ANSI C84.1, Class A voltage and Rule 208. The Hotel has a ten volt drop through 250 feet[21] of #10AWG wire[22] between the utility service and the terminal voltage of its farthest air-conditioning unit (20 amps to and from a 250 foot run

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[18] Mr. Wheeler's Response to Second Set of Data Requests from APS, A.2-2.
[19] Wheeler direct testimony, 3:14:19.
[20] A.A.C. R14-2-802(F)(2) requires APS to maintain its standard voltage within the limits of the 1989 edition of ANSI C84.1.
[21] Wheeler Response to Second Set of Data Requests from APS, A.2-3.
[22] Wheeler Response to Second Set of Data Requests from APS, A.2-2.

with a resistance of 0.9989 ohms/1000 feet = 9.989 volts). As a result, APS could serve the Hotel with ANSI C84.1, Class A voltage, the same as the rest of the customers on the feeder, while remaining in compliance with Rule 208, and still have sufficient voltage to operate 187 volt rated air-conditioning units.

Q. WOULD AIR-CONDITIONING UNITS RATED AT 208-230 VOLTS AND AIR-CONDITIONING UNITS RATED AT 208/230 VOLTS WITH A MINIMUM VOLTAGE REQUIREMENT OF 197 VOLTS FAIL PREMATURELY WHEN THE SERVICE VOLTAGE IS PROVIDED CONSISTENT WITH THE ANSI STANDARD VOLTAGE?

A. It is likely that the air-conditioning units would eventually fail in both cases. Lower voltage to Mr. Wheeler's air-conditioning units means that the units have to draw more amps. More amps means that the heat generated within the air-conditioning units' motors is greater and the speed that the insulation ages is faster. If Mr. Wheeler purchased "208-230V" rated air-conditioning units, then the air-conditioning units likely would fail prematurely under the ANSI C84.1, Class A voltage required by Rule 208. If Mr. Wheeler purchased "208/230V" rated air-conditioning units with a minimum rating of only 197 volts, connected with the 10 volt drop through the Hotel wiring, then those air-conditioning units would also likely fail prematurely. If the original air-conditioning units were rated "208/230V" but had a minimum voltage of 187 volts, then the units would have worked properly. Given the eleven years of satisfactory service of the original air conditioning units,[23] it is likely that the original air-conditioning units were 208/230V rated for a minimum of 187 volts.

Q. IS THERE ANYTHING ELSE WHICH SUGGESTS THAT MR. WHEELER BOUGHT REPLACEMENT AIR-CONDITIONING UNITS THAT WERE NOT CAPABLE OF OPERATING AT 187 VOLTS, THE MINIMUM VOLTAGE WHICH TAKES INTO ACCOUNT THE VOLTAGE DROP BETWEEN THE APS DELIVERY POINT AND THE OUTLET IN THE FARTHEST ROOM?

A. Yes. Attachment DRL-5, attached hereto, is a copy of a repair estimate sent from Mr. Wheeler to APS on November 23, 2008. The estimate quotes replacement

[23] Wheeler direct testimony, 3:17-19.

costs for Amana PTAC air conditioners, specifically, twenty-five Amana model PBE123A35MA air-conditioners. Attachment DRL-6, attached hereto, Installation Instructions and Owner's Manual, Thru-the Wall Room Air Conditioner with optional Electric Heat,[24] clearly shows that the model requires a minimum voltage of 197 volts. Mr. Wheeler identified Amana[25] as one of the brands (but did not supply the specific model) of replacement air-conditioners that he purchased.

IV. CONCLUSION

Q. WOULD YOU PLEASE SUMMARIZE YOUR DIRECT TESTIMONY?

A. My analysis indicates that the replacement air-conditioning units were likely not like-for-like replacements for the original air-conditioning units in that they are likely not rated for a minimum voltage of 187 volts. This minimum rating is required to take into account the ten (10) volt drop caused by the wiring in the Hotel between the APS delivery point and the farthest room at the Hotel.

Q. DOES THAT CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes it does.

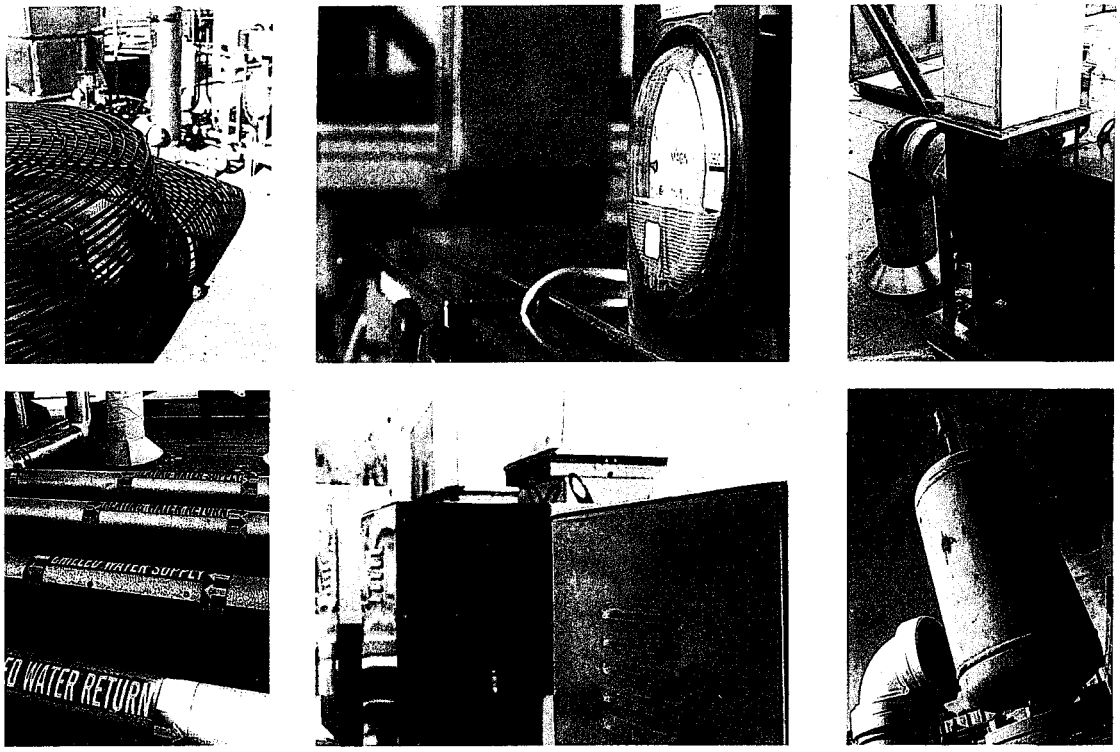
[24] *See* Attachment DRL-6, p. 7, Table 1.
[25] Wheeler Response to Second Set of Data Requests from APS, A.2-1.

ATTACHMENT DRL-1

the standard in safety

Underwriters Laboratories

Marking Guide
Electrical Heating and Cooling Equipment
January 2010



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71-01/2010

PREFACE

Because of changes in installation codes, the increasing complexity of the equipment involved, and other factors, more and more markings are being used on electrical heating and cooling equipment.

The markings described in UL 1995, the "*Standard of Safety for Heating and Cooling Equipment*", and UL 1996, the "*Standard of Safety for Electric Duct Heaters*", are required on the various types of electrical heating and cooling equipment for proper and safe installations. Markings that apply only to servicing and operating the equipment, or markings placed on the equipment by the manufacturer that are not required by UL, are not covered in the Guide.

The adequacy of the markings described is determined as part of the investigation of equipment bearing the UL Listing Mark.

Underwriters Laboratories Inc. (UL) has developed this guide for use by code and inspection authorities, contractors, installers, users, designers and other interested parties to aid in determining what markings are pertinent for safe and proper installation of electrical heating and cooling equipment, and to understand the significance of these markings in order to facilitate a reasonably safe and code-compliant installation.

UL Marking Guides are updated as necessary due to new product development, changes in the National Electrical Code®, or the need for clarification. To confirm the current status of any UL Marking Guide, please consult the Code Authorities page of the UL Web Site at **www.ul.com/codeauthorities.**

The Table of Contents lists the main headings and their page numbers. The Index gives an alphabetical list of the specific items and the section(s) number where information can be found. All references to the National Electrical Code® have been updated to the 2008 edition.

Your comments or suggestions are welcome and appreciated. They should be sent to:

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INTRODUCTION

USE OF THIS GUIDE

This guide is intended to assist regulatory authorities, designers, and installers in determining the suitability of electric heating and cooling equipment in a particular installation and use, and to address concerns related to fire, shock, and mechanical hazards.

Products are Listed or Classified by UL under an appropriate product category. A four-letter code (shown in parenthesis) following every category title in this guide is the UL product category code designation. A list of heating and cooling equipment product categories evaluated by UL, along with the applicable standard(s), can be found in Appendix A.

Each UL product category code provides a direct link to the Guide Information for the product category. The Guide Information includes the scope of the products covered, information relating to limitations or special conditions applying to the product, the requirements used for the investigation of the products, installation and use information, and information on product markings and the UL Mark to be used on the product.

The product markings identified in this guide do not include every possible marking that could be provided either on a product or in its installation or operation instructions. The purpose of these markings is to provide you with an indication of the type of text and location of markings that address features that may be critical in determining if a product is certified and / or if it is installed correctly. Refer to the specific Guide Information for the product category for additional marking information.

The numbering for code sections used in this document may change as the specific code is updated. A list of model codes and standards applicable for each product can be found in Appendix B.

Additional information can be found at **www.ul.com**.

INFORMATION ON LISTING VERSUS CLASSIFICATION

Most codes and regulations require the certification of heating and cooling equipment to applicable safety-related standards. They also may require this equipment to be certified to energy performance standards as well. Products that are certified to safety-related standards have been evaluated with regard to all reasonably foreseeable safety-related hazards, including fire, electrical shock and mechanical hazards. Such products are termed "UL Listed." Products that are certified to a limited range of hazards, or for use under specific conditions are termed "UL Classified."

It is important to distinguish the difference between "UL Listed" and "UL Classified" and the relation these terms have with the term "listed," as used in various codes. The term "listed" in the codes generally indicates that the product is required to be evaluated in accordance with the appropriate standard(s) by an independent third party certification organization such as UL. The term "listed" in the codes should not be confused with the term "UL Listed," as explained above. It is important to recognize that not all certification agencies make this distinction in their certification services.

INFORMATION ON UL MARKS

There are several types of UL Marks that can be found on heating and cooling equipment. General information on each of these Marks is provided below. Each has its own specific meaning and significance. The only way to determine if a product has been certified by UL is to look for the UL Mark on the product itself.

The UL Mark on a product means that UL has tested and evaluated representative samples of that product and determined that they meet the requirements in the applicable standard(s). Under a variety of UL programs, certified products are periodically checked by UL at the manufacturing facility to determine that they continue to comply with the standard(s).

The UL Marks may only be used on, or in connection with products certified by UL, and under the terms of a written agreement between the manufacturer and UL.

UL Listing Mark

This is one of the most common UL Marks. If a product carries this Mark, it means UL found that representative samples of this product met UL's *safety* requirements. These requirements are primarily based on UL's own published Standards for Safety, or other recognized third party standards. The UL Listed Mark includes the UL symbol, the word "Listed," the product or category name, and a control number assigned by UL.

UL Classification Mark

This Mark appears on representative samples of products that UL has evaluated but only with respect to specific properties, a limited range of hazards, or suitability for use under limited or special conditions. The UL Classified Mark includes the UL symbol, the word "Classified," a statement of the scope of evaluation, the product or category name, and a control number assigned by UL.

UL Gas-Fired Mark

UL's Gas-Fired Mark is used exclusively on gas-fired appliances and equipment. The Gas-Fired Mark indicates a product's compliance to nationally recognized gas standards, including UL, ANSI Z21/Z83 Series and CSA/CGA standards. The UL Gas-Fired Mark signifies that a product has been evaluated to reasonably foreseeable hazards including both gas and electrical hazards.

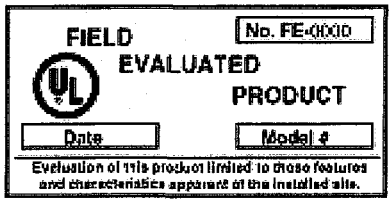
Gas-fired equipment evaluated to Canadian national standards is authorized to display the Canadian Gas-Fired Mark. For gas-fired equipment evaluated to both U.S. and Canadian standards, the combination U.S. and Canadian Gas-Fired Mark is authorized.

UL Energy Mark

The UL Energy Mark appears on air conditioners and furnaces, and similar products evaluated to U.S. and Canadian energy efficiency standards. These products are already certified for safety by UL before earning the UL Energy Mark.

FIELD EVALUATIONS

You may encounter situations in which you are unable to determine if a product has been listed by a third-party organization. Or in other situations you might encounter a product bearing a listing label that may have been modified in the field, and now you question whether or not the product still complies with the applicable standard. UL offers a field evaluation service that provides data to assist you in making your decision whether to accept the product and/or approve the installation. Anyone directly involved with a product – including manufacturers, owners, contractors, and regulatory authorities – can request a Field Evaluation. Detailed information for this program can be found on UL's Web site at **www.ul.com/field.**



1. GENERAL INFORMATION

UL Standards for electrical heating and cooling equipment include requirements for the location, legibility and permanence of the markings described in this Guide. These requirements vary depending on the importance of the marking, environmental and use conditions, and a number of other factors. UL evaluates the reliability of an adhesive used to secure a marking. UL requires markings to be located where they will be visible after the equipment is installed; and affixed to a permanent unit part, or to a part that requires the use of a tool to remove and that must be in place for the unit to operate properly except for certain supplementary markings.

Normally, nameplate markings must be located where they can be read without using tools to partially disassemble the unit. Access to the nameplate of a unit designed for built-in installation may require removal of a panel or grill that gives access to the field wiring compartment.

2. LISTING MARKS

Section 110.3(A)(1) of the *National Electrical Code®(NEC®)* states that "suitability of equipment may be evidenced by listing or labeling." Only units that bear a UL Listing Mark are UL Listed. For electrical heating and cooling equipment, the UL Mark that is required on the unit includes: the name and/or symbol of Underwriters Laboratories Inc.; the word "LISTED;" a UL control number; and the product or category name. Some Listed Heating and Cooling Equipment may contain a Listed Gas Heating Section. This will be identified on the unit by the UL *Gas-fired Listing* Mark that is provided either on the Listed heating and cooling equipment or on a Listed gas-fired heating section or portion of a Listed Unit.

3. COMPANY IDENTIFICATION

If there is a question on the design or construction of a unit, the identification of the organization responsible for the product is important. This is one of the basic markings required by *NEC®* Section 110.21.

UL requires that the responsible manufacturer or private labeler be identified on the unit nameplate by a company name, trade name or trademark. This company is also known as the "Listee" and is the name that appears in UL's published Directories. UL provides a Index of Tradenames and Trademarks in the Online Certifications Directory at **www.ul.com/database** .

4. MODEL IDENTIFICATION

The nameplate of every unit bearing a UL Listing Mark is required to include a distinctive model identification. This may be a "Model No.," "Type," "Cat. No.," "Part No.," or similar identification,

and may consist of any combination of numbers and letters. The model designation is important when referencing the manufacturer's installation instructions or other published literature, and when contacting the manufacturer or UL with questions about the product. The model designation is also important for determining the acceptable use of "split-system" sections, or accessories (see "Split-Systems" and "Use of Accessories").

5. SPLIT-SYSTEMS

Many central cooling air conditioners and heat pumps are Listed as "split-systems." Such Listings are given to equipment for which two or more sections of the system have been evaluated together. Sections of systems are typically identified on the Listing Mark as "Section of Central Cooling Air Conditioner" or "Section of Heat Pump," but may be identified as another type of Listed product such as a "Fan Coil Unit" or an "Electrical Central Heating Furnace." These Listed combinations are identified in the UL *Electrical Appliance and Utilization Equipment Directory*. It is important to note that combinations of equipment not identified in UL's published Listings have not been evaluated by UL.

6. USE OF ACCESSORIES

UL evaluates accessories to determine their suitability for field installation and use with specific models of UL Listed equipment. Listed accessories bear a Listing Mark that includes the word "accessory" in the product or category name (see "Listing Marks"). The Listing Mark may indicate the specific equipment type with which the accessory is to be used (such as "Accessory for Heat Pump"). If the Listing Mark indicates "Air Conditioning Equipment Accessory," it is commonly designed for use on more than one type of heating or cooling equipment. In all cases, however, the accessory is Listed only for equipment marked (on wiring diagram, etc.) to indicate the permitted use of the specific accessory. Many Listed units are marked for use with more than one accessory. In some cases, the marking will indicate that if one accessory is used, another must be used in conjunction.

One common marking for accessories relates to the use of supplementary electric resistance heaters. Typically, such a marking will indicate the optional use of any one of a series of heater accessories. It will usually also specify some action to be taken by the installer to indicate which heater has been installed or that no heater has been installed. Failure of the installer to perform the specified action can be considered as noncompliance with *NEC*® Section 110.3(B). For example, the marking may state, "Any of the following heater accessories may be installed. Installer to check appropriate block" followed by a list of accessory model numbers and associated electrical ratings, including a line stating "none." To comply with *NEC*® Section 110.3(B), the installer must mark the appropriate block. The accuracy of this installer marking can be verified by examining the markings on the accessory.

For some accessory types, such as a compressor "hard start" kit, the intended mounting location within the unit may not be obvious. In such cases, the unit marking is required to indicate the intended mounting location.

A unit Listed for use with accessories requiring wiring connections to the unit will show these connections on an attached wiring diagram (see "Wiring Diagram").

7. EXTERNAL LOADS OR LINE VOLTAGE SWITCHING DEVICES

A unit that provides a means for connecting an external load, such as a cooling tower, an evaporator blower motor, or a blower motor that circulates air across duct heaters, is marked to specify the maximum rating of each such load. These markings may also specify the minimum wire sizes to be used. Minimum wire size markings are required when the load is a motor connected to a multimotor or combination load circuit and the wire size normally adequate for carrying the load current would not be protected properly by an overcurrent device for the circuit.

A unit with a means of connecting a switching device in other than a Class 2 control circuit is marked with the minimum required ratings for each such device.

These markings are located in the unit where field wiring is to be connected to the remote load or switching device, or on the wiring diagram attached to the unit (see "Wiring Diagram").

8. SUPPLEMENTARY OVERCURRENT PROTECTION

NEC® Section 424.22(C) permits supplementary overcurrent protective devices required for subdivided loads of resistance type heating elements in electric space heating equipment to be supplied as a separate assembly by the heater manufacturer. All units that require this supplementary overcurrent protection, but do not have the protective devices factory installed, are marked to identify the separate assembly available from the unit manufacturer. This information is marked on or adjacent to the nameplate containing the electrical ratings of the heating elements. The assembly has a separate UL Listing, and the common identification on its Listing Mark is "Control Panel for Specific Electric Space Heating Equipment."

Other specific Listed separate assemblies such as a panelboard, however, may be referenced by the marking on the heating unit. In any case, the proper use of the separate assembly identified on the unit will provide compliance with *NEC*® Sections 424.22(B) and (C).

9. ELECTRICAL RATING, GENERAL

The nameplate for each Listed unit includes the appropriate electrical ratings. These ratings identify the required characteristics of each electrical circuit to be connected to the unit and also the load characteristics that the unit will impose on each circuit.

For a unit with a single motor as its only energy consuming component, the motor nameplate may provide the required electrical ratings if all ratings on the motor nameplate apply to its use in the unit, and the motor nameplate is visible as installed. If motor ratings are shown on the unit nameplate, they take precedence over the ratings on the motor nameplate.

10. VOLTAGE RATING

All equipment requiring connection to an electrical supply source is required to include the voltage rating of each source on the unit nameplate. The rating includes the voltage as either a single nominal value such as "230 V" or as a voltage range such as "220—240V." Standard voltage ranges are 110—120, 200—208, 220—240, 254—277, 440—480 and 550—600. Units marked with a single nominal value within one of these voltage ranges can be connected properly to any

voltage within the indicated range, but not to a different voltage. For example, a unit marked "230 volts" can be connected properly to a 240-volt supply source, but not to a 208-volt supply source.

Some equipment is marked for use on more than one voltage. Individual voltage ratings may be a single value or a range of values as indicated above, with each of the multiple ratings separated from the others by a slash (e.g., "208/240" or "220—240/440—480") or by a separate line or column in a tabulation of ratings.

When inductive loads are involved, it is usually necessary to change some connections to make the equipment suitable for one of the voltage ratings. Instructions for these changes are usually indicated on the wiring diagram attached to the unit and typically involve at least a change in a control circuit transformer tap within the equipment.

If the inductive load is a motor, the instructions may appear on the motor itself, with a marking to indicate the voltage for which it is factory connected and how to reconnect it for another voltage.

Many motors and other components with dual voltage ratings, however, are used in equipment that is UL Listed for a single voltage only. When a unit is UL Listed for more than one voltage, this is indicated on the unit nameplate.

Some equipment showing two voltage ratings may be designated to have both voltages supplied from the same supply circuit. In such cases, the rating indicates the number of wires needed in the supply circuit (e.g., "120/240 V, 3W" or "120/240 V, 3ph, 4W") or the number of wires will be indicated clearly on the wiring diagram attached to the unit.

Some equipment designed for connection to a 2-wire branch circuit nominally rated at 208 or 240 volts, may not be suitable for potentials exceeding 120 volts to ground. Such equipment is marked "Maximum Voltage to Ground 120" (or the equivalent) near the supply voltage rating.

11. FREQUENCY RATING

Some form of frequency rating is required with each marked voltage rating. This may be identified as "Cycles," "Cycles per Second," "Hertz" or an appropriate abbreviation. A unit or unit circuit for connection to direct current will be marked to indicate this suitability.

12. ELECTRICAL LOAD RATINGS

The unit nameplate indicates the electrical load on each supply circuit, other than a Class 2 control circuit, to which the unit is intended to be connected. These load ratings include any remote loads or accessories identified by markings on the unit (see "Remote Loads" and "Use of Accessories"). In general, the individual segments of this load rating are appropriately identified. Rather than individual ratings for each load segment, a single overall rating may be given:

1) When a unit does not include any motors rated at 1/8 horsepower or more; or

2) When a unit rated for single-phase alternating current includes a hermetic refrigerant motor-compressor and other loads, and its markings indicate a minimum circuit ampacity and maximum size of the overcurrent device of 15 amperes at 240 volts or less, or 20 amperes at 120 volts (see

"Minimum Circuit Ampacity" and "Branch-Circuit, Short-Circuit and Ground-Fault Protection").

For some units intended to be connected to two or more supply circuits, it may be necessary to consult the unit wiring diagram to determine which loads are connected to each circuit (see "Wiring Diagram").

The load rating may be expressed in watts or kilowatts for resistance loads such as electric heaters and motors rated less than 1/8 horsepower. All other load ratings are expressed in amperes.

For hermetic refrigerant motor-compressors, the required individual segment rating is always given in rated-load amperes (RLA). Locked-rotor amperes (LRA) are also included but may be omitted for single-phase compressors with an RLA rating of 9 amperes or less at 115 volts, or 4.5 amperes or less at 230 volts.

Air conditioning liquid chillers with "star-delta" start centrifugal motor-compressors and not factory equipped with a controller or overload protection for that motor are marked with LRA ratings for both the star and delta connections (see "Remote Overload Protection for Motors").

For all other motors, the required individual segment rating is expressed in amperes, full-load amperes, or an appropriate abbreviation. A locked-rotor current rating is not required.

A pilot duty (electromagnetic) load, or a resistance load of less than 1 ampere need not be identified separately on the unit nameplate. Also, a load such as a crankcase heater need not be identified separately if it is not energized concurrently with an identified larger load, such as a compressor motor. The unit nameplate ratings for motor loads may differ from the ratings on the motor nameplates. Unit nameplate ratings should be used for properly sizing the supply conductors, disconnect means, etc., since these ratings reflect the actual loads that will be imposed by operation of the motor in the unit.

Units with dual voltage ratings may also show dual-load ratings or a single-load rating representing the highest load imposed at either voltage. Dual-load ratings can be shown in tabular form or separated by a slash. For example, a motor rating of "120/240 V, 6.4/ 3.2 A" indicates the motor is rated 6.4 amperes at 120 volts and 3.2 amperes at 240 volts.

13. MOTOR HORSEPOWER RATINGS

In equipment where the selection of a properly rated remote controller or disconnect means is dependent on the horsepower rating of a motor, the horsepower rating is required to be included in the unit nameplate (see "Electrical Rating, General"). It is not necessary that a horsepower rating be included on the unit nameplate for a hermetic refrigerant motor-compressor.

If the nameplate is marked with the disconnect size the horsepower is not required to be marked for the other motors.

A fan or blower motor rated at less than 1/8 horsepower when its ampere or wattage rating is included on the unit nameplate

14. BRANCH-CIRCUIT SELECTION CURRENT

The nameplate on a unit that includes a hermetic refrigerant motor-compressor may show branch-circuit selection current for the motor-compressor in accordance with *NEC*® Section 440.4(C). This rating may be identified by a suitable abbreviation and will always be equal to or higher than the motor-compressor RLA rating marked on the unit nameplate. The branch-circuit selection current rating for the motor-compressor is to be used instead of the rated-load amperes in determining appropriate ratings for externally mounted controllers and disconnecting means, branch-circuit conductors, and short-circuit and ground-fault protective devices for these conductors. A branch-circuit selection current rating is always included on the unit nameplate if the motor-compressor's thermal protector or the protective system built into the unit permits a continuous current flow greater than 156 percent of the rated-load current for the motor-compressor, or the single overall ampere rating for the unit marked on the unit nameplate (see "Electrical Load Ratings").

15. SUPPLY WIRE SIZE

According to *NEC*® Section 424.3(B), the ampacity of branch-circuit conductors supplying fixed electric space heating equipment consisting of resistance elements with or without a motor shall be not less than 125 percent of the total load connected to the circuit. Units incorporating fixed electric space heating means on the same circuit with a motor usually show the minimum required ampacity for the conductors supplying that circuit (see "Minimum Circuit Ampacity"). If a circuit supplying fixed electric space heater does not include a motor, the unit marking needs not to show a minimum circuit ampacity. The above noted *NEC*® requirement ordinarily applies to the proper sizing of the supply conductors for such a circuit.

NEC® Sections 424.22(D) and (E) indicate exceptions to the requirement for sizing such conductors based on 125 percent of the load. Units with fixed electric space heating loads arranged in accordance with these exceptions are marked with a minimum conductor size for each such circuit involved. Such markings are located on or adjacent to the unit nameplate. For other markings that specify minimum conductor size, see "Temperature Ratings of Field Installed Wiring" and "External Loads for High Voltage Switching Devices."

16. MINIMUM CIRCUIT AMPACITY

In general, a unit designed to have more than one motor, or a motor with other loads, supplied from a single branch-circuit, must be marked to show the minimum required supply-circuit conductor ampacity for each circuit. There are two exceptions:

1) If the branch-circuit involved is to be rated 15 amperes, and the unit is marked "Use Only On A 15 Ampere Branch-Circuit;" and

2) If the unit is to be supplied through a remote control assembly specified on the unit nameplate, and the minimum ampacities are specified on that assembly.

These ampacity markings are in accordance with *NEC*® Section 430.7(D) and 440.4(B) and are computed in accordance with Section 430.24 and 440.33. Any remote loads identified by other markings on the equipment and supplied from the unit are included in these computations. The

marking is on or adjacent to the unit nameplate and is usually identified as "Minimum Circuit Ampacity" or its abbreviation.

17. BRANCH-CIRCUIT, SHORT-CIRCUIT AND GROUND-FAULT PROTECTION

Units required to be marked with a minimum circuit ampacity (see "Minimum Circuit Ampacity") are also required to show the maximum ampere rating of the short-circuit and ground-fault protective device for each applicable circuit. These markings also conform with *NEC*® Section 430.7(D). They are computed in accordance with Section 430.53 and take into account any remote loads used in the ampacity calculations. The branch-circuit, short-circuit and ground-fault protection marking is included on the same label as the ampacity marking and is typically identified as "Maximum Fuse Amps," "Maximum Fuse or HACR Type Circuit Breaker Amps," "Maximum Fuse or Circuit Breakers Amps," "Maximum Overcurrent Protection Amps" or their suitable abbreviations.

There are several other situations when the maximum ampere rating of the short-circuit and ground-fault protective device must be marked on the unit, even though a marking for minimum circuit ampacity may not be required. Typical examples are overcurrent protection devices for separate high voltage control circuits or transformers in the unit. These markings are identified in the same manner as described above, but can be located on an attached wiring diagram (see "Wiring Diagram") or adjacent to the terminals or leads to which the supply circuit wires are to be connected, rather than on or adjacent to the unit nameplate.

The markings for short-circuit and ground-fault protection always include some indication of the type of protection device as well as the maximum current rating. This is significant since the various types of devices recognized by the *NEC*® to provide this protection do not necessarily provide the same level of protection for all units. Briefly, if the marking indicates:

1) Only "Fuse," then only fuses are to be used;

2) "HACR Type Circuit Breaker" and "Fuse," then either fuses or circuit breakers marked "HACR Type" may be used; or

3) "Fuse or Circuit Breaker" or "Overcurrent Protection," then fuses or any type of circuit breaker (including "HACR Type") may be used.

In any case, the devices used should be covered by the *NEC*® to provide short-circuit and ground-fault protection.

The maximum rating and type of protective device specified in the marking described above are those considered in the evaluation of the unit for Listing, and are intended to apply to the protective devices installed on the line side of the supply circuit conductors, not to protective devices factory installed in the unit.

18. BRANCH-CIRCUIT RATING

NEC® Section 424.3(A) indicates that branch circuits supplying two or more outlets for fixed electric space heating equipment shall be rated 15, 20, 25 or 30 amperes. Although this is rarely applicable to the type of equipment covered in this Guide, some units rated 16 amperes or less

may not be suitable for connection to 20- or 30-ampere branch-circuits. Such units show the maximum rating of the branch-circuit to which they are to be connected. This marking will be on or adjacent to the unit nameplate, or near the area where supply wires are to be connected.

19. INTEGRAL OVERLOAD PROTECTION FOR MOTORS

Most electrical heating and cooling equipment includes appropriate overload protection for each motor in accordance with Part C of *NEC*® Article 430. In many cases, the unit or the individual motor is marked to indicate that this protection is provided. Even if there are no such markings, it can be assumed that adequate protection is provided for each motor unless the unit markings indicate the need for remote devices to provide such protection (see "Remote Overload Protection for Motors").

A unit with a thermally protected hermetic refrigerant motor-compressor always includes a marking in accordance with *NEC*® Section 440.4(A) to indicate the type of thermal overload protection provided for each motor-compressor. A unit that uses thermal protection complying with *NEC*® Sections 440.52(A)(2) and (B)(2) is marked "Motor-Compressor Thermally Protected," or an equivalent statement to reference the motor-compressor(s) involved, unless the motor-compressor itself is marked "Thermally Protected." When protection is provided by an integral protective system in a unit, complying with *NEC*® Sections 440.52(A) (4) and (B)(4), the unit is marked "Motor-Compressor Thermally Protected System," or an equivalent statement to reference the motor-compressor(s) involved.

A unit that includes a 3-phase motor and overload protection for that motor other than an overcurrent unit in each motor supply conductor will provide adequate primary single-phase failure protection when supplied by transformers connected wye-delta or delta-wye. Such a unit is marked to indicate that the motor is protected under primary single-phasing conditions.

20. REMOTE OVERLOAD PROTECTION FOR MOTORS

Some units evaluated to determine the adequacy of specific motor controllers (starters) to provide motor overload protection may be shipped from the factory without the controller installed. For these units, UL requires that the manufacturer provide the proper controller for remote mounting, and the unit must be marked to identify this controller. The marking includes the controller manufacturer's name, the model designation and the rating of the overcurrent (heater) element to be used in the overload relay of the controller. This marking is located either where field wiring connections to the controller are to be made, or on the wiring diagram attached to the unit (see "Wiring Diagram").

Some units that contain a continuous-duty single-speed blower motor rated over 1 horsepower as the only load on a supply circuit need not include overload protection for that motor when:

1) The motor is located where it will not be adversely affected by high ambient air temperatures during normal use of the unit; and,

2) Energization of any electric space heaters in the unit cannot occur without the blower operating.

These units are marked to indicate the need for providing a remote controller with overload protection devices rated or selected for compliance with the installation codes specified by the jurisdictional authority.

Most air conditioning liquid chillers that use a centrifugal motor-compressor are not factory equipped with a controller or overload protection for that motor. In this case, the unit nameplate will indicate that these components are not provided and designate the manufacturer's specifications for the components to be installed remotely. The specifications include the electrical rating of the required controller, the start sequencing, the overload protection trip current and the connections to the chiller electrical control system. If a current transformer is to be provided as part of the controller to provide a signal input circuit to the chiller control system, the specifications will also include requirements for the current transformer and any necessary shunting resistor.

21. CONNECTION TO NONMETAL ENCLOSED WIRING

Most UL Listed equipment is provided with knockouts or openings designed to accommodate properly sized conduit fittings for any of the appropriate types of wiring systems covered by the *NEC®*. Some units, however, are designed only for connection to a system other than metal-clad cable or conduit. These units are marked to indicate the appropriate type of system or systems to be used. This marking will be visible when power supply connections are being made.

22. EQUIPMENT GROUNDING CONNECTION

Except as indicated below, every unit is required to have a means for connecting the equipment grounding conductor for each circuit, other than a Class 2 control circuit, to which the unit is to be connected. If a wire binding screw is provided for this purpose, it will have a green colored head. A pigtail lead for this purpose will be green and may have yellow stripes. A pressure type wire connector will be marked "G," "Gr," "Ground," "Grounding," or the equivalent, on or near the connector, or will be identified on the unit wiring diagram. The grounding terminal may be identified by the symbol "  ."

A unit that requires connection to a circuit with power supply conductors larger than No. 2 AWG does not have to be provided with means for connecting an equipment grounding conductor for that circuit. Such a unit may be grounded by an appropriate metallic raceway, but it will be marked "If This Unit Is Supplied By A Wiring System That, In Accordance With The National Electrical Code, Requires The Installation Of An Equipment Grounding Conductor Or Conductors, A Terminal Or Terminals For Connection Thereof Must Be Installed," or an equivalent statement.

23. FACTORY-PROVIDED WIRE CONNECTORS

Some units have pigtail leads for connection to supply or control circuit wiring when the unit is installed. To help provide a reliable splice, these leads are ordinarily no more than two wire sizes smaller than the minimum size copper conductor required by the *NEC®* for the external circuit. When two or more pigtail leads are to be connected to the same external circuit conductor, each pigtail may be more than two wire sizes smaller, if a suitable reusable wire connector, such as a twist-on wire connector, is factory-provided on the pigtails. If so, the unit is marked to indicate that the provided connector is to be used for field wiring splice connection.

Some units equipped with pigtail leads for splice connections to an external line voltage circuit have reusable wire connectors on these leads that may not be suitable for splicing to properly sized external circuit wiring. These wire connectors may be used, for example, to insulate lead ends, not necessarily used in every installation. Such units are marked to indicate that these wire connectors are not for field wiring connections.

Either type of marking described above will be located in the field wiring area where plainly visible during installation and inspection.

24. COPPER OR ALUMINUM WIRING

Units provided with terminals for field-connected wiring are marked to indicate the use of copper conductors only or whether aluminum and/or copper clad aluminum conductors may also be used. This marking is independent of any marking on the terminals and visible during unit installation and inspection after unit installation. Such a marking is typically located on a surface adjacent to the terminals or included on the attached unit wiring diagram. The conductor material(s) specified by the marking applies to the wires connected to the unit itself. Other conductor materials, however, may be used elsewhere in the circuits supplying the unit, provided that proper consideration is given to ampacities, splicing methods, etc.

25. TEMPERATURE RATING OF FIELD INSTALLED WIRING

For some equipment, the testing and construction are based on the use of wiring with 75°C insulation. However, most equipment, where ampacities of 100 or less are involved, is marked for use with 75°C rated conductors at 75°C ampacities. The use of wiring with 75°C insulation is necessary when conductor ampacities higher than 100 are required. When the use of wiring with insulation rated higher than 75°C (or 75°C) is required because of terminal or wiring compartment temperatures, the equipment must be marked to specify the minimum temperature rating (90°C) and the minimum conductor size of the wires unless the conducter size is to be based on the 75°C wire ampacity. Such markings are located adjacent to the field-wiring connection point or on an attached wiring diagram and are visible while making the connections and after they have been made. Some equipment is marked to indicate an area for locating field wiring and splices to prevent excessive insulation temperatures.

26. WIRING DIAGRAM

Most units have an attached wiring diagram. Such a diagram is required on a UL Listed unit when the method of connection to the electrical supply is not obvious, or if it is necessary to electrically connect an accessory or other remote load to the unit. Also, such a diagram is always required on a duct heater and includes the proper external connections for interlocking with the blower motor to insure compliance with *NEC*® Section 424.63. Many of the other markings concerning proper field-wiring connections described elsewhere in this Guide may be included in this wiring diagram.

27. CONNECTION TO LOW VOLTAGE SUPPLY SOURCE

Some units require an external supply source for low -voltage control circuits. The required voltage rating of this source (typically 24 volts) will be identified on the unit wiring diagram (see "Wiring Diagram") or by a marking adjacent to the terminals or leads to which the supply wires

are to be connected. The minimum necessary capacity rating of the supply transformer will also be included in this marking unless it is less than 5 volt amperes. If the supply is required to be a limited energy type because of wiring or loads within the unit, the marking will also indicate this (e.g., "Class 2," etc.).

28. EXTERNAL DEVICES AND/OR WIRING IN LOW VOLTAGE CIRCUITS

Many units are intended for connecting external low-voltage control circuit switching devices and wiring. If the power supply for such a circuit is part of the unit and the unit is marked Class 2 the circuit is a Class 2 control circuit per *NEC*® Article 725 and may be wired accordingly. If external to the unit, the type of supply source will determine the external wiring and components to be used as explained in Section 27.

If the type of unit transformer, the function of the control circuit, or other items require that the circuit be treated as a Class 1 control circuit, the unit will be marked "Wire Per NEC Class 1" or the equivalent. This marking is located on the attached wiring diagram (see "Wiring Diagram") or in the immediate vicinity of the terminals or leads provided for connection to the control circuit.

29. MULTIPLE CLASS 2 SUPPLIES

A unit with a built-in transformer that provides a Class 2 control circuit supply for connection to a heating/ cooling thermostat or an equivalent device will be marked to indicate that isolation shall be maintained between this circuit external to the unit and separate external Class 2 output circuits. This marking may be a part of the wiring diagram (see "Wiring Diagram") that shows the proper wiring connections necessary to maintain this separation, or it may be a statement such as "Use Thermostat With Isolating Contacts To Prevent Interconnection Of Class 2 Outputs." The statement may be located in the immediate area of the unit's field-wiring Class 2 circuit connections, or on the unit wiring diagram.

A unit that contains two or more built-in transformers to supply separate external Class 2 control circuits is marked similarly to warn that separation must be maintained between these circuits external to the unit.

Failure to heed these markings can result in control circuits exceeding the limitations for Class 2 control circuits as defined in *NEC*® Article 725.

30. INSTALLATION CLEARANCES

Many types of units require clearances between the cabinet and attached duct work, and combustible materials. These clearances are required to be marked on the unit nameplate. The required clearances are given in inches.

Except units that show "Duct Heater" as the product identity with the Listing Mark, all equipment with electric resistance space heaters is marked with the required clearance even if the "clearance" is zero.

Duct heaters need to be marked only with required clearances that are greater than zero. All duct heaters rated 50 kilowatts or less, however, are required to be suitable for zero clearance

installations.

Designated clearances other than zero are based on tests with uninsulated sheet metal ducts attached. Under these conditions, temperatures not higher than established maximum values have been measured on a wooden test enclosure, representing combustible construction, with the specified clearance (air) from the unit and ducts. When clearances are required between an attached outlet duct and combustible materials, the marking usually specifies the length of duct beyond the plenum or unit cabinet from which clearances must be maintained. If no distance is specified, the clearances need not be maintained from the portions of duct that are more than 6 feet from the plenum.

31. STATIC PRESSURE

The external static pressure imposed by the duct system attached to a unit can affect the unit air flow adversely. UL tests equipment at a high enough static pressure to take into account the effect of typically connected duct work; the minimum test static required is based on the rated heating and/or cooling capacity of the equipment. Tests on larger equipment require higher static pressures to account for the anticipated use of longer, more complex duct systems. Some units are marked to indicate the static pressure at which they were tested.

32. REFRIGERANT TYPE

Units employing a compressor with or without a refrigerant coil indicate the refrigerant to be used for field charging and the refrigerant used for any factory charge (see "Refrigerant Amount"). This designation is a number in accordance with ASHRAE Standard 34, or UL 2182, the Standard for Refrigerants, and is either prefixed or suffixed by the word "Refrigerant" or prefixed by the letter "R" or the trade name of the refrigerant. The use of a refrigerant type other than one designated in the marking is not covered by the UL Listing of the unit, except as noted in the section "Refrigerant Retrofit." Units without a compressor need not be marked with the refrigerant type.

33. REFRIGERANT AMOUNT

The nameplate on a unit containing a refrigerant compressor is marked with information concerning the amount of refrigerant. For a self-contained unit with the full amount of refrigerant needed for proper operation of the system, the marking will state the factory refrigerant charge weight.

A unit requiring field charging that is a section of a complete system Listed by UL (see "Split-Systems"), or one that contains a complete refrigerant system is marked to show the correct refrigerant charge weight or how to determine the correct charge. The marking to show how to determine the correct charge may refer to other markings on the unit or to the installation instructions. In either case, the nameplate always includes a blank for the installer to mark the total system charge weight.

UL Listed units that do not contain the complete refrigerant systems and are not a section of a complete system Listed by UL, merely include a blank on the nameplate for the installer to mark the total system charge weight.

33A. REFRIGERANT RETROFIT

The information marked on the equipment nameplate relative to refrigerant type and amount of refrigerant is critical when equipment is to be evaluated using the installation requirements of ASHRAE 15, "Safety Code for Mechanical Refrigeration." In these cases, the information in the ASHRAE standard, such as refrigerating system classification, table of allowable refrigerants and amounts, and system application requirements, is used to make calculations that ensure that the refrigerant type and amount are suitable for the application, the size of the room, the type of occupancy, etc.

In view of the national and international environmental protocol restrictions on the use of ozone-depleting chemicals and the increasing availability of alternative refrigerants, situations will arise in the field for which the equipment's original refrigerant is retrofitted with another type of refrigerant. The amount of the new refrigerant may also change from the amount of original refrigerant used.

In some cases, the alternative refrigerant being retrofitted will not be included in the ASHRAE 15 standard. For the interim period, until such time as the ASHRAE standard can be revised, information (such as allowable amounts per cu. ft. of space) has been included in the UL Listing Report covering the equipment. This information may be obtained from the equipment manufacturer.

34. REFRIGERANT PRESSURE

A unit with refrigerant-containing components is marked to indicate the pressure for which the refrigerant system or any of its components were factory tested for leakage. Separate test pressures may be marked for the discharge (high) and suction (low) sides of the system. The pressure is identified as "Design Pressure" and appears on the unit nameplate.

These pressure markings are of little concern to installers or inspectors when the unit involved is one of the following:

1) A unit that is marked to indicate that it is factory charged (see "Refrigerant Amount");
2) A unit serving as a section of a UL Listed system (see "Split-Systems") charged with the correct refrigerant type and amount (see "Refrigerant Type" and "Refrigerant Amount"); and,
3) A unit containing a complete refrigerant system charged with the correct refrigerant type and amount.

For these types of units, the factory test pressure is adequate for the factory charge or the designated field charge.

For other types of units, the adequacy of the factory test pressure may need to be determined by measurements on the installed system.

A unit requiring connection to a remote condenser that is not part of a UL Listed system is also marked to specify the minimum design pressure of the remote condenser. To comply with this specification, the "Design Pressure" marked on the condenser should be at least as high as the minimum design pressure specified, and the condenser should be the type specified.

35. HEATING AND COOLING COILS

Equipment intended to employ water or steam as a heat exchange medium for the conditioned air is required to be marked with the fluid type(s) for which it has been evaluated. If a coil is for hot (or both hot and cold) water, the marking indicates the maximum permissible inlet water temperature. If the coil is for steam, or for water at a temperature exceeding 200°F, the marking indicates the maximum permissible pressure. If the coil is for cooling only, this information is marked. Such markings are generally located in the area where piping connections are made to the unit.

36. SUITABLE FOR OUTDOOR USE

A unit evaluated for outdoor installation is identified by a marking "Outdoor Use" or equivalent statement on or near the nameplate. These units are investigated for adequate corrosion protection and the ability of the enclosure to prevent accumulation of water, which could result in risk of electric shock or fire. Some equipment such as a through-the-wall unit, is marked to indicate that only a portion of the unit may be mounted outdoors. Equipment that is UL Listed for outdoor use is identified either by an appropriate footnote or by the designation of the Listed equipment (i.e., outdoor section) in UL's published Listings. A unit not marked as indicated above is UL Listed for indoor installation only.

37. MOUNTING POSITION

The intended mounting position of most units is obvious from their construction and/or position of their unit markings. For some equipment, particularly duct heaters, the mounting position is not obvious. Most duct heaters are suitable for mounting in either horizontal or vertical ducts. All duct heaters and some similar types of equipment are required to be marked with their acceptable mounting positions (e.g., "This Side Up In Horizontal Duct," "This Side Up In Vertical Duct," etc.). Other equipment, such as indoor air handlers, are often investigated and UL Listed for mounting in several positions (e.g., upflow, downflow, horizontal).

For some types of equipment, including all units incorporating electric resistance space heaters, it is particularly important that the unit be oriented properly, as to which side is up when mounted in the horizontal position.

Note that a unit suitable for mounting in any one of several positions sometimes may be properly installed with the markings located sideways or upside down. If there is any question concerning the mounting position of a UL Listed unit, and there are no markings on the unit to indicate that it may be mounted in this position, consult the manufacturer's installation instructions. UL reviews the instructions packaged with the unit as part of its investigation.

38. AIR FLOW DIRECTION

For some duct heaters, proper operation of the temperature limiting devices is dependent on the direction of air flow across the heating elements. Such units are marked with an arrow and appropriate wording to indicate the proper direction of air flow.

39. AIR VELOCITY

Proper operation of electric resistance space heaters is dependent on the quantity of air moving past the elements. The adequacy of the air moving means is determined as part of the investigation of all central electric space heating equipment Listed with specific fans or blowers. This pertains to units with both heaters and blowers factory installed and to units marked to indicate the use of field-installed heater accessories (see "Use of Accessories").

Multispeed Blower Motors
Some units designed for field-installed heaters use a multispeed blower motor, and it may be necessary to adjust the fan speed when certain heaters are installed. Such equipment is marked to indicate the need for this change, and details showing how to accomplish it are included in markings, usually on the wiring diagram.

Large Commercial/Industrial Equipment
Some very large commercial and industrial type equipment with fixed electric space heating use belt-driven, adjustable speed blowers. The manufacturer's installation instructions include directions for setting the blower speed based on the external static pressure. UL verifies these instructions as part of its product investigations, and these instructions should be followed to assure adequate air flow.

Duct Heaters
One type of unit UL does not investigate for use with specific air moving equipment is a duct heater. *NEC*® Section 424.59 requires provision of uniform and adequate air flow over the face of the heating elements in a duct heater. Every duct heater is marked to indicate the minimum required air flow. This marking may include the specific minimum velocity, but in most cases, it will reference the installation instructions for details. The installation instructions typically include a chart or graph showing the minimum required air flow based on the heater kilowatt rating and the temperature of the air entering the heater. They also include directions for using the graph, and generally at least one example. The manufacturer's instructions, packaged with the heater, are reviewed as part of the UL investigation. It is important that they be followed, as also indicated in *NEC*® Section 424.66.

Minimum air velocities for duct heaters are usually specified in feet per minute, but may be specified in cubic feet per minute, if the duct heaters are to be installed only in a duct of the same size as the heater. The installation instructions should be consulted for any restrictions in this regard.

NEC® Section 424.59 states that the airflow shall be uniform as well as adequate. Another factor that should not be overlooked is the fine print note in *NEC*® Section 424.59. Generally, an unobstructed straight run of duct at least 4 feet long on the inlet side of the heater is adequate to insure fairly uniform air flow across the duct area. Obstructions on the outlet side of the heater, however, can also affect uniformity of airflow. Published information for Duct Heaters (KOHZ) in the UL White Book offers some additional guidance.

40. INLET AIR TEMPERATURE

UL's investigation of most equipment is based on the assumption that the air entering an indoor unit is at normal room temperature. UL tests are conducted with inlet air temperatures of 80°F.

Some indoor units are investigated and Listed for connection to duct systems where the air entering the unit is preheated by some other means. Since duct heaters are typically used in such installations, any unit identified as a "Duct Heater" as part of the Listing Mark is marked to indicate a maximum entering air temperature (see *NEC*® Section 424.60). For some duct heaters, this marking may reference the installation instructions that, as indicated elsewhere in this Guide, have been investigated as part of the Listing and should be consulted. Fan units may also be used in applications where the inlet air is preheated, and if tested to cover this application, will also be marked to indicate a maximum entering air temperature. If not so marked, a maximum entering air of 80°F is assumed. Use of equipment in systems that preheat inlet air to a temperature higher than its marked maximum inlet temperature, or 80°F if not marked, can result in overheating of wiring, electrical components and duct work.

41. DUCT CONNECTIONS

Units designed to be connected to a duct system for conditioned air are Listed for installation in accordance with the applicable portions of the National Fire Protection Association Standard for Installation of Air Conditioning and Ventilating Systems, NFPA 90A, and/or the Standard for Warm Air Heating and Air Conditioning Systems, NFPA 90B. Certain unit markings may limit the types of installations permitted by these Standards.

NFPA Standards 90A and 90B permit certain types of residential installations of nonheating equipment without a noncombustible duct or equivalent barrier beneath a bottom air discharge or return air opening in a unit. A unit that does not include a means of heating but requires such a barrier is marked "For Nonresidential Installation Only."

A unit not investigated for connection to a duct system as defined in these Standards, may be marked "This Unit Is Intended Only For Free-Air Discharge Or For Connection To A Duct Supplying Only One Room."

Certain types of equipment that cannot be properly installed with attached duct work in rooms having a ceiling height of 7-1/2 feet or less may be marked to indicate the minimum required ceiling height.

42. Short-Circuit Current Rating

NEC® Section 440.4(B), now requires that multimotor and combination-load equipment shall be provided with a visible nameplate marked with the short-circuit current rating, with the following exception:

Multimotor and combination-load equipment used in one and two family dwellings, cord and attachment plug connected equipment, or equipment supplied from a branch circuit protected at 60 amps or less shall not be required to be marked with a short-circuit current rating.
All these types of markings described above are located on or adjacent to the unit nameplate.

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NEC® Section

APPENDIX A

UL HEATING AND COOLING EQUIPMENT PRODUCT CATEGORIES

UL does list this type of equipment and continues to develop new product categories to address the safety issues associated with this type of equipment. Below is a list of product categories that UL currently lists to address these types of products. Each product category is tabulated with a UL Category Code. By clicking on the code, you will be linked to the UL Guide Information for the category and any Listings or Classifications under that Product Category in the UL Online Certifications Directory database at **www.ul.com/database**.

Category Code	Category Name	Standard Used
LZLZ	**Electric Heating and Cooling Equipment**	
KTFV	Absorption Air Conditioning Equipment	UL 1995, UL 795, UL 296, ANSI Z21.40.1
ACKZ	Air conditioners, packaged terminal	UL 484, ANSI Z21.86
ABFY	Air conditioning equipment accessories	UL 1995
KZZV	Central furnaces	ANSI Z21.47
SGYU	Condensing and Compressor Units	UL 1995
KOHZ	Duct heaters	UL 1996
LZPG	Ductless heating and cooling equipment, large, open building	UL 1995
LZPU	Heater assemblies Classified for use on Specified Equipment	UL 1995
LZFE	Heating and Cooling Equipment	UL 1995
KMLW	Remote control panels for electric duct heaters	UL 1996
KKWS	Room Air Heaters, Fixed and Location Dedicated	UL 2021
ACVS	Special purpose air conditioners	UL 484
MJAT	Specialty heating and heating-cooling appliance accessories	UL 1995, UL 462, UL 207, UL 295, UL 795, UL 296
	Gas-Fired Heating and Cooling Equipment	
LLRR	Commercial radiant heaters	ANSI Z83.19 or Z83.20
LKQA	Outdoor patio heaters	ANSI Z83.26
LTCT	Unit heaters	ANSI Z83.8
LPOL	Unvented room and log heaters	ANSI Z21.11.2
LPNH	Vented room heaters	ANSI Z21.86
LPPM	Vented fireplace heaters	ANSI Z21.88
	Solid-Fuel-Fired Heating and Cooling Equipment	
LBHZ	Solid-fuel-fired central furnaces	UL 391
DGAW	Solid-fuel type room heaters	UL 1482
	Oil-Fired Heating and Cooling Equipment	
LGJR	Floor furnaces	UL 729
LUDZ	Unit heaters	UL 731
	Kerosene-Fired Heating and Cooling Equipment	
LQLT	Room heaters	UL 896
	Combination-fired Heating Equipment	
LANT	Gas-Oil-Fired Central furnaces	ANSI Z21.47 and UL 727
LTQR	Gas-oil-fired unit heaters	ANSI Z83.8 and UL 731
LBEV	Solid-fuel Combination central furnaces	UL 391

APPENDIX B: HEATING AND COOLING EQUIPMENT CODES AND STANDARDS

Heating and cooling equipment must be installed in accordance with model codes and installation standards. These codes require these products to be listed and labeled in accordance with applicable product standards.

UL standards are typically identified as Standards for Safety and cover reasonably foreseeable risks associated with a product. Limitations applicable to the products covered by the standard are delineated in the Scope section of the standard. UL standards are intended to:

- Identify requirements for evaluation of products and provide consistency in the application of these requirements.
- Provide guidance for development of products by manufacturers.
- Provide requirements compatible with nationally recognized installation codes

An UL Outline of Investigation is a document that contains the construction, performance, and marking criteria used by UL to investigate a product when the product is not covered by the scope of an existing UL Standard for Safety. Outlines are not consensus documents and do not require review by an UL Standards Technical Panel (STP) or other external group.

ANSI Z21.11.2	Gas-Fired Room Heaters, Volume II, Unvented Room Heaters
ANSI Z21.47	Gas-Fired Central Furnaces
ANSI Z21.86	Vented Gas-Fired Space Heating Appliances
ANSI Z21.88	Vented Gas Fireplace Heaters
ANSI Z83.8	Gas Unit Heaters and Gas-Fired Duct Furnaces
ANSI Z83.19	Gas-Fired Low-Intensity Infrared Heaters
ANSI Z83.20	Gas-Fired High-Intensity Infrared Heaters
ANSI Z83.26	Gas-Fired Outdoor Infrared Patio Heaters
IFGC	International Fuel Gas Code
IMC	International Mechanical Code
NEC (NFPA 70)	National Electrical Code
NFGC (NFPA 54)	National Fuel Gas Code
UL 207	Refrigerant-Containing Components and Accessories, Nonelectrical
UL 295	Commercial-Industrial Gas Burners
UL 296	Oil Burners
UL 391	Solid-Fuel and Combination-Fuel Central and Supplementary Furnaces
UL 462	Heat Reclaimers for Gas-, Oil-, or Solid Fuel-Fired Appliances
UL 484	Room Air Conditioners
UL 727	Oil-Fired Central Furnaces
UL 729	Oil-Fired Floor Furnaces
UL 731	Oil-Fired Unit Heaters
UL 795	Commercial-Industrial Gas Heating Equipment
UL 896	Oil-Burning Stoves
UL 1482	Solid-Fuel Type Room Heaters
UL 1995	Heating and Cooling Equipment
UL 1996	Electric Duct Heaters
UL 2021	Fixed and Location-Dedicated Electric Room Heaters
UMC	Uniform Mechanical Code

ATTACHMENT DRL-2

2002 STANDARD for

AIR-CONDITIONING AND REFRIGERATING EQUIPMENT NAMEPLATE VOLTAGES

AIR-CONDITIONING &
REFRIGERATION
INSTITUTE

Standard 110

4100 N. FAIRFAX DR., STE. 200 • ARLINGTON, VIRGINIA 22203

IMPORTANT

SAFETY RECOMMENDATIONS

It is strongly recommended that the product be designed, constructed, assembled and installed in accordance with nationally recognized safety requirements appropriate for products covered by this standard.

ARI, as a manufacturers' trade association, uses its best efforts to develop standards employing state-of-the-art and accepted industry practices. However, ARI does not certify or guarantee safety of any products, components or systems designed, tested, rated, installed or operated in accordance with these standards or that any tests conducted under its standards will be non-hazardous or free from risk.

Note:

This standard supersedes ARI Standard 110-97.

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AIR-CONDITIONING AND REFRIGERATING EQUIPMENT NAMEPLATE VOLTAGES

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish, for air-conditioning and refrigerating equipment: definitions; voltage rating requirements; equipment performance requirements; and conformance conditions.

1.1.1 *Intent.* This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors, and users.

1.1.2 *Review and Amendment.* This standard is subject to review and amendment as technology advances.

1.2 The provisions herein are recommendations intended for implementation only through reference by other authoritative documents.

Section 2. Scope

2.1 *Scope.* This standard applies to 60 Hz electrical voltage ratings and operating limits as applied to air-conditioning and refrigerating equipment, heat pumps, and electric furnaces.

2.1.1 *Exclusions.* This standard does not apply to 50 Hz electrical voltage ratings

Section 3. Definitions

All terms in this document shall follow the standard industry definitions in the current edition of *ASHRAE Terminology of Heating, Ventilation, Air Conditioning and Refrigeration* unless otherwise defined in this section.

3.1 *"Shall" or "Should."* "Shall" or "should" shall be interpreted as follows:

3.1.1 *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.1.2 *Should.* "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.2 *Voltages.*

3.2.1 *Equipment Nameplate Voltage Rating.* The nominal Utilization Voltage marked on the equipment nameplate by the manufacturer (Table 1).

3.2.2 *Nominal System Voltage.* A nominal value assigned to the electric power supply system for the purpose of conveniently designating its voltage class.

3.2.3 *Service Voltage.* The voltage at the point where the electric systems of the supplier and the user are connected.

3.2.4 *Utilization Voltage.* The voltage at the line terminals of the utilization equipment.

Section 4. Voltage Rating Requirements

4.1 *Standard System Voltage Relationships.* Table 1 presents the basic relationships between standard Nominal System Voltages and Utilization Voltages for air-conditioning and refrigeration equipment and components. (Data derived from ANSI C84.1).

4.2 *Application of Voltage Ranges.* (See ANSI C84.1).

4.2.1 *Range A-Service Voltage.* Electric supply systems are to be so designed and operated that most Service Voltages are within the limits specified for this range. The occurrence of Service Voltages outside of these limits should be infrequent.

4.2.2 *Range A-Utilization Voltage.* User systems are to be so designed and operated that, with Service Voltages within Range A limits, most Utilization Voltages are within the limits specified for this range.

Utilization equipment shall be designed and rated to give fully satisfactory performance throughout this range.

4.2.3 *Range B-Service and Utilization Voltages.* This range includes voltages above and below Range A limits that necessarily result from practical design and operating conditions on supply or user systems or both. Although such conditions are a part of practical operations, they shall be limited in extent, frequency and duration. When they occur, corrective measures shall be undertaken within a reasonable time to improve voltages to meet Range A requirements.

Table 1. Standard System Voltage Relationships for Power Circuits[1]

Nominal System Voltage	Equipment Nameplate Voltage Rating[2, 3]	Voltage Range A			Voltage Range B		
		Minimum		Maximum	Minimum		Maximum
		Utilization Voltage[1]	Service Voltage	Utilization and Service Voltage	Utilization Voltage[1]	Service Voltage	Utilization and Service Voltage
Single- Phase							
120	115	108	114	126	104	110	127
208	208(200)* or 208/230(200/230)*	187	197	218	180	191	220
240	230 or 208/230(200/230)*	216	228	252	208	220	254
277	265	249	263	291	240	254	293
Three-Phase							
208	208(200)* or 208/230(200/230)*	187	197	218	180	191	220
240	230 or 208/230(200/230)*	216	228	252	208	220	254
480	460	432	456	504	416	440	508
600	575	540	570	630	520	550	635

*Alternate values.

Notes: 1. Minimum Utilization Voltages for 120 thru 600 volt combination lighting and power circuits serving cord-and plug-connected equipment are:

Nominal System Voltage	Range A	Range B
120	110	106
208	191	184
240	220	212
277	254	245
480	440	424
600	550	530

2. It is recognized that there are in existence, power systems whose operating characteristics deviate from the voltage range limits of this Table. It shall not be construed that nameplate voltage rated equipment, suitable for application to such systems and deviating from the values appearing in this table, may not be produced.

3. Equipment having more than one marked rated voltage, which is permitted to be connected to these voltages without individual adjustment, should have the voltages separated by a hyphen.

Example: 208-230V; The equipment may be operated at these utilization voltages or at voltages between these values without individually adjusting for the difference between them.

Equipment having more than one marked rated voltage, which requires rewiring or other adjustments made by the installer to the equipment to permit connection to these voltages, should have the voltages separated by an oblique stroke.

Example: 208/230V; The equipment may be operated at these utilization voltages only if the installer makes the proper wiring or adjustment to the equipment for each voltage as specified by the manufacturer.

Insofar as practicable, utilization equipment shall be designed to give acceptable performance in the extremes of this range of Utilization Voltage, although not necessarily as good performance as in Range A.

Exception. For 208 V systems only, motor driven equipment shall be designed to start and operate satisfactorily under rated load conditions at the extremes of Range B, but not necessarily under maximum load conditions. For rated and maximum load conditions, see the industry standards for the product concerned.

It must be recognized that, because of conditions beyond the control of the supplier or user, or both, there will be infrequent and limited periods when sustained voltages outside of Range B limits will occur. Utilization equipment may not operate satisfactorily under these conditions, and protective devices may operate to protect the equipment. When voltages occur outside the limits of Range B, prompt corrective action is recommended. The urgency for such action will depend upon many factors, such as the location and nature of load or circuits involved, and the magnitude and duration of the deviation beyond Range B limits.

Section 5. Equipment Performance Requirements

5.1 *Equipment Standard Rating Requirements.* Equipment standard rating tests, in accordance with equipment rating standards, shall be conducted at the Equipment Nameplate Voltage Rating.

Section 6. Conformance Conditions

6.1 *Conformance.* While conformance with this standard is voluntary, conformance shall not be claimed or implied for products or equipment within its *Purpose* (Section 1) and *Scope* (Section 2) unless such claims meet all of the requirements of the standard.

APPENDIX A. REFERENCES - NORMATIVE

A1 Listed here are all standards, handbooks and other publications essential to the formation and implementation of the standards. All references in this appendix are considered as part of the standard.

A1.1 ANSI C84.1-1995, *Electrical Power Systems and Equipment - Voltage Ratings (60 Hz)*, 1995, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, U.S.A.

A1.2 *ASHRAE Terminology of Heating, Ventilation, Air Conditioning & Refrigeration*, Second Edition, 1991, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

APPENDIX B. REFERENCES - INFORMATIVE

B1 Listed here are all standards, handbooks, and other publications which may provide useful information and background but are not considered essential. References in this appendix are not considered part of the standard.

B1.1 IEC Standard Publication 60038, *IEC Standard Voltages*, 1983, International Electrotechnical Commission, 3 rue de Varembe, P.O. Box 131, 1211 Geneva 20, Switzerland.

ATTACHMENT DRL-3

AMANA 26" BUILT-IN AIR CONDITIONERS

Through-the-wall design for flush-mount applications

Cooling Only or Electric Heat or Heat Pump Models

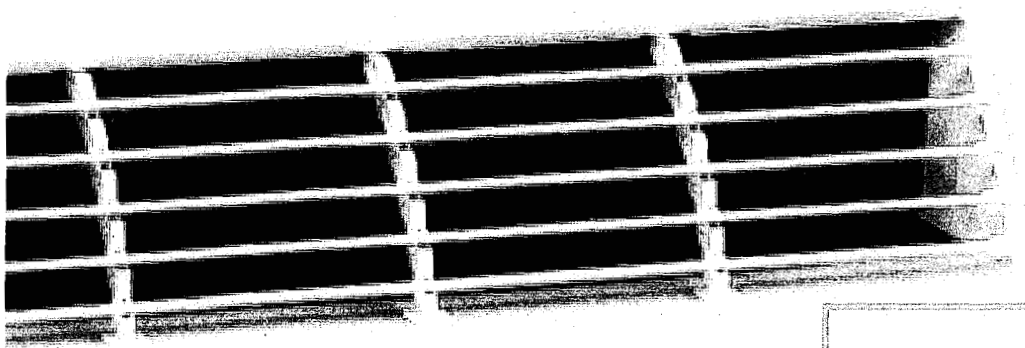
Complete guest comfort with easy to use controls

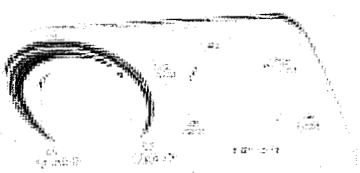
Specifications for:

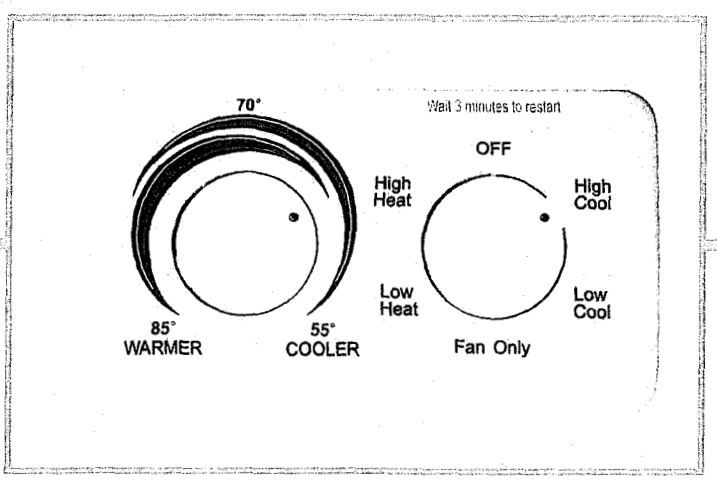
Cooling Models:
PBC092A00MA
PBC122A00MA
PBC093A00MA
PBC123A00MA

Electric Heat Models:
PBE093A35MA
PBE123A35MA

Heat Pump Models:
PBH092A12MA
PBH093A35MA
PBH113A35MA







PBC - Cooling only controls not shown.

- **High Energy Efficiency with models up to 9.5 EER** saving you money when compared to other competition models.
- **Easy removable condenser top** that allows for quick and complete cleaning of outdoor coils. This access for cleaning the outdoor coil enables easy removal of dirt and debris to dramatically lengthen the life of the compressor and other sealed system components. Six easy access screws and let the cleaning begin! Not available on competitor models!
- **Easy access slide out filter** has a permanent polypropylene filter mesh that is easy to remove and clean
- **Accessory Wall Sleeve: PBWS01A** is a solid-side, heavily insulated metal sleeve. It includes a stamped aluminum exterior grille with a weather-seal rear enclosure for installation without the chassis. The sleeve has a solid bottom for complete weather-tight installation. An optional PBWMFC can be used when a more permanent weather seal is needed for sleeves installed without the chassis.
- **100% Full Factory run test** on all units for high reliability and dependability. Units start the first time - every time!
- **4-Way Adjustable airflow** to allow for cooling or heating to any part of the room..
- **Quiet Operation.** Designed with guest comfort in mind — providing reliable, quiet operation for years to come.

Heating & Air Conditioning
Amana®

It's just what you'd expect from an industry leader.

	Cooling Only Models				Electric Heat Models		Heat Pump Models		
Goodman Model	PBC092A00MA	PBC122A00MA	PBC093A00MA	PBC123A00MA	PBE093A35MA	PBE123A35MA	PBH092A12MA	PBH093A35MA	PBH113A35MA
General Features:									
Voltage	115	115	230 / 208	230 / 208	230 / 208	230 / 208	115	230 / 208	230 / 208
Approx. chassis weight	80 lbs	80 lbs	80 lbs	80 lbs	85 lbs	85 lbs	85 lbs	85 lbs	85 lbs
Approx. shipping weight	95 lbs	95 lbs	95 lbs	95 lbs	98 lbs	98 lbs	98 lbs	98 lbs	98 lbs
Cooling:									
Capacity / BTUH	9,300	11,600	9,300 / 9,100	11,600 / 11,200	9,300 / 9,100	11,600 / 11,200	9,000	9,000 / 8,700	11,000 /10,700
Amps	8.8	10.7	4.2 / 4.6	5.3 / 5.8	4.2 / 4.5	5.4 / 5.8	8.5	4.2 / 4.6	5.4 / 5.7
Watts	1,010	1,227	962 / 947	1,228 / 1,208	964 / 931	1,231 / 1,213	985	967 / 953	1,228 / 1,195
CFM	258	270	258	270	258	270	258	258	270
E.E.R.	9.5	9.4	9.5 / 9.5	9.4 / 9.4	9.5 / 9.5	9.4 / 9.4	9.4	9.5 / 9.5	9.0 / 9.0
Energy Star Qualified	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Dehumification - pts/hr	2.5	3.4	2.5	3.4	2.5	3.4	2.5	2.5	3.4
Electric Heat:									
Capacity / BTUH	n/a	n/a	n/a	n/a	11,000 / 9,000	11,000 / 9,000	3,900	11,000 / 9,000	11,000 / 9,000
Amps	n/a	n/a	n/a	n/a	15.2 / 13.8	15.2 / 13.8	12.0	15.2 / 13.8	15.2 / 13.8
Watts	n/a	n/a	n/a	n/a	3,500 / 2,877	3,500 / 2,877	1,150	3,500 / 2,877	3,500 / 2,877
Heat Pump: (Reverse cycle)									
Capacity / BTUH	n/a	n/a	n/a	n/a	n/a	n/a	8700	8,500 / 8,200	10,100 / 9,800
Amps	n/a	n/a	n/a	n/a	n/a	n/a	7.5	3.7 / 4.0	4.6 / 4.8
Watts	n/a	n/a	n/a	n/a	n/a	n/a	870	857 / 832	1,055 / 1,012
C.O.P	n/a	n/a	n/a	n/a	n/a	n/a	3.0	3.0 / 3.0	2.7 / 2.7
Adjustable changeover thermostat	n/a	n/a	n/a	n/a	n/a	n/a	Yes	Yes	Yes
Thermostatic drain valve	n/a	n/a	n/a	n/a	Yes	Yes	Yes	Yes	Yes
Electrical Data:									
Circuit Breaker Size	15-amps	15-amps	15-amps	15-amps	20-amps	20-amps	15-amps	20-amps	20-amps
Plug type	Parallel	Parallel	Tandem	Tandem	Perpendicular	Perpendicular	Parallel	Perpendicular	Perpendicular
Power cord length	8.0' w/LCDI	8.0' w/LCDI	6.0' w/LCDI	6.0' w/LCDI	6.0' w/LCDI	6.0' w/LCDI	8.0' w/LCDI	6.0' w/LCDI	6.0' w/LCDI

Note: Units ship without the optional PBWS01A wall sleeve and require a solid-side sleeve for field installation. If installing into existing sleeves, call your Amana sales person for compatibility assessment or adapter kits. The product warranty can be voided if units are installed into improper sleeves or used with improper grilles.

Features: (all models)

Agency Approval	U.L (Under Writers Laboratory listed for safety ratings)
Chassis Type	Slide-out for easy installation and service accessibility
Fan speeds:	2 speeds: High & Low
Energy Saver	Yes - (Cooling only - Auto fan operation)
Fan ONLY	Yes - High Speed
Exhaust CFM	Yes-TBD
Discharge air	Top discharge with 4-way adjustable air throw
Slide-out-filter	Top Pull-out Polypropylene - Permanent filter that is washable
Condensate drain spout	Yes - external drain spout on the PBWS01A optional wall sleeve

Dimensions:	Height	Width	Depth
PBWS01A Sleeve	15 5/8"	26.0"	16 7/8"
With chassis installed		Depth with chassis installed and room front cover attached = 21 7/8"	
Sleeve Cut-outs:	15 13/16"	26 3/16"	Maximum wall thickness = 16 3/8"

Plug Type:

Parallel — 15 Amps 125 Volts

Tandem — 15 Amps 250 Volts

Perpendicular — 20 Amps 250 Volts

Optional Accessories:

Solid-Side Wall sleeve	PBWS01A - Insulated Metal - Solid bottom - Solid-Side Wall Sleeve. Includes weather board and stamped aluminum exterior grille - Stonewood Beige.
Metal Front Cover	PBWMFC - Insulated Room-Side Panel - for use when the PBWS01A is installed without the chassis for prolonged periods of time
Charcoal Filter	PBCFK - washable permanent filter media with activated charcoal - odor absorbsion affective for up to 6-months
Architectural Grille	AGK26SB - Architectural Louvered, Extruded Aluminum Exterior Grille - Custom Color
Internal Drain Kit	DK900D - drain kit for external or internal condensate drainage - attaches to PBWS01A sleeve

5 year Parts and Labor Warranty:

1-year entire unit & 5-year sealed system components. Goodman will repair or replace any factory defective part or sealed system leak caused by a defective part and pay labor and associated service costs directly related to the part replacement or repair. See product warranty for complete details.

Heating & Air Conditioning Amana®

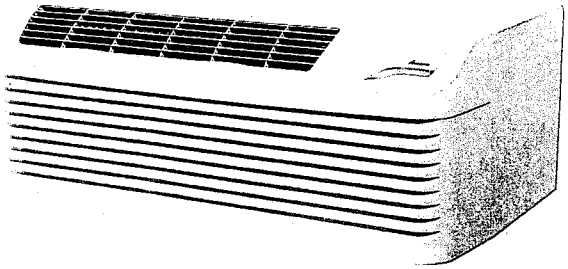
It's just what you'd expect from an industry leader.

ATTACHMENT DRL-4

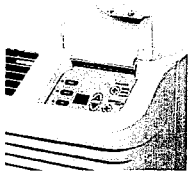
Heating & Air Conditioning
Amana®

PTAC Air Conditioners and Heat Pumps

Product Specifications



DigiSmart Control Board



12.1 EER / 3.4 COP

Product Features

- Quiet Operation: STC of 28
- Assembled in the USA for 30 years
- Increased Dehumidification Capacity
- 100% Run Tested at our plant in Fayetteville, TN, for leaks
- 7⅝" Unit Front Depth: one of the shallowest silhouettes in the industry today
- Removable Condenser Shroud allows easy access to enable regular cleaning of coils
- Easy Pull-Out Filters that are washable and easy to maintain
- Filter Dryer for Sealed System Refrigerant
- 7-Button Touch Pad provides complete control to guests for in-room comfort while maintaing energy efficiency
- Condensate Dispersion System removes condensate from indoor cooling operation and evaporates it into the atmosphere through the condenser
- DigiSmart™ Front Desk Control and energy management software
- Room Freeze Protection is activated when the unit senses temperatures of 40°F or below
- Versatile Style that blends into any room's color scheme and decor
- Easy to Service with On-Board LED Diagnostics
- DigiSmart™ Wireless Remote Thermostat is available
- Remote Temperature Sensing for guest climate control
- Extended Heat Pump Heating down to as low as 24°F outdoor ambient temperature
- Zero Floor Clearance allows unit to be installed flush to a finished floor
- 30-Second Fan-Off Delay
- Compressor Lock-In prevents compressor short-cycling
- Constant Fan Mode
- Hidden Ventilation Control
- High-Pressure Switch

5 YEAR PARTS LIMITED WARRANTY* R-410A REFRIGERANT

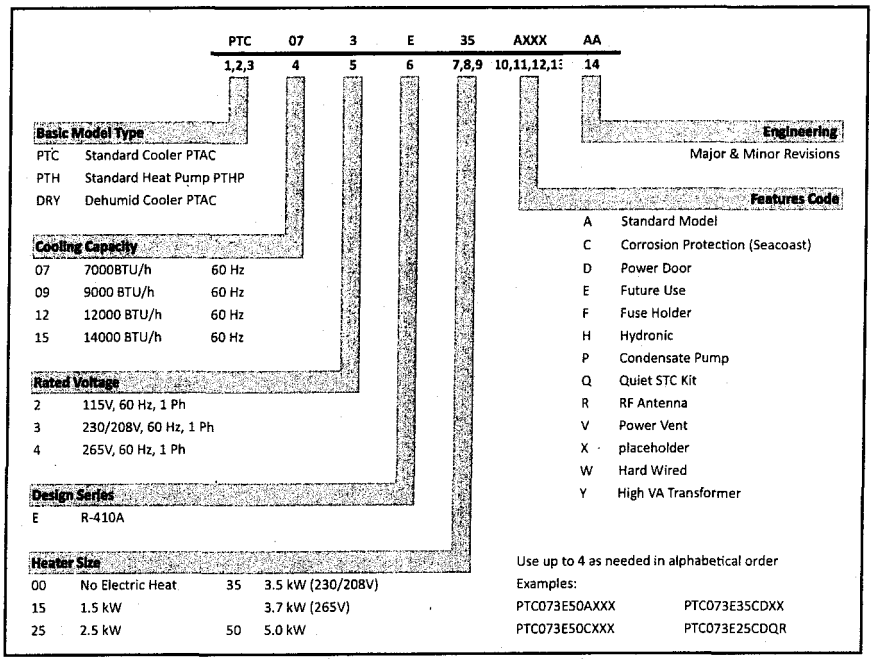
C SP US C INTERTEK ETL LISTED US AHRI CERTIFIED AHRI CERTIFIED ISO 9001

First YearWarranty: Parts & Labor
Second through Fifth Year: Parts & Labor on certain sealed system components
Second through Fifth Year: on certain functional parts only
* Complete warranty details available at www.amana-ptac.com.

PROUDLY ASSEMBLED IN THE U.S.A. FOR OVER 30 YEARS Amana

Assembled in the USA for 30 years:
Units are 100% run-tested and triple-tested for leakage.

NOMENCLATURE



PRODUCT SPECIFICATIONS: PTC MODELS — COOLING/ELECTRIC HEAT

R-410A REFRIGERANT

230/208 VOLTS

MODEL [1,6,8,9]		PTC 073E**AXXX	PTC 093E**AXXX	PTC 123E**AXXX	PTC 153E**AXXX
Voltage [1,3]		230 / 208	230 / 208	230 / 208	230 / 208
Capacity (BTU/h)		7,600 / 7,500	8,700 / 8,500	11,500 / 11,200	14,000 / 13,600
Amps[12]		3.5 / 3.5	4.1 / 4.1	5.6 / 5.6	7.0 / 7.0
Watts[12]		650 / 630	775 / 725	1095 / 1075	1415 / 1375
EER		11.7 / 11.9	11.2 / 11.7	10.5 / 10.4	9.9 /9.9
UNIT WITHOUT ELECTRIC HEATER					
Min. Circuit Amps [2,4,12]		4.2	5	6.8	8.5
CFM (Cool/Wet Coil)	High	290	290	290	340
	Low	264	264	264	314
CFM (Dry Coil)	High	310	310	310	360
	Low	282	282	282	332
Ventilated Air, CFM (Fan Only)*		65*	65*	65*	65*
Dehumidification (Pints/Hr.)		1.7	2.2	3.6	4.4
Net Weight (lbs.)		99	103	106	117
Ship Weight (lbs.)		114	118	123	134

265/277 VOLTS

MODEL [1,6,8,9]		PTC 074E**AXXX	PTC 094E**AXXX	PTC 124E**AXXX	PTC 154E**AXXX
Voltage [1,3]		265	265	265	265
Capacity (BTU/h)		7,600	8,900	11,600	14,000
Amps[12]		3.0	3.6	4.8	6.0
Watts[12]		640	775	1,085	1,430
EER		11.9	11.5	10.7	9.8
UNIT WITHOUT ELECTRIC HEATER					
Min. Circuit Amps [2,4,12]		3.6	4.4	5.9	7.3
CFM (Cool/Wet Coil)	High	290	290	290	340
	Low	264	264	264	314
CFM (Dry Coil)	High	310	310	310	360
	Low	282	282	282	332
Ventilated Air, CFM (Fan Only)*		65*	65*	65*	65*
Dehumidification (Pints/Hr.)		1.7	2.2	3.6	4.4
Net Weight (lbs.)		99	103	106	116
Ship Weight (lbs.)		114	118	123	133

* Approximately 95 CFM with optional power vent kit. Actual vent CFM performance will vary due to application and installation conditions. See Notes on following page.

PRODUCT SPECIFICATIONS: PTC / PTH MODELS — ELECTRIC HEAT PERFORMANCE

(Primary Heating for PTC Models; Auxiliary Heating for PTH Models; See below for Power Cord Configuration)

VOLTAGE	ELECTRIC HEAT (kW)	NO. OF STAGES	NOMINAL HEATING (BTU/H)			TOTAL WATTS[8]	TOTAL AMPS	MIN. CIRCUIT AMPACITY[2]	MOP[4] (AMPS)	POWER CORD
			@ 230V	@ 208V	@ 265V					
230/208V	2.5	1	8,500	6,800	--	2,570 / 2,115	11.2 / 10.1	14.0	15	6-15 P
230/208V	3.5	1	12,000	9,900	--	3,570 / 2,935	15.5 / 14.1	19.4	20	6-20 P
230/208V	5	1	17,100	14,000	--	5,070 / 4,160	22.1 / 20.0	27.5	30	6-30 P
265V	2.5	1	--	--	8,500	2,570	9.7	12.1	15	7-20 P
265V	3.7	1	--	--	12,600	3,770	14.2	17.8	20	7-20 P
265V	5	1	--	--	17,100	5,070	19.2	23.9	25	7-30 P

* PTH/PTC09*E50*/* has the same airflow as a PTC/PTH12*E**** (not available on 7,000 BTU/h models).

NOTES:

1. All 265-volt models must use an Amana® brand sub-base (PTSB4**E) or an Amana® brand hard-wire kit (PTPWHWK4).
2. Minimum Circuit Ampacity (MCA) ratings conform to the National Electric Code; however, local codes should apply.
3. Minimum voltage on 230/208-volt models is 197 volts; maximum is 253 volts.
   Minimum voltage on 265-volt models is 238.5 volts; maximum is 291.5 volts.
4. Overcurrent protection for all units without electric heaters is 15 amps. Overcurrent protection on 265-volt models must be cartridge-style time-delay fuses (included and factory-installed on all Amana® brand 265-volt chassis). See heater performance for total MCA.
5. Heating capacity and efficiency based on unit operation without condensate pump; unit automatically switches to electric heat at approximately 24°F outdoor ambient.
6. Total watts for 12,000 and 15,000 BTU/h models; subtract 70 watts for PT07/09*E**A*
7. Specify two-digit heater kW size to complete model number.
8. Total amps for 12,000 and 15,000 BTU/h models; subtract 0.2 amps for PT07/09*E*A*.
9. R-410A refrigerant used in all systems.
10. All units meet or exceed ASHRAE 90.1 standards.
11. All units less than 250 volts have a Leak Current Detector Interrupter (LCDI) power cord and meet UL 484 standards.
12. Refer to electric heat performance data for total MCA and recommended overcurrent protection. Amps and Watts notation refers to compressor only.

PRODUCT SPECIFICATIONS: PTH MODELS — COOLING/HEAT PUMP/ELECTRIC HEAT

230208 VOLTS

R-410A REFRIGERANT

MODEL [1,6,8,9]		PTH 073E**AXXX	PTH 093E**AXXX	PTH 123E**AXXX	PTH 153E**AXXX
Voltage [1, 3]		230 / 208	230 / 208	230 / 208	230 / 208
Capacity (BTU/h)		7,600 / 7,500	9,000 / 8,900	11,500 / 11,100	14,000 / 13,900
Amps[12]		3.5 / 3.5	4.1 / 4.1	5.6 / 5.6	7.0 / 7.0
Watts[12]		650 / 620	770 / 765	1095 / 1065	1460 / 1465
EER		11.7 / 12.1	11.7 / 11.6	10.5 / 10.4	9.6 / 9.5
UNIT WITHOUT ELECTRIC HEATER					
Min. Circuit Amps [2, 4, 12]		4.2	5.0	6.8	8.5
CFM (Cool/Wet Coil)	High	290	290	290	340
	Low	264	264	264	314
CFM (Dry Coil)	High	310	310	310	360
	Low	282	282	282	332
Ventilated Air, CFM (Fan Only)*		65*	65*	65*	65*
Dehumidification (Pints/Hr.)		1.7	2.2	3.6	4.4
Net Weight (lbs.)		108	112	115	126
Ship Weight (lbs.)		123	127	132	143

265,277 VOLTS

MODEL [1,6,8,9]		PTH 074E**AXXX	PTH 094E**AXXX	PTH 124E**AXXX	PTH 154E**AXXX
Voltage [1, 3]		265	265	265	265
Capacity (BTU/h)		7,500	9,000	11,500	14,000
Amps [12]		3.0	3.6	4.8	6.0
Watts [12]		635	780	1115	1430
EER		11.8	11.5	10.3	9.8
UNIT WITHOUT ELECTRIC HEATER					
Min. Circuit Amps [2, 4, 12]		3.6	4.4	5.9	7.3
CFM (Cool/Wet Coil)	High	290	290	290	340
	Low	264	264	264	314
CFM (Dry Coil)	High	310	310	310	360
	Low	282	282	282	332
Ventilated Air, CFM (Fan Only)*		65*	65*	65*	65*
Dehumidification (Pints/Hr.)		1.7	2.2	3.6	4.4
Net Weight (lbs.)		108	112	115	125
Ship Weight (lbs.)		123	127	132	142

* Approximately 95 CFM with optional power vent kit. Actual vent CFM performance will vary due to application and installation conditions.See Notes on previous page

PRODUCT SPECIFICATIONS: PTH MODELS — REVERSE-CYCLE HEATING PERFORMANCE

230/208 Volts

HEATING CAPACITY[1]	PTH 073E**AXXX	PTH 093E**AXXX	PTH 123E**AXXX	PTH 153E**AXXX
Voltage [1, 3]	230 / 208	230 / 208	230 / 208	230 / 208
BTU/h [5]	6,800 / 6,800	8,300 / 8,100	10,900 / 10,500	13,500 / 13,300
Amps [12]	3.5 / 3.5	4.1 / 4.1	5.6 / 5.6	7.0 / 7.0
Watts [12]	605 / 605	735 / 720	1040 /1020	1365 / 1345
COP[5]	3.3 / 3.3	3.3 / 3.3	3.1 / 3.1	2.9 / 2.9
CFM (Dry)	310	310	310	360

265/277 Volts

HEATING CAPACITY[1]	PTH 074E**AXXX	PTH 094E**AXXX	PTH 124E**AXXX	PTH 154E**AXXX
Voltage [1, 3]	265	265	265	265
BTU/h [5]	6,800	8,200	11,000	13,500
Amps [12]	3.0	3.6	4.8	6.0
Watts [12]	585	730	1040	1365
COP [5]	3.4	3.3	3.1	2.9
CFM (Dry)	310	310	310	360

COP = Coefficiency of Performance; per AHRI test procedures, units are rated for capacities and efficiencies.

NOTES:

1. All 265-volt models must use an Amana® brand sub-base (PTSB4**E) or an Amana® brand hard-wire kit (PTPWHWK4).
2. Minimum Circuit Ampacity (MCA) ratings conform to the National Electric Code; however, local codes should apply.
3. Minimum voltage on 230/208-volt models is 197 volts; maximum is 253 volts.
   Minimum voltage on 265-volt models is 238.5 volts; maximum is 291.5 volts.
4. Overcurrent protection for all units without electric heaters is 15 amps. Overcurrent protection on 265-volt models must be cartridge-style time-delay fuses (included and factory-installed on all Amana® brand 265-volt chassis). See heater performance for total MCA.
5. Heating capacity and efficiency based on unit operation without condensate pump; unit automatically switches to electric heat at approximately 24°F outdoor ambient.
6. Total watts for 12,000 and 15,000 BTU/h models; subtract 70 watts for PT07/09*E**A*
7. Specify two-digit heater kW size to complete model number.
8. Total amps for 12,000 and 15,000 BTU/h models; subtract 0.2 amps for PT07/09*E*A*.
9. R-410A refrigerant used in all systems.
10. All units meet or exceed ASHRAE 90.1 standards.
11. All units less than 250 volts have a Leak Current Detector Interrupter (LCDI) power cord and meet UL 484 standards.
12. Refer to electric heat performance data for total MCA and recommended overcurrent protection. Amps and Watts notation refers to compressor only.

CONTRACTOR'S BID SHEET

Furnish and install air-cooled through-the-wall package terminal air conditioners amd heat pumps (assembled in the USA). Units are rated in accordance with the ARI (Air Conditioning & Refrigeration Institute) Standards 310/380-93, CSA (Canadian Standards Association) EEV certification programs and ETL listed.

RATINGS

Each unit must meet the following specifications:

ARI rating of _____BTUH cooling (and _____ BTUH reverse cycle heating with a COP of _____ at 47° F O.D.)

Electric resistance heat of _____ BTUH. Total Amp draw must be of _____ and _____ Watts at _____ volts.

The unit must remove a minimum of _____ pints of moisture per hour when operated at rating conditions. The EER must be a minimum of _____ EER.

UNIT CHASSIS

Each unit must be slide out design shipped with room cabinet front installed. Unit chassis must have the ability to be installed with 0 clearance from finished floor. An electrical power cord must be included with chassis and installed by the manufacturer to assure proper NEMA 6 or 7 configuration and UL-approved length. Units less than 250 volts must also have a LCDI power cord. Unit must be tested for conformance to ASTME water infiltration specification ASTME 331-86, which ensures no water infiltration when tested at 8" rain per hour at 63 mph wind for 15 minutes.

ROOM CABINET

The monochromatic front of the room cabinet must be able to be field-secured to chassis to inhibit tampering. Filter must be accessible without removing room front. Cabinet depth must not exceed 7⅝" to minimize unit's impact on room space.

COILS

Unit's coils must have rifled copper tubing expanded into rippled-edge louvered aluminum fins. Exterior coil must be of a two-row slab coil design with removable shroud top to allow easy-access for cleaning of the exterior coil.

HEAT PUMPS

Each unit must include a change-over thermistor that senses an outside ambient switch-over temperature as low as 24°F, lock-open refrigerant reversing valve during heat pump operation, temperature-activated defrost drain and automatic emergency heat operation to override the heat pump's change-over thermostat and bring on electric resistance heaters in the event of a sealed system failure. Unit must not operate compressor and electric heaters simultaneously.

COMPRESSOR

The compressor must be hermetically sealed, internally isolated, rotary-type and permanently mounted on rubber isolators. No removal or adjustment of compressor hold-down bolts is to be required during installation.

WARRANTY

The warranty is for Full One Year on the entire unit; Full 2nd through 5th Year on the entire sealed refrigerant system components; Limited Second through Fifth Year on functional parts only.

UNIT DIGITAL CONTROLS

The unit's control must be completely wired and accessible from the top of the chassis. Controls shall be a LED touch-pad design with seven large, easy-to-read and use buttons: Heat – Cool – Off – Fan – Temp+ (plus) – Temp- (minus) and two red seven-segment LED temperature displays. Unit shall have a green status LED to advise owner of operational diagnostic messages. Unit shall have one-button activation via membrane touch-pad. Unit control board shall have an 18-pin low-voltage connector to allow for easy connection to remote wired devices. Unit shall have two serial-port connectors for easy connection to wired or wireless EMS (Energy Management Systems).

Unit must have the ability to *easily configure owner-selectable* and programmable functions:

- Fan-cycle operation
- Electronic temperature limiting for cooling
- Electronic temperature limiting for heating
- Enhanced dehumidification cooling operation
- Unoccupied 18-hour temperature set-back
- Un-rented temperature set-back
- Multiple unit twinning to one wired thermostat
- Load-shedding operation
- Front-desk on-off or temperature set-back

Unit must be able to connect to approved remote devices:

- Wired thermostat
- Wired door motion sensor
- Wired room motion sensor
- Wired room-to-room transfer fan
- Front Desk Control
- Future RF wireless communications devices

Unit must be able to acquire and display operational temperature data from up to six installed thermistors to include:

- IAT—Indoor air temperature (black)
- ICT—Indoor coil temperature (red)
- IDT—Indoor discharge temperature (yellow)
- OCT—Outdoor coil temperature (blue) (heat pumps & Wireless cooler models)
- OAT— Outdoor Air Temperature (Wireless-ready models only)
- Orange—Miscellaneous thermistor or analog device (optional)

EVAPORATOR/CONDENSER FANS

Direct drive with a permanent, split-capacitor, two-speed indoor motor. Condensate must be directed onto the back and sides of the coil to aid in evaporation and removal.

AIR DISCHARGE

Must be a sloped surface so that obstructions cannot be placed on the unit. Discharge conditioned air can be directed into the room at an angle of 16 or 56 degrees from the vertical position. The discharge grille must be of polycarbonate material to resist bending, cracking, rusting and corrosion.

Product Specifications

New installations typically require a minimum of WS900E wall sleeve and an outdoor grille.

Wall Sleeves (WS900E)

The wall sleeve must be industry-accepted dimensions: 14⅛" depth x 42" width x 16$^{1}/_{16}$" height and constructed of G90 HDG galvanized steel with a baked corrosion-inhibiting urethane primer and baked-polyester topcoat enamel. Sleeve must be insulated and shipped with a weather resistant rear closure panel installed.

Outdoor Grilles

Outdoor grille must be architecturally extruded, louvered aluminum (AGK01*B), one-piece polymer-blend injection molded louver (PGK01*B) or standard stamped aluminum (SGK**B). All other grilles must be submitted to the PTAC manufacturer for feasibility, airflow characteristics and compliance with UL regulations, where necessary.

The optional accessories listed below perform specific functions required in some installations.

Condensate Drain Kit (DK900D)

Attaches to the bottom of the wall sleeve for directional-controlled internal or external disposal of condensate, defrost or rain water.

Sub-base Kit (PTSB***E)

Necessary for UL listing requirements for 265V units (Hard Wire Kit may be substituted for Sub-base kit). Optional for 230/208V units. Must be pre-wired to facilitate field-electrical connections and include a NEMA 6 or 7 configuration electrical receptacle. It must have 2 leveling screws for sleeve support and accurate unit leveling during installation. Locations for field installation of physical disconnect switches, cartridge-style fuse holders and circuit breakers must be provided. Side-skirts must be provided with sub-bases. *(PTSB000E Non-Electrical Sub-base available.)*

Power Vent & Damper

Must be provided to maximize ventilation air intake to up to approximately 95 CFM. Power vent must be off and damper door closed when unit fan is de-energized.

Fuse Holder (included in 265V chassis)

Must be installed either in the unit or the sub-base and must match the electrical requirements of the chassis.

Security Key Locks (KL03E)

Must be installed to prevent tampering of the unit controls. Unit room cabinet must also be secured to the chassis with field supplied screws. UL-approved for institutional use only.

Disconnect Switch

Power disconnect switch must be installed in sub-base for use as a physical disconnect, where required by local codes.

Duct Kits (MDK02E, EDK02B, TDK02B, PTDK01E, DDK01E)

Three kits must be supplied to provide ducted, conditioned air into a second room: a main duct kit, an extension duct kit and a terminal duct kit.

Hydronic Heat Kit

Is required for heating functions instead of electric resistance heaters. Unit must retain complete service access with the kit installed. Proper water or steam valves must be used.

Condensate Removal Pump (Heat Pumps only)

Must be installed to assist in removing the condensate developed by the heat pump operation and transfer it to the indoor coil to dissipate into the room, adding humidity to the room.

Circuit Breaker Kit

Must be installed in sub-base to provide overcurrent protection for proper 230/208V amperage. Can also be used as a physical disconnect where local codes permit for 230/208 voltage.

Hard Wire Kit

Must be used to permanently wire chassis for hard wire purposes. (For 265V units, Hard Wire Kit may be substituted with Sub-base Kit.)

Thermostats

A manufacturer-approved manual, auto changeover or programmable traditionally wired thermostat must be installed to provide full remote operation of the chassis. A Remote Escutcheon Kit must be used to indicate remote operation.

ATTACHMENT DRL-5

Valley of the Sun Heating & Cooling, Inc.
1435 E University Drive
Suite #105
Tempe, AZ 85281
480-377-8095

Estimate

Date	Estimate #
11/24/2008	466

Bill To:

JALLL llc
Remote Accounting Division
220 E. 37th St. Suite A
Boise ID 83714

Ship To

America's Choice Inn & Suites
Lynn Wheeler
2888 Butterfield Trail
Gila Bend, AZ 85337
602-881-7291

P.O. No.	Bid Good For
Amana PB and AE	30 DAYS

Item	Description	Qty	Cost	Total
PBE123A35MA	AMANA PB PTAC, ELECTRIC HEAT, 11,600BTU, 208/230V, 20AMPS	25	440.00	11,000.00
PBWS01A	AMANA BEIGE INSULATED WALL SLEEVE W/GRILLE FOR PB PTACS	25	61.00	1,525.00
AE123A35MA	AMANA RAC UNIT, ELECTRIC HEAT, 12000BTU, 208/230V, 20AMP	48	385.00	18,480.00
AE183A35MA	AMANA RAC UNIT, ELECTRIC HEAT, 18000BTU, 208/230V, 20AMP	2	490.00	980.00
FREIGHT	FREIGHT CHARGE 1 TIME SHIPMENT	1	0.00	0.00

Thank you for choosing Valley of the Sun!

Subtotal	$31,985.00
Sales Tax (8.1%)	$2,590.79
Total	**$34,575.79**

Thank you,
Miguel Chinchillas
Sales Manager
Valley of the Sun Heating & Cooling, Inc.
866-600-3300 ext. 103
Fax: 800-261-7220
www.valleyofthesuninc.com

Commercial LIC # 154438L-39 • Residential LIC # 154437C-38R

AGUIRRE & KIN, INC.
General Contractor
AZ Lic #ROC180328
(623) 694-4821 Cell Fax (928) 683-8782
P.O. Box 975 Gila Bend AZ 85337

PROPOSAL

PROPOSAL NO.

SHEET NO.

DATE 9/1/08

PROPOSAL SUBMITTED TO:	WORK TO BE PERFORMED AT:
NAME Lynn Wheeler	ADDRESS 2888 Butterfield Trl.
ADDRESS PO Box 368	CITY, STATE Gila Bend Az 85337
CITY,STATE Gila Bend Az 85337	DATE OF PLANS N/A
PHONE NO. 602)881-7291	ARCHITECT N/A Lynn Wheeler Contract.

We hereby propose to furnish the materials and perform the labor necessary for the completion of
74 A/C WINDOW TYPE UNITS REMOVE & DISPOSE OF, REPLACE and REPAIR OPENINGS TO ACCOMODATE NEW UNITS. Furnish Labor and MATERIALS as well as Equip. needed to Perform job scope.
PRICE PER UNIT as follows
REMOVE & DISPOSE 43.00 ea Removal of Gas included. (FREON RECOVERY)
REPLACE & REPAIRS 243 ea CUT, TRIM, INSULATE, TRIM, STUCCO, PAINT
MATERIALS 59.00 ea
TOTAL PER UNIT 345.00 (Three hundred forty Five dlls w/no ——)

Materials include Quick dry Joint Compound, CAULK, FASTNERS MASONRY, SCREWS Lumber, INSULATION (FOAM) PAINT, STUCCO MIX, plastic. TAPE & TRIM board.

This price reflects 74 units. Units to be delivered and readily available in order to honor the ABOVE price. Prices too change if done in various stages. PAINTING TO BE SPOT PAINTED ONLY - NO PAINT BLENDING or finishing. No Electrical work or plumbing re-routing included. Picking up of Large DEBRIS only Room cleaned by others.

All material is guaranteed to be as specified, and the above work to be performed in accordance with the drawings and specifications submitted for above work and completed in a substantial workmanlike manner for the sum of:
#25,530.00 TWENTY FIVE THOUSAND FIVE HUNDRED Thirty w/no —— Dollars ($25,530.00)
with payments to be as follows 30%. Down. 30% at half 30% at 3/4 10% completion

Any alteration or deviation from above specifications involving extra costs will be executed only upon written order, and will become an extra charge over and above the estimate. All agreements contingent upon strikes, accidents, or delays beyond our control.

Respectfully submitted Aguirre and Kin Inc
Per [signature]

Note - This proposal may be withdrawn by us if not accepted within 20 days.

ACCEPTANCE OF PROPOSAL

The above prices, specifications and conditions are satisfactory and are hereby accepted. You are authorized to do the work as specified. Payments will be made as outlined above.

SIGNATURE ——

DATE —— SIGNATURE ——

Ademar 9450

ATTACHMENT DRL-6

Thru-the-Wall Room Air Conditioner with optional Electric Heat

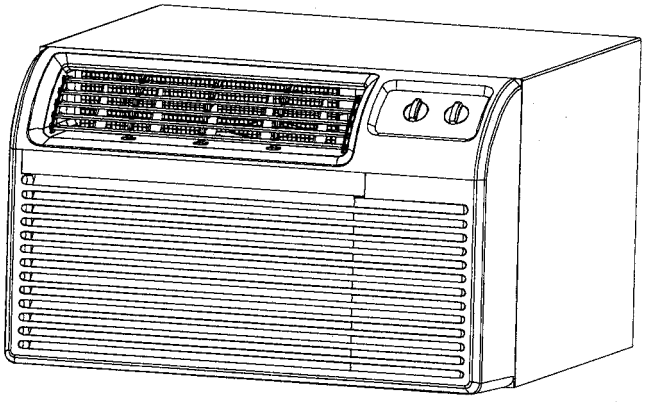
Installation Instructions and Owner's Manual

This manual must be left with the owner of the equipment.

Contents

⚠ WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury, or death.



⚠ RECOGNIZE THIS SYMBOL AS A SAFETY PRECAUTION.

ATTENTION INSTALLING PERSONNEL

As a professional installer you have an obligation to know the product better than the customer. This includes all safety precautions and related items.

Prior to actual installation, thoroughly familiarize yourself with this Instruction Manual. Pay special attention to all safety warnings. Often during installation or repair it is possible to place yourself in a position which is more hazardous than when the unit is in operation.

Remember, it is your responsibility to install the product safely and to know it well enough to be able to instruct a customer in its safe use.

Safety is a matter of common sense...a matter of thinking before acting. Most dealers have a list of specific good safety practices...follow them.

The precautions listed in this Installation Manual are intended as supplemental to existing practices. However, if there is a direct conflict between existing practices and the content of this manual, the precautions listed here take precedence.

IMPORTANT NOTE TO THE OWNER

This equipment is to be serviced by professionally trained personnel only. If this equipment is improperly installed, adjusted or altered by an unqualified person, a safety hazard may result.

IMPORTANT NOTE TO THE SERVICER

Read this manual and familiarize yourself with the specific items which must be adhered to before attempting to service this unit. The precautions listed in this manual should not supersede existing practices but should be considered as supplemental information.

Transportation Damage

All units are securely packed in shipping containers approved by the National Safe Transit Association. The carton should be checked upon arrival for external damage. If damage is found, immediately make a written request for inspection by the carrier's agent.

In the event of damage:

1. Note on the delivery receipt any visible damage to shipment or container.
2. Notify carrier promptly and request an inspection.
3. File the claim with the following supporting documents within the six month statute of limitations.
   a. Original Bill of Lading, certified copy, or indemnity bond.
   b. Original paid freight bill or indemnity.
   c. Original invoice or certified copy, showing trade and other discounts or reductions.
   d. Copy of the inspection report issued by carrier's representative at the time damage is reported to the carrier.

The carrier is responsible for making prompt inspection of damage and for a thorough investigation of each claim. The distributor or manufacturer will not accept claims from dealers for transportation damage.

Unpacking The Unit

1. Cut the carton banding and open the carton.
2. Remove the literature, hardware pack, upper styrofoam shipping blocks, and styrofoam corner posts.
3. Remove the front assembly.
4. Lift the unit from the remaining carton.
5. Dispose of the cardboard and styrofoam at an approved Recycle Center. Check all contents for damaged or missing parts. In case of concealed damage, notify the carrier as soon as possible—preferably within 5 days. Refer to step 3 of the *Transportation Damage* section if damage or missing parts are noted.

Parts Supplied

Size	Description	Quantity
#8 x 3/8"	Blunt Point Sheet Metal Screw	1

(This screw is used for ground wire connection to the sleeve)

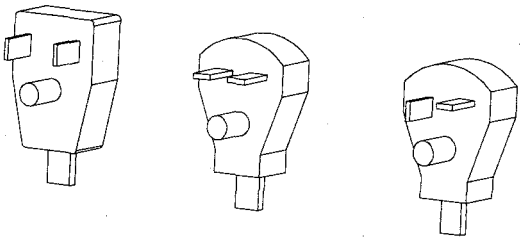
Unit Accessories

This unit is designed for through-the-wall installation in new or existing buildings. To complete the installation in an existing wall sleeve, a TWKGSLV rear louver panel kit, a TWEAK2 or TWFAK2 adapter kit is required.

If the sleeve is an Amana® brand wall sleeve, use the TWKGSLV rear louver panel kit. If the sleeve is an Emerson wall sleeve, use the TWEAK2 adapter kit, If the sleeve is a Fedders or Freidrich wall sleeve, use the TWFAK2 adapter kit.

Operating Instructions

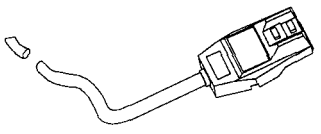
Check the data specification plate and ensure the proper voltage and current rating for the type of power plug on the unit is available. DO NOT REMOVE THE GROUNDING PRONG FROM THE POWER CORD. See Figure 1 for the types of acceptable plugs. Do not use an extension cord for the installation of this product. Refer to the data specification plate for electrical requirements.



110V 15 amp **230V 15 amp** **230V 20 amp**

Figure 1

- **LCDI or AFCI Power Cords** - Underwrites Laboratories and the National Electric Code (NEC) now require power cords that sense current leakage and can open the electrical circuit to the unit on units rated at 250 volts or less. In the event that unit does not operate, check the reset button located on or near the head of the power cord as part of the normal troubleshooting procedure.



LCDI power Cord

⚠ WARNING

To prevent electrical shock, property damage, personal injury, or death, do not remove grounding prong from plug. Follow all operating instructions.

Installation Instructions

To ensure that the unit operates safely and efficiently, it must be installed, operated, and maintained according to these installation and operating instructions and all local codes and ordinances, or, in their absence, with the latest edition of the National Electrical Code. The proper installation of this unit is described in the following sections. Following the steps in the order presented should ensure proper installation.

SLEEVE INSTALLATION

In order for condensate water to drain properly inside the unit, the sleeve must be installed properly:

- Level from right to left.
- A slight downward pitch from the indoor side to the outdoor side as shown in Figure 3.

Refer to the Installation Instructions supplied with the wall sleeve for a complete description of the installation procedure.

NOTE: *Wall sleeve (PBWS01A) is not shipped with chassis and must be purchased separately.*

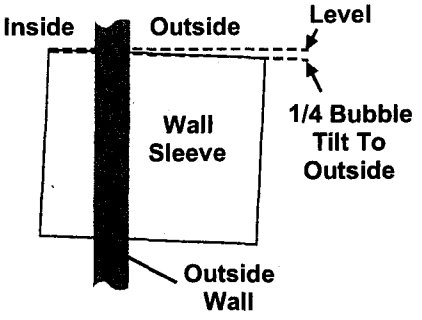


Figure 2

REAR LOUVER PANEL

A TWKGSLV rear louver panel kit is required for unit installation into an existing Amana® brand 26" wall sleeve. A TWEAK2 or TWFAK2 adapter kit is required for unit installation into an existing 27" wall sleeve. The rear louver panel directs air flow for proper unit operation and protects the outdoor coil. The panel must be installed before installing the chassis. These kits are not supplied with the unit. Refer to the Installation Instructions supplied with the rear louver panel kit for a complete description of the installation procedure.

CHASSIS INSTALLATION

1. Remove front grille. See Figure A.

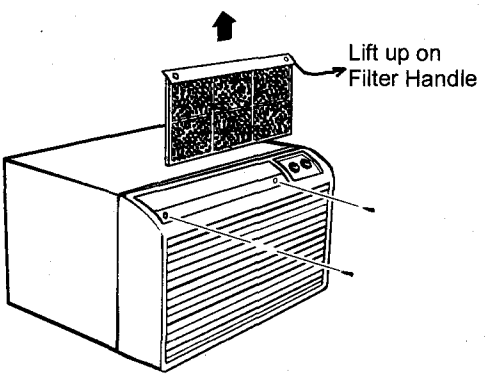
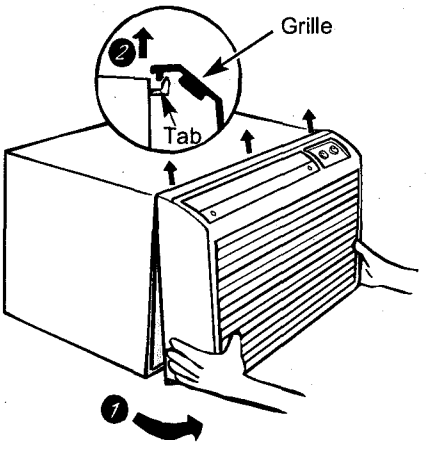


Figure A

The front grille can be removed for more thorough cleaning or to make the model and serial numbers accessible. To remove, pull the filter out and remove the two grille screws.



Pull the grille out from the bottom and lift up from the tabs on the top of the case.

2. Remove the grounding screw and wire next to the grounding symbol on right side of chassis control panel (Figure 3). Attach other end of ground wire to the hole in the bottom right side of the sleeve with #8 x 3/8" blunt point sheet metal screw. The hole on the sleeve is indicated by grounding symbol on the sleeve. Slide chassis part of the way into the sleeve and reattach the ground wire back to the hole on the right side on the control panel area next to the grounding symbol.

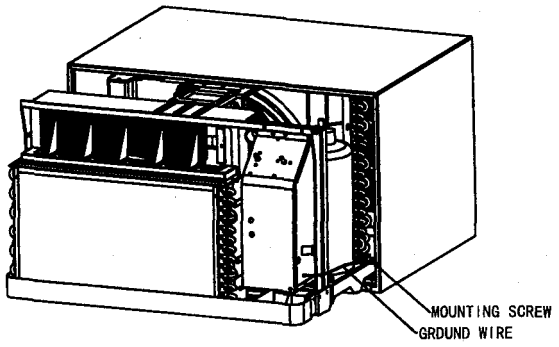


Figure 3

3. Remove shipping pads inside air conditioner next to compressor. (See Figure B.)

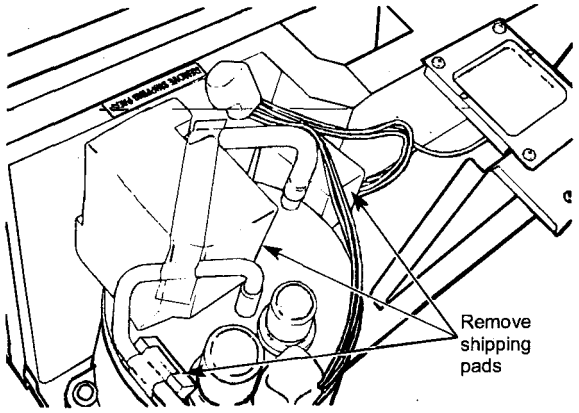


Figure B

4. Carefully slide the chassis into the sleeve. Ensure that the ground wire is not pinched or in the path of the condenser fan.
5. Loosen locking plate screw and rotate tab with tab behind wall case flange (See Figure C) then tighten locking plate screw.

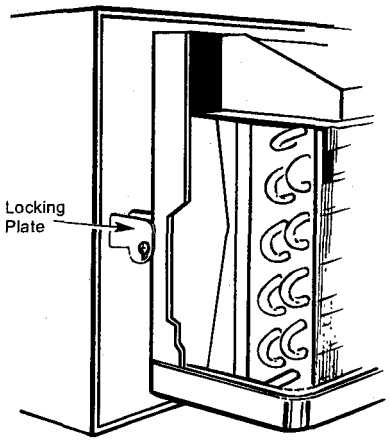


Figure C

6. If outlet is on the left side of the unit. route power cord as shown in Figure D.

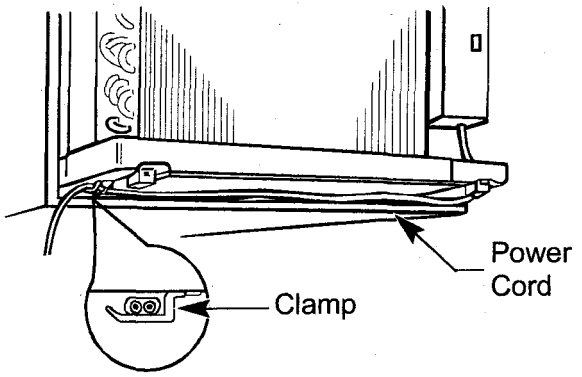
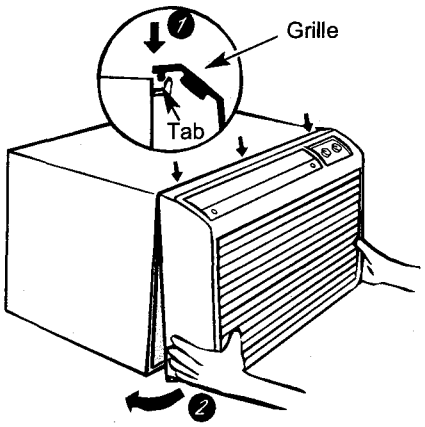


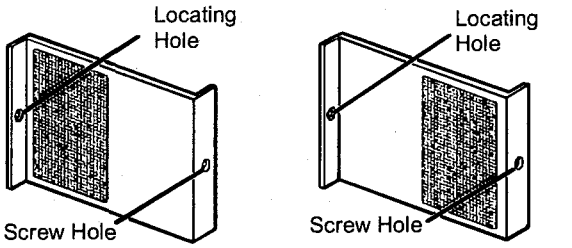
Figure D

To replace front grille:



Hook the tabs on the front grille even with the tabs on the case and snap into place. Replace the screws and filter. Refer to Page 4, Figure A.

VENT CONTROL AND AIR DIRECTION (See Figure E)
The vent control is located behind the front grille on the right side of the air discharge area. When set at **CLOSE** only the air inside the room will be circulated and conditioned. When set at **OPEN**, some inside air is exhausted outside.



OPEN position
(Mesh end toward back)

CLOSE position
(Mesh end toward front)

Figure E

To open or close the vent:

1. Remove the front grille.
2. Remove the vent card screw.
3. Remove the vent card, turn it over and replace it by locating rear hole in card over locating pin inside air discharge and reattaching screw at front.

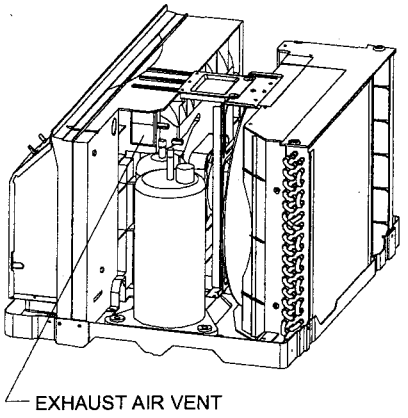
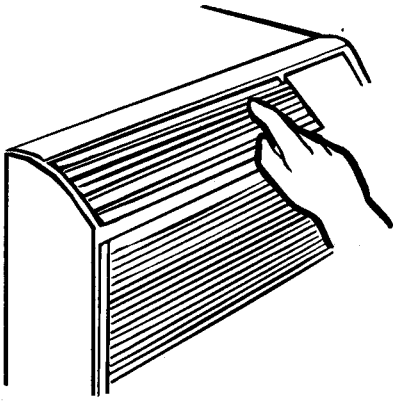


Figure 4

AIR DIRECTION:

Horizontal louvers on the front grille let you control the air direction up and down.



Remove the front grille to adjust the vertical louvers side-to-side to direct the air left or right.

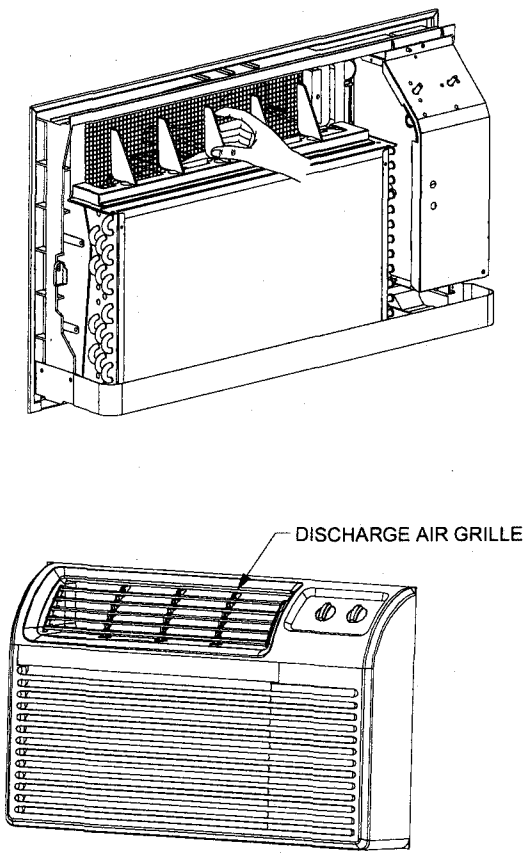


Figure 5

IMPORTANT NOTES:

1. The unit is equipped with a rubber-grommet-mounted compressor. These grommets are factory set and require no adjustment.
2. Obstruction to air flow must be checked and removed. Check the indoor and outdoor grilles for obstructions. The unit must be located where curtains, furniture, trees, or other objects do not block air flow to and from the unit. If air is obstructed and/or deflected back into the unit, the air conditioner's compressor may cycle on and off rapidly. This could cause damage to the compressor.

Wiring

Before wiring the unit, please review the following warnings and cautions.

⚠ WARNING

To avoid the risk of electrical shock, personal injury or death, do not service this unit without first opening all disconnects and/or removing the unit cord set plug from the wall outlet.

⚠ WARNING

To avoid the risk of electrical shock, personal injury, or property damage, do not use an extension cord with this unit.

⚠ WARNING

To avoid the risk of fire, property damage, or personal injury, use only copper conductors.

⚠ WARNING

To avoid the risk of personal injury, wiring to the unit must be properly polarized and grounded.

⚠ WARNING

This air conditioner is not meant to provide unattended cooling or life support for persons or animals who are unable to react to the failure of this product.

The failure of an unattended air conditioner *may result in extreme heat in the conditioned* space causing overheating or death of persons or animals. Take proper precautions to avoid unattended operation.

VOLTAGE MEASUREMENTS

Before connecting the unit, measure the supply voltage. Voltage must fall within the voltage utilization range given in Table 1.

Operating Voltage		
Unit Voltage Rating	Voltage Utilization Range	
	Minimum	Maximum
230/208	197	253
115	103	126

Table 1
Operating Voltage

Unit Operation

COOLING MODELS - PBC

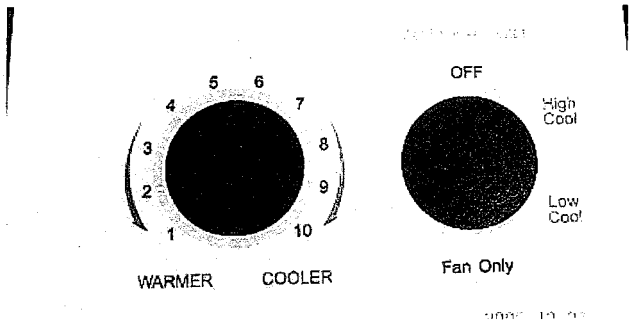
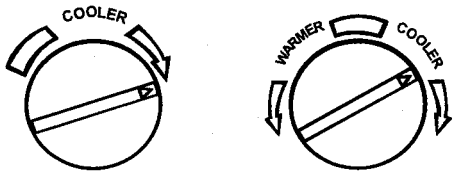


Figure 6

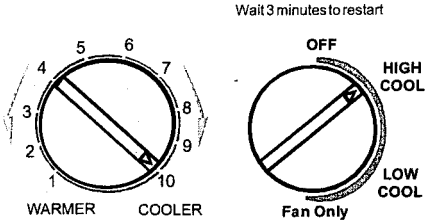
Two rotary knobs (Figure 6) control temperature and operational modes. They are located to the top left of the cabinet front.

THERMOSTAT SETTING



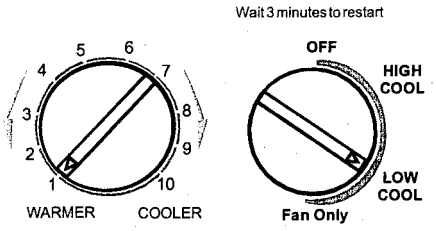
The thermostat controls the room temperature by turning either the compressor or electric heater on and off while the fan is running. Turn the thermostat control clockwise to provide a cooler room temperature; turn it counterclockwise to provide a warmer one.

NOTE: If the fan cycle switch (see Additional Control Inputs) is in the CYCLE mode, both the compressor and fan will cycle on and off during the cooling modes.



HIGH COOL

This setting provides the most cooling output at the highest efficiency possible. In this mode the fan runs on high and the compressor cycles on and off.



LOW COOL

This setting dehumidifies the air and provides the quietest fan operation. In this mode the fan runs at the lowest speed and the compressor cycles on and off.

HEAT PUMP MODELS - PBE & PBH

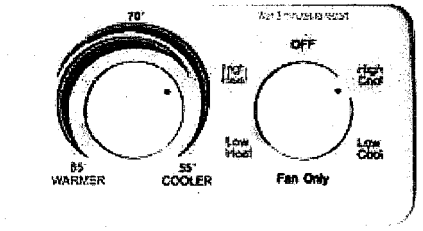
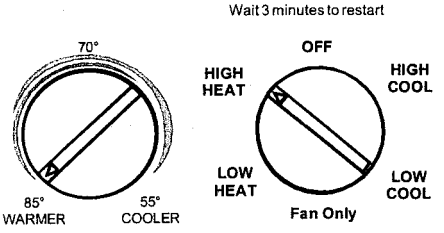
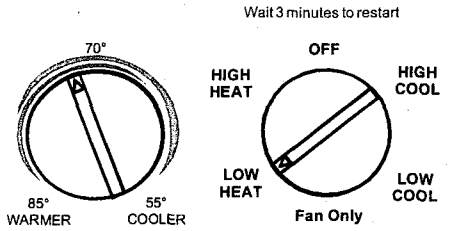


Figure 7



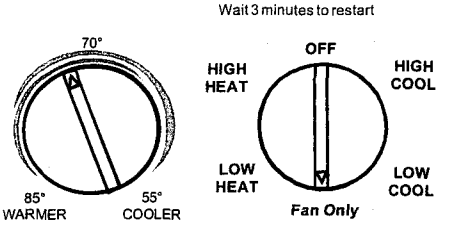
HIGH HEAT

On high heat, the fan runs at its highest speed. In this mode the electric heater cycles on and off by thermostat.



LOW HEAT

On low heat, the fan runs at its lowest speed and provides the quietest fan operation. In this mode the electric heater cycles on and off by thermostat.



FAN ONLY

This setting circulates air. If the exhaust air option is used, this setting will exhaust stale indoor air. In this mode, the fan runs continuously at high speed without compressor operation.

HEAT PUMP MODELS - PBE & PBH

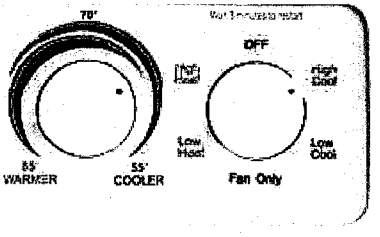


Figure 8

When the outdoor temperature is lower than 25°F, heat is provided by the electric heater in the air conditioner instead of by the heat pump.

ADDITIONAL CONTROL INPUTS

NOTE: Not available on all models.

Fan Cycle Switch

The fan cycle switch is located behind the plastic front assembly underneath the control knob (Figure 9). The fan cycle switch sets the operational mode of the fan. In the NORMAL position, the fan will run continuously whenever the unit is in the heat or cool mode. In the CYCLE position, the fan will cycle on and off with the compressor when the unit is in the cool mode. This switch can only be set by a servicer.

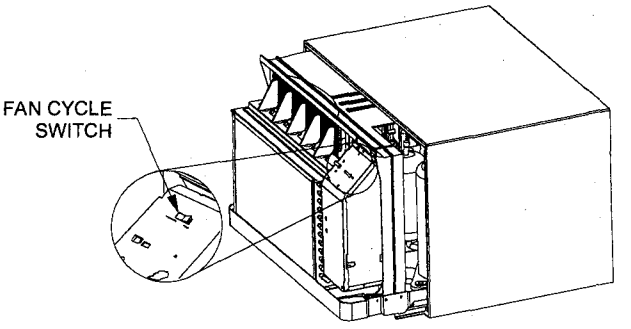


Figure 9

Preventative Maintenance

⚠ WARNING

To prevent death or personal injury due to electrical shock, unplug the unit at the wall outlet or turn off power at the fuse box or circuit breaker before servicing the unit.

INTAKE AIR FILTER

The intake air filter should be cleaned when it is dirty or at least once a month. The intake air filter is constructed of durable polypropylene.

The following procedure is used to remove the intake filter:

1. Remove the filter by lifting up on filter handle. See Figure A.
2. Remove intake air filter from front panel.
3. Clean filter with a vacuum or running water. If using water, please be sure that the filter is not excessively wet when replaced.
4. Reverse this procedure to reinstall the filter.

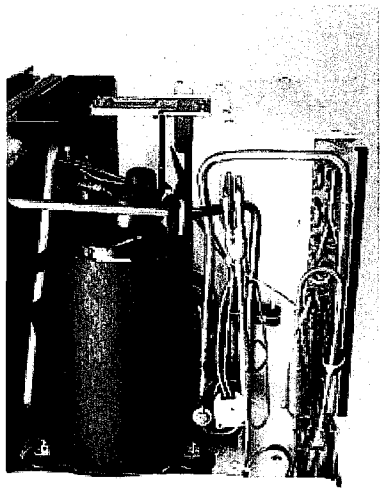
COMPRESSOR
The compressor is hermetically sealed, permanently lubricated and requires no additional oiling.

FRONT PANEL AND GRILLE
The front panel and grille can be cleaned with a mild soap or detergent. Do not use hydrocarbon-based cleaners (e.g. acetone, benzene, naphtha, gasoline, etc.) to clean the front panel or grille. Use care when cleaning the control area. Do not use an excessively wet cleaning cloth.

SCHEDULED MAINTENANCE
To achieve continuing top performance and high efficiency, a regular cleaning/inspection schedule must be established. Maintaining this schedule can be accomplished by either a local maintenance staff or an authorized servicer and must follow the instructions described in this manual.

- If the unit is operated in a dusty climate, dust may collect in the basepan and clog the condenser coil. It is advisable to remove the unit from the sleeve and thoroughly clean the basepan and condenser coil on a periodic basis.
- If the unit is installed ocean side or in a corrosive atmosphere, its life may be greatly reduced by the corrosive environment. Under these conditions, the unit should be removed from the sleeve and completely cleaned once a year. At that time any scratches or blisters on the painted surfaces should be sanded and repainted.

OUTDOOR COIL CLEANING
The coils on the outdoor side of the air conditioner should be checked regularly. For cleaning outside coil, remove the 6 screws that mount the condenser coil top cover to condenser shroud.



Normal Operating Sounds and Conditions

POPPING OR GURGLING SOUNDS
This sound is the refrigerant traveling through the lines. This is a normal sound which may be heard for a few seconds after the unit shuts off.

WATER TRICKLING SOUNDS
This sound is produced by the water as it is picked up and run over the coils. This procedure improves the efficiency of the unit and helps with water removal.

WATER DRIPPING
Water will collect in the basepan during high humidity days.

STARTING DELAY
You may notice a short delay in the startup if you try to restart the unit too soon after turning it off or if you adjust the thermostat right after the compressor has shut off. This delay protects the compressor.

Obtaining Service
In the unlikely event this unit requires repair or servicing beyond what is covered in this manual, contact an authorized service organization.

To obtain an authorized servicer, contact your sales representative or agency.

Heating & Air Conditioning

Amana

LIMITED WARRANTY

AE, AH, PBC, PBE, PBH

RAC Window Type H & C

This Amana® brand heating or air conditioning product is warranted by Goodman Company, L.P. ("Goodman") to be free from defects in materials and workmanship under normal use and maintenance as described below:

- The SEALED SYSTEM COMPONENTS (limited to the condenser and evaporator coils, compressor, reversing valves and connecting tubes), and refrigerant leaks, are warranted for a period of **FIVE YEARS**, and labor for SEALED SYSTEM COMPONENT replacements and refrigerant leak repairs is covered for a period of **FIVE YEARS**, except as provided below.
- All remaining parts are warranted for a period of **ONE YEAR**, and labor for all remaining part replacements is covered for a period of **ONE YEAR,** except as provided below.

The warranty period begins on the date of the original purchase. If that date cannot be verified, the warranty period begins three months from the month of manufacture (indicated by the first four digits of the serial number (yymm)).

As its only responsibility, and your only remedy, Goodman will furnish a replacement part, without charge for the part, to replace any part that is found to be defective due to workmanship or materials under normal use and maintenance. Goodman will furnish labor for any defective part replacement, and to repair any refrigerant leak when the leak is caused by a defect in workmanship or materials under normal use and maintenance, only when service is performed by an authorized Amana® brand servicer. To locate an authorized Amana® brand servicer, contact Goodman Consumer Affairs at the number or address located at the bottom of this certificate.

For warranty credit the defective part must be returned to an Amana® heating and air conditioning products distributor by an authorized Amana® brand servicer. Any part replaced, or leak repaired, pursuant to this warranty is warranted only for the unexpired portion of the warranty term applying to the original part.

These warranties are in lieu of all other express warranties.

ALL IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE, ARE LIMITED TO THE DURATION OF THIS WARRANTY. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

GOODMAN SHALL IN NO EVENT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO EXTRA UTILITY EXPENSES OR DAMAGES TO PROPERTY. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply to you.

Goodman is not responsible for:

1. Damage or repairs required as a consequence of faulty installation or application.
2. Damage as a result of floods, fires, winds, lightning, accidents, corrosive atmosphere or other conditions beyond the control of Goodman.
3. Use of components or accessories not compatible with this unit.
4. Products installed outside the United States or Canada.
5. Normal maintenance as described in the installation and operating manual, such as cleaning of the coils, filter cleaning and/or replacement.
6. Parts not supplied or designated by Goodman.
7. Damage or repairs required as a result of any improper use, maintenance, operation or servicing.
8. Failure to start due to interruption and/or inadequate electrical service.
9. Changes in the appearance of the product that do not affect its performance.

This warranty gives you specific legal rights, and you may also have other rights that may vary from state to state.

Model # & Serial # _____

Date of Purchase _____

Part No. PW-342
Printed in USA

For further information about this warranty, contact **Goodman Consumer Affairs** at (877) 254-4729 or by mail to **7401 Security Way, Houston, Texas 77040**.

DIRECT TESTIMONY OF GREGORY TESLEVICH

On Behalf of Arizona Public Service Company

Docket No. E-01345A-10-0210

February 4, 2011

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DIRECT TESTIMONY OF GREGORY TESLEVICH
ON BEHALF OF ARIZONA PUBLIC SERVICE COMPANY
(Docket No. E-01345A-10-0210)

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. Gregory Teslevich, 2121 West Cheryl Drive, Phoenix, Arizona 85072.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am an Engineer for Arizona Public Service Company ("APS" or "Company").

Q. WHAT ARE YOUR PROFESSIONAL QUALIFICATIONS?

A. I received a Bachelors of Science Degree in Electrical Engineering from Arizona State University in 1984.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to address the subject of the power quality monitoring equipment used to record the data presented in the graphs (attached hereto as Attachments GT-1, GT-2, and GT-3). I will also discuss the various voltage reports, interpretation of graphs, and acceptable voltage range for motors.

II. SUMMARY OF TESTIMONY

Q. PLEASE SUMMARIZE YOUR TESTIMONY.

A. In my testimony, I support the Company's position that APS supplied service to the America's Choice Inn and Suites ("Hotel") at the voltage requirements adopted by the Arizona Corporation Commission[1] ("Commission), which is the American National Standards Institute C.84.1-1989 standard ("ANSI Standard") for the voltage supply of 208/120 volts. I will demonstrate that the voltage recorded by APS from June 21-27, 2006 shows that the values were within those required by the ANSI Standard.

[1] A.A.C. R14-2-208(F)(2).

III. AMERICAN NATIONAL STANDARDS INSTITUTE C.84.1-1989 STANDARD AND INTERPRETATION OF VOLTAGE READINGS

Q. WOULD YOU PLEASE DESCRIBE THE AMERICAN NATIONAL STANDARDS INSTITUTE C.84.1-1989 STANDARD?

A. The Commission adopted the ANSI Standard as the voltage standard for use by the regulated electric utilities in its jurisdiction; therefore, it is the voltage standard that the Company must adhere to in delivering service to its customers *See* A.A.C. R14-2-208(F)(2).

The ANSI Standard establishes nominal voltage ranges and operating tolerances for electric power systems. The ANSI Standard explains that "[t]he design and operation of power systems and the design of equipment to be supplied from such systems should be coordinated with respect to [the ANSI Standard] voltages so that, insofar as practicable, the equipment will perform satisfactorily throughout the range of actual utilization voltages that will be encountered on the system. In order to further this objective, the [ANSI Standard] establishes, for each nominal system voltage, two ranges for service voltage and utilization voltage variations, designated as Range A and Range B."[2]

For the 208/120 volt nominal service voltage supply, the acceptable voltage in Voltage Range A is a maximum 218 volts and a minimum 197 volts.[3] In Voltage Range B, the maximum is 220 volts and a minimum 191 volts. In Section 2.4.3 of the ANSI Standard, Range B includes voltages above and below Range A limits that result from practical design and operating conditions on supply or user systems, or both.[4] The ANSI Standard states that, "[w]hen [voltage deviations] occur, corrective measures shall be undertaken within a reasonable time to improve voltages to meet Range A requirements."[5]

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[2] AM. NAT'L. STD. (1988), p. 8.
[3] *Id.*, Table 1 – Standard Nominal System Voltages and Voltage Ranges, p. 10.
[4] *Id.*, p. 8.
[5] *Id.*, p. 8.

The ANSI Standard defines nominal utilization as "the voltage rating of certain utilization equipment used on the system."[6] The nominal utilization voltage for a 208/120 volt system is 200 volts.[7] These voltages are typically measured at the line terminals of utilization equipment.[8] It is recognized that the voltage at utilization points is normally somewhat lower than at the service point. As an example, when an electric air-conditioner on top of a home's roof is running, it has a utilization voltage level that is lower than the service voltage level at the service point. The service point is typically where the electric meter and breaker protecting the wiring to the air-conditioner is located. The utilization voltage is lower because of the voltage drop caused by current flowing in the resistance of the wire from the air-conditioner back to the service point. The ANSI Standard also provides information on voltage unbalance. In this regard, the ANSI Standard recommends that "[e]lectric supply systems should be designed and operated to limit the maximum voltage unbalance to 3 percent when measured at the electric-utility revenue meter under no-load conditions."[9]

Q. WOULD YOU PLEASE DESCRIBE THE COMPANY'S SERVICE SCHEDULE 1?

A. Service Schedule 1 is a Commission-approved document that states APS's Terms and Conditions for the Standard Offer and Direct Access Customers to connect electric service to a customer. The ANSI Standard is reflected in the Company's Service Schedule 1, Section 5.1 (Service Voltage) which reads, "Company will deliver electric service to the designated point of delivery, as specified in Section 6.3 of this Schedule, at the standard voltages specified in the Electric Service Requirement Manual published by Company and as specified in A.A.C. R14-2-208(F)."

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[6] *Id.*, Section 2.1.2.6, p. 7.
[7] *Id.*, Table 1, p. 10.
[8] *Id.*, Section 2.1.2.5, p. 7.
[9] *Id.*, Appendix D, Section D.2, p. 17.

Q. WOULD YOU PLEASE DESCRIBE WHAT A POWER QUALITY RECORDER IS?

A. A Power Quality Recorder is a generic term that describes an electrical apparatus that measures electrical properties which allows electrical systems to function in their intended manner without significant loss of performance or service life. The Power Quality Recorder may measure various power quality parameters, such as voltages, currents, power, frequency, voltage sags/swells and harmonics.

Q. WHAT IS THE PURPOSE OF TAKING A READING USING A POWER QUALITY RECORDER, SOMETIMES REFERRED TO AS A RECORDING VOLT METER OR RVM?

A. A Power Quality Recorder used during a voltage investigation is intended to record voltage and current. The voltage and current data is recorded as a Voltage Stripchart. The only setting for the Voltage Stripchart is the Voltage Stripchart Interval, i.e., one minute, two minutes, three minutes. The scanner records every Voltage Stripchart using the same Interval setting.

During the Interval period, the scanner records the history of the largest and smallest one-cycled values for each Voltage Stripchart, as well as calculating and storing a running average. At the end of the Interval, the "max," "min," and "average" values for that time period are recorded as a Voltage Stripchart data point. For example, if the Voltage Stripchart Interval is set to one minute, at the end of each minute, the Voltage Stripchart will record (1) the average Root Mean Square ("RMS") voltage, (2) the minimum one-cycle RMS voltage, and (3) the maximum one-cycle RMS voltage. The Power Quality Recorder calculates the average, maximum, and minimum values using all the 3,600 60Hz cycles recorded during that minute.

These values are illustrated as three traces on a graph: a maximum; a minimum; and an average. The maximum and minimum values are unique because each gives the worst case value for every Interval with single-cycle measurement

resolution. The average trace is based on the average of the values during the Interval. The traces are color identified, and all or some of the traces may be present on the graph depending on the user's selection.

Q. WHAT ARE THE VARIOUS REPORTS THAT THE POWER QUALITY RECORDER PRODUCES?

A. The Power Quality Recorder produces a Voltage Cycle Report, a Voltage Minute Histogram Report, and a Voltage Out of Limits Report.

1. The RMS Voltage Cycle Report divides the 600 volts voltage range into 600 bins, each one volt wide, giving a bin for zero volts, a bin for one volt, two volts, all the way up to 600 volts. After each 60Hz cycle is measured, the voltage is rounded to the nearest volt and put in the appropriate bin. The bins are counters that count how many cycles were at a certain voltage. For example, if the 108 volt bin has a count of 45, then there have been 45 cycles with an RMS voltage of exactly 108 volts sometime during the recording session.
2. The Voltage Minute Histogram Report averages (every cycle is included) the voltage (current is similar) each minute of the recording period. At the end of the minute, the Histogram bin counter for that average value is incremented, which results in a Histogram of one minute average voltages. For example, if the voltage was 123 volts for 55 seconds, then 115 volts for five seconds, the average would be 122 volts, and the 122 volt bin counter would be incremented. The Histogram is unable to report how long a voltage was at a certain level. For example, if the Histogram indicated that the voltage was at 208 volts for ten minutes during the record period, and the duration as five days, 23 hours, five minutes and one second, the voltage could have been at either 208 volts for one minute at ten different times or 208 volts for ten continuous minutes.

3. The RMS Voltage Out-of-Limits Report provides information based on the inquiry voltage limits given. For example, a query of the data to provide the average voltages out of limits of a minimum 197 volts to a maximum 218 volts would produce a report giving the time(s) when this event occurred.

Q. DID APS PLACE RECORDING VOLT METERS AT THE HOTEL?

A. Yes. APS placed a recording volt meter at the Hotel in June 2006, June 2007 and August 2007.

Q. WHAT WERE THE RESULTS OF THE RECORDING VOLT METERS THAT APS PLACED AT THE HOTEL?

Based on voltage recordings taken by APS, APS confirmed that it maintained voltage to the Hotel consistent with the voltage required under ANSI Standard. APS corrects its system when it determines that there is excessive voltage unbalance. The voltage recordings did not record any unbalance limits greater than 3%. The recordings did show that the Hotel's then current loads were very unbalanced, which could potentially cause the greater voltage unbalances that were recorded between the three channels. The table below provides a data sample of the current and voltage recorded at a specific date and time. Comparing the current values under Ch1, Ch2, and Ch3 demonstrates the unbalance.

HOTEL CURRENT AND VOLTAGE VALUES ON 06/21/06 15:29:00

			Ch1	Ch2	Ch3
Current Avg	06/21/06	15:29:00	84	128	156
Voltage Avg	06/21/06	15:29:00	217	213	209

This unbalance would not affect the air-conditioning units because they were single phase, but they could contribute to the voltage difference between phases. The channel with the highest average current load is the same channel with the lowest average voltage.

Q. WOULD YOU PLEASE EXPLAIN HOW THESE RECORDING VOLT METERS CONFIRMED THAT THE SERVICE VOLTAGE DELIVERED TO THE HOTEL WAS WITHIN THE VOLTAGE STANDARDS FOR THIS SERVICE?

A. The attached graphs (using data recorded June 21-27, 2006) do not indicate voltage ranges being out of range for any extended length of time, nor do the graphs show any excessive voltage out of range. For further explanation, below is a list of detailed graphs (attached hereto) that were developed from the voltage and current cycle history recorded June 21-27, 2006:

GRAPH 1: A graph of the minimum, average, and maximum values of voltage and current, attached hereto as Attachment GT-1.

GRAPH 2: The same as Graph 1 except Graph 2 isolates the voltage, minimum, average, and maximum values, attached hereto as Attachment GT-2.

GRAPH 3: The same as Graph 2, except Graph 3 now depicts the phase currents are unbalanced (*see* scale on the right side of Graph 3), attached hereto as Attachment GT-3.

Q. WOULD YOU PLEASE EXPLAIN THE RELATIONSHIP OF A MOTOR RATING TO A VOLTAGE SUPPLY RATING TO WHICH THE MOTOR IS CONNECTED?

A. According to the National Electrical Manufacturers Association ("NEMA"), the standard for motors is Publication MG1-2009. The "General Section" of Section 14.35 of this Publication states, "Induction motors for operation on 208 volt systems should be rated for 200 volts." Thus, if a motor is rated for a 208-230 or 208/230 volt supply, the buyer should verify that the motor will operate continuously as designed within the voltage supply range to which it is connected.

In general, motors are designed to operate within +/-10 percent of their nameplate rating. For example, a NEMA rated 200 volt motor will operate within a range of 180-220 volts continuously. Motors operating beyond their nameplate ratings do not automatically fail immediately when exceeding those ratings momentarily; however, if the motors are continuously operated beyond nameplate rating, that could cause damage to the motors.

IV. CONCLUSION

Q. WOULD YOU PLEASE SUMMARIZE YOUR DIRECT TESTIMONY?

A. APS provided service voltage within the ranges recommended by the ANSI Standard. The Hotel is serviced by APS at 208/120 volts 3 phase, 4 wire. ANSI Standard sets forth a 197 volts minimum and 218 volts maximum range for this service. The Power Quality readings taken by APS at Mr. Wheeler's request between June 17 and 21, 2006 confirm that the service voltage delivered to the Hotel was within the ANSI Standard for this service.

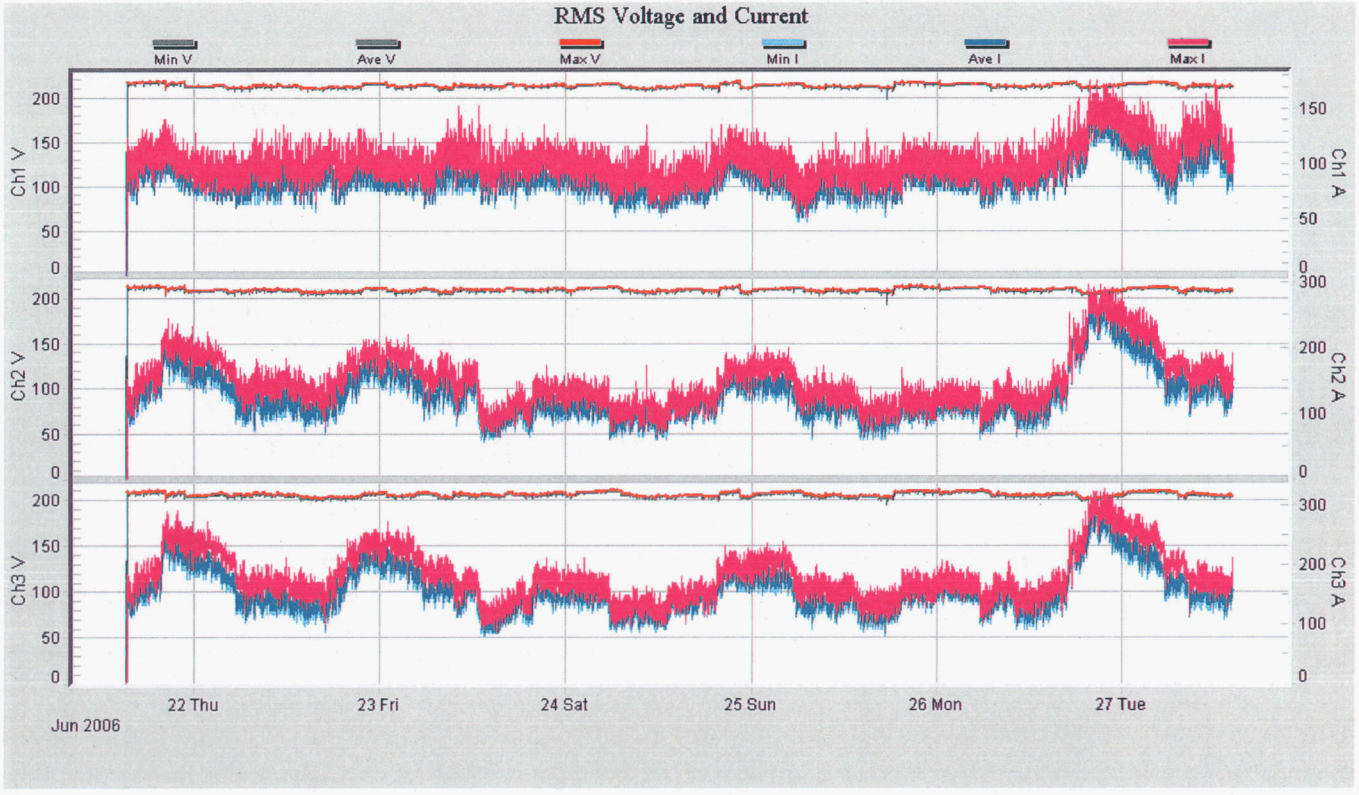
Q. DOES THAT CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes it does.

ATTACHMENT GT-1

GRAPH 1

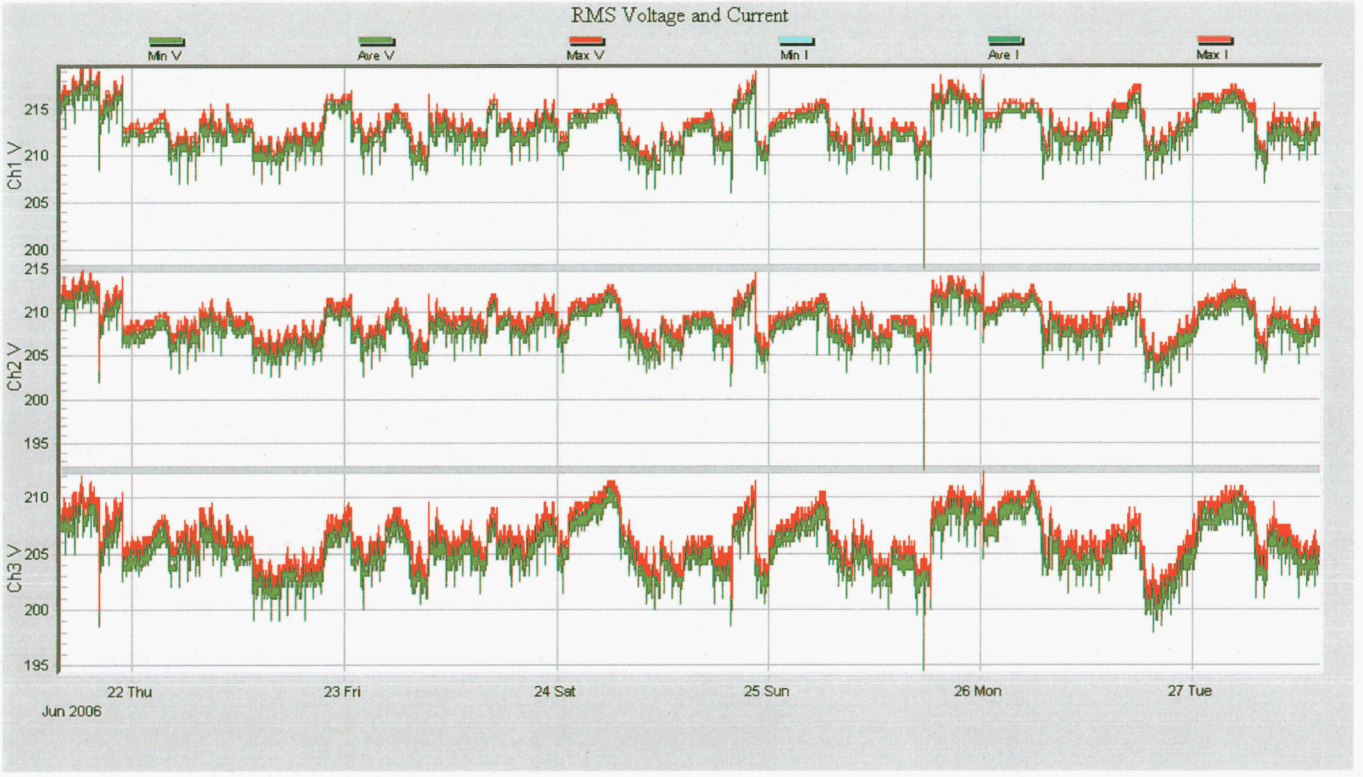
Minimum, average, and maximum values of voltage and current
for the recording period of June 21–June 27, 2006



ATTACHMENT GT-2

GRAPH 2

Same as Graph 1 except that Graph 2 isolates the voltage minimum, average, and maximum values

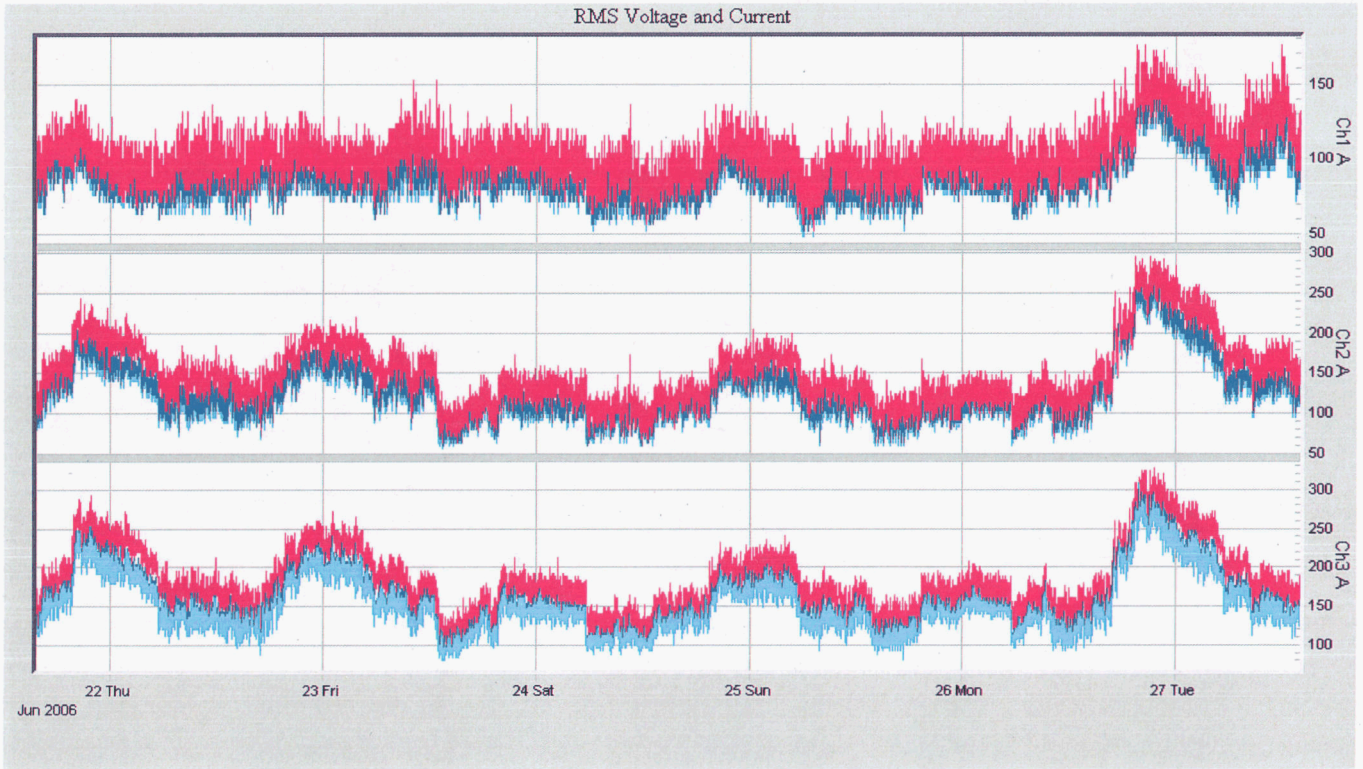


ATTACHMENT GT-3

GRAPH 3

Same as Graph 2 except Graph 3 isolates the current minimum, average, and maximum values

The graph readily shows that the phase currents are unbalanced (*see* Current Scale to the right side of the graph).



DIRECT TESTIMONY OF KENNETH R. WOLF

On Behalf of Arizona Public Service Company

Docket No. E-10345A-10-0201

February 4, 2011

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DIRECT TESTIMONY OF KENNETH R. WOLF
ON BEHALF OF ARIZONA PUBLIC SERVICE COMPANY
(Docket No. E-01345A-10-0201)

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. Kenneth R. Wolf, 400 North Fifth Street, Phoenix, Arizona 85004.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am a Procurement Consultant for Arizona Public Service Company ("APS" or "Company").

Q. WHAT ARE YOUR PROFESSIONAL QUALIFICATIONS?

A. I received a Bachelor in Science in Marketing from the University of Arizona in 1983 and am also a certified Energy Manager. I have been employed with APS for over 27 years during which time I held the following positions: Power Procurement Consultant; Manager of Key Accounts and Rural Business Support; Southwest Valley District Manager; Electric Power Originator; and Customer Service Representative.

Q. PURPOSE OF TESTIMONY.

A. I will discuss the Complainant's, Mr. Lynn Wheeler, request to increase the voltage to America's Choice Inn & Suites Hotel ("Hotel"). Mr. Wheeler requested that the voltage be increased to a level above the standard Range A voltage service that APS is required to provide per American National Standards Institute C84.1 – 1989 ("ANSI Standard") pursuant to A.A.C. R14-2-208(F)(2).

II. SUMMARY OF TESTIMONY

Q. PLEASE SUMMARIZE YOUR TESTIMONY.

A. In my Testimony, I support APS's position that the Company provided adequate electric service to the Hotel pursuant to the ANSI Standard; however, APS increased the voltage to the Hotel at Mr. Wheeler requests after Complainant signed the Request for a Voltage Variance Agreement ("Agreement"), attached hereto as Attachment KRW-1.

III. REQUEST FOR VOLTAGE VARIANCE

Q. WHAT IS THE POINT OF DELIVERY AT WHICH THE HOTEL TAKES ELECTRIC SERVICE FROM APS?

A. The point of delivery demarcation point at the Hotel is the APS meter, which is consistent with APS's Service Schedule 1, Section 6.3.1. The Hotel owns all equipment "behind" the meter, including the switchgear or meter panel where the APS wiring and meter are located. APS owns all the equipment "ahead" of the meter, including the meter itself. APS's obligation is to provide sufficient levels of service (in this case adequate voltage) to the customer at the point of delivery.

Q. WHAT IS THE SERVICE VOLTAGE AT WHICH THE HOTEL RECEIVES SERVICE?

A. APS is providing the Hotel with overhead electric service at 208/120 volts. APS maintains the 208/120 volt service within the standard Range A voltage service that APS is required to provide per the ANSI Standard.

Q. DID THE COMPANY INCREASE THE VOLTAGE TO THE HOTEL TO A LEVEL ABOVE THE ANSI STANDARD? IF YES, ON WHAT DATE DID IT DID SO?

A. Yes. On August 30, 2007, APS raised the taps to 105% of the normal utility delivery voltage on the 12,000 volt, 208/120 three-phase transformers supplying electric service to the Hotel.

Q. WHY DID THE COMPANY INCREASE THE VOLTAGE TO THE HOTEL TO A LEVEL ABOVE THE ANSI STANDARD?

A. Mr. Wheeler requested that APS increase the voltage to the Hotel in an effort to boost the 208 voltage to the air-conditioning units. Mr. Wheeler stated that the air-conditioning units have nameplate ratings of 208-230 volts, and this rating is incompatible with the 208/120 volts Range A voltage that APS provides. APS increased the voltage to the Hotel after Mr. Wheeler executed (on August 29, 2007) the Request for a Voltage Variance Agreement. In that Agreement, Mr. Wheeler acknowledged that "APS is the electric service provider for the [Hotel]. APS is currently providing the [Hotel] with electric power at 208/120 volts,

which is within the standard 'Range A' voltage service APS is required to provide per [ANSI Standard]."

IV. CONCLUSION

Q. WOULD YOU PLEASE SUMMARIZE YOUR DIRECT TESTIMONY?

A. The Company provided adequate electric service to the Hotel consistent with the ANSI Standard. APS increased the voltage to the Hotel at Mr. Wheeler's request after he signed an Agreement acknowledging that APS provided electric service within the range required by the ANSI Standard, and accepting and assuming the risk of damage to Complainant's equipment that might result from the increase in voltage.

Q. DOES THAT CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes it does.

ATTACHMENT KRW-1

REQUEST FOR VOLTAGE VARIANCE

THIS REQUEST FOR VOLTAGE VARIANCE (this "Agreement") is made and entered into this 29 day of Aug, 2007, by and between **ARIZONA PUBLIC SERVICE COMPANY**, an Arizona corporation, hereinafter referred to as "APS," and **THE JALLL CO., LLC**, an Arizona limited liability company, hereinafter referred to as "Customer."

RECITALS

A. Customer is doing business as Americas Choice Inn & Suites located at 2888 Butterfield Trail, Gila Bend, AZ 85337 (the "Property").

B. APS is the electric service provider for the Property. APS is currently providing the Property with electric power at 120/208 volts, which is within the standard "Range A" voltage service APS is required to provide per American National Standards Institute ("ANSI") C84.1 – 1989.

C. The existing heat pump window units at the Property have nameplate ratings of 208 - 230 volts, which is not compatible with the 120/208 volts "Range A" voltage provided by APS. Consequently, the heat pumps have not been working properly.

D. Customer has requested that APS increase the tap settings up to 1.05% of the normal utility delivery voltage on the 12,000 volt, 120/208 three-phase transformers supplying electric service to the Property (the "Voltage Variance").

E. Customer's request for the Voltage Variance is an effort to boost the 208 voltage to the heat pumps. However, this Voltage Variance will also increase voltage to equipment served on the 120 volt leg of the Customer's electric service and may result in damage to that equipment.

F. APS is willing to implement the Voltage Variance to the Property provided that Customer understands the risk of damage to Customer's equipment and accepts and assumes this risk.

NOW, THEREFORE, in consideration of the foregoing recitals, and further consideration of the following agreements, promises and provisions, the parties hereto agree as follows:

AGREEMENT

1. Customer acknowledges the accuracy of the recitals stated above.

2. Customer hereby acknowledges that it is aware of, and understands, the potential problems associated with the Voltage Variance, including, but not limited to, damage to

the electrical equipment of Customer and guests staying at the Property such as lights, computers, televisions, etc.

3. Customer agrees to be fully responsible for any problems resulting from the Voltage Variance and to waive any and all claims against APS for any damages resulting from the Voltage Variance. Additionally, Customer agrees to indemnify and hold APS harmless from and against any and all claims, costs, losses, demands or damages incurred by APS as a result of the Voltage Variance.

IN WITNESS WHEREOF the parties hereto have executed this Agreement on the day and year first above written.

ARIZONA PUBLIC SERVICE COMPANY,
an Arizona corporation

By: Ken Wolf
Ken Wolf
Title: West Valley Manager

THE JALLL CO., LLC
An Arizona limited liability company

By:
Title: Property Manager