BSR/ACCA 15 OBD – 201x Standard

On-Board Diagnostic Codes for HVACR Equipment

{COVER}

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FOREWORD

Modern heating, ventilation, air conditioning and refrigeration (HVACR) systems have become increasingly sophisticated, intricate, and complex (e.g., hybrid heating-cooling systems, variable-speed operation, variable-flow refrigerant, enhanced controls), which adds layers of complexity to equipment installation, servicing, maintenance, and problem diagnosis. A consistent on-board diagnostics (OBD) code nomenclature reduces the need for field practitioners to cross-reference multiple error code directories from within a manufacturer's equipment lineup as well as across the spectrum of product producers. This can reduce field installation and servicing errors to better ensure that installed equipment capacity and efficiency are as designed.

That a code can be characterized by this Standard does not require any equipment manufacturer to support that specific functionality. It is not required or implied that equipment offerings from any manufacturer must have the capability (e.g., embedded controllers, sensors, switches, etc.) to provide any minimum set, or level, of on-board fault and / or performance code identification. This Standard supports code identifications without consideration as to whether (1) the needed sensors / controls / relays / switches / etc. are in HVACR equipment offerings, and (2) whether such capability exists within the industry for application to HVACR equipment.

This Standard supports flexibility so that OEMs and aftermarket component producers can continue to offer unique attributes, characteristics, and other proprietary aspects that differentiate their brands. Furthermore, OBD codes may also expedite the requisite technician training for new equipment offerings, and allow technicians to successfully diagnose faults on a broader range of equipment types.

INTRODUCTION

This Standard details a naming schema for designating fault and performance codes associated with heating, ventilating, air-conditioning, and refrigeration (HVACR) equipment.

As defined and used in this Standard, the naming schema standardizes codes based on *Location* (with a *Modifier*), *Mode of Operation*, *Process*, *Operating Parameter*, and *Performance Descriptor*. The schema accommodates operating faults and / or performance characteristics that are commonly identified by today's equipment diagnostic capabilities, and that may need to be identified as enhanced sensors and controls are applied to future HVACR offerings. Additionally, this Standard supports the incorporation of proprietary, manufacturer-specific information that individual manufacturers may choose to make available to field practitioners.

The standardized codes identify fault and/or performance situations within HVACR systems and permit field practitioners to focus on the area(s) and component(s) causing incorrect equipment operation or performance. The fault and performance codes indicate suspected problems or problem areas, and are not intended to be used as a directive for to the proper service procedure.

This Standard does not detail possible causes or diagnostic information associated with the fault codes and / or performance issues. Such prognosis / diagnosis / troubleshooting instructions are currently provided by the equipment / component manufacturer with their product documentation and servicing procedures.

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FIGURE 1: CODE NAMING SCHEMA SCHEMATIC

Location (§4.1)

Unit Level
- Ah = **A**ir **H**andler
- Bs = **B**oiler, **S**team
- Bw = **B**oiler, **W**ater
- Ch = **CH**iller
- Cu = **C**ondensing **U**nit
- Ct = **C**ooling **T**ower
- Do = **D**edicated **O**utdoor air
- Fu = **FU**rnace
- Rt = **R**oof**T**op unit
- Sa = **S**olar **A**rray
- Ts = **T**hermal **S**torage

Subsystem Level
- Ed = **E**lectronic **D**rive
- Eu = **E**conomizer **U**nit
- Er = **E**nergy **R**ecovery
- Rd = **R**eturn **D**uct
- Sd = **S**upply **D**uct
- Ve = **VE**ntilator

Component Level
- Ac = **AC**cumulator
- Cc = **C**ondenser **C**oil
- Ce = **C**oil **E**vaporator
- Co = **CO**mpressor
- Cr = **C**apacitor, **R**un
- Cs = **C**apacitor, **S**tart
- Db = **D**amper, **B**ypass
- De = **D**amper, **E**xhaust
- Dr = **D**amper, **R**eturn
- Ds = **D**amper, **S**upply
- Dz = **D**amper, **Z**one
- Ec = **E**xp. / metering device, **C**ond
- Ee = **E**xp. / metering device, **E**vap
- Fb = **F**urnace **B**urner
- Fc = **F**an, **C**ondenser
- Fd = **F**ilter **D**ryer
- Fe = **F**an, **Evap**
- Fr = **F**an, **R**eturn
- Fx = **F**an, e**X**haust
- Fs = **F**an, **S**upply (i.e., blower)
- Hx = **H**eat e**X**changer (Aux)
- Mb = **M**otor, **B**lower
- Mc = **M**otor, **C**ondenser
- Mi = **M**otor, **I**nducer
- Mp = **M**otor, **P**ump
- Pa = **P**ump, **A**bsorber
- Pc = **P**ump, **C**ondenser
- Pe = **P**ump, **E**vaporator
- Pg = **P**ump, **G**enerator
- Pm = **P**hase **M**onitor
- Re = **RE**ceiver
- Vb = **V**alve, **B**alancing
- Vg = **V**alve, **G**as
- Vr = **V**alve, **R**eversing
- Vs = **V**alve, **S**plit condensor

Location Modifier (§4.2)

[multiple stages / components / circuits / positions]
- 1 = 1st Stage (or compont, or circuit, or position)
  thru
- 9 = 9th Stage (or compont, or circuit, or position)
- A = 10th Stage (or compont, or circuit, or position)
  thru
- Z = 35th Stage (or compont, or circuit, or position)
- – = default for base scenario

Performance Descriptor (§4.6)

C = **C**losed	P = **P**olarity
D = **D**etected	R = out of expected **R**ange
G = **G**rounded	S = **S**horted
H = **H**igh	T = **T**ripped
L = **L**ow	X = lockout / manual reset
N = **N**o signal	Y = lockout / automatic reset
O = **O**pen	# = Measured Operating Value

Digits	1	2	3	4	5	6	7	8		9	10	11	12	13
	A	h	–	C	R	T	e	H	/					

Mode of Operation (§4.3)
- A = **A**uxiliary / emergency heating mode
- C = **C**ooling mode
- D = **D**ehumidification mode
- E = **E**conomizer mode
- F = de**F**rost mode
- H = **H**eating mode
- M = hu**M**idification mode
- P = **P**urge mode
- U = **U**tility DR power reduction mode
- R = **R**eheat mode
- V = **V**entilation mode
- X= e**X**haust mode
- – = no information provided

Process (§4.4)
- A = **A**ir movement / system
- C = **C**ombustion system
- F = **F**uel movement / System
- I = **I**gnition System
- L = **L**ubricant/oil movement/system
- M = **M**oisture control system
- P = **P**ower production system
- R = **R**efrigerant movement / system
- W or H = **W**ater (or **H**ydronic loop) movement / system
- – = no information provided

Operating Parameters (§4.5)

Operational Elements
- Cl = **C**harge **L**evel
- Ec = **E**lec. **C**urrent (amps)
- Fv = **F**low **V**ol. (CFM, gpm)
- Mo = **MO**isture (%, ppm)
- Pe = **P**ower, **E**lectrical (watts)
- Pr = **PR**essure
- Rh = **R**elative **H**umidity
- Sc = **S**ub**C**ool
- Sh = **S**uper**H**eat
- Te = **TE**mperature
- Ve = flow **VE**locity (FPM)
- Vo = **VO**ltage

Combustion Elements
- Cd = **C**arbon **D**ioxide (CO_2)
- Cm = **C**arbon **M**onoxide (CO)
- Ff = **F**lame **F**ailure
- Fr = **F**lame **R**ollout
- No = **N**itrogen **O**xide (NOx)
- Ox = **O**Xygen (O_2) conc.

Other Elements
- Ca = **CA**pacity (MBTU/h)
- Cb = **C**ontrol **B**oard
- Cc = **C**ommunications/**C**ontrols
- Co = **CO**mposition
- Ef = **EF**ficiency (%)
- Lk = **L**ea**K**s
- Mr = **M**ass flow **R**ate (lbs/hr)
- Rs = **R**otational **S**peed (RPM)
- Sm = **SM**oke (ppm)
- Sp = **S**ound **P**ressure (dba)
- Vi = **VI**bration (Hz)

Additional Coding (8th digit contingent)
Fault Code (§4.7.1): proprietary OEM coding (opt)
Performance Code (§4.7.2): actual attribute value

Fault Code Example Shown
Ah – C R Te H = Air Handler, in the Cooling Mode, Refrigerant Temperature High

1.0 PURPOSE

This Standard details a naming schema for designating fault and performance codes associated with heating, ventilating, air-conditioning, and refrigeration (HVACR) equipment.

2.0 SCOPE

This Standard applies to new HVACR equipment for use in new and existing residential buildings, commercial buildings, and commercial refrigeration applications.

Equipment not included within this scope are:

- HVACR equipment that do not provide fault / performance codes (e.g., equipment that are only controlled by analog devices).
- HVACR equipment not designed / manufactured to support the naming schema defined in this Standard (e.g., equipment utilizing fault codes that are not in conformity to this standard).
- Equipment with DDC controls that utilize graphics or plain-language reporting of diagnostics either to a controller display or to a front-end building controls system.

3.0 DEFINITIONS

The terms below are unique to this standard. See Appendix B ("Glossary") for definitions of other terms commonly used in the HVACR industry.

Air Movement System: The components within an HVACR system which facilitate or initiate the movement of air.

Combustion System: The components of a furnace or combustion system related to the burning of a fuel, providing combustion air, and venting of combustion products.

Fault Code: An alpha-numeric designator that indicates system problems as identified / stored / communicated by an on-board diagnostic system. The fault code identifies a particular problem area and are intended to provide the technician with information as to what type of fault(s) – and associated component location(s) – that might be occurring. Fault codes are to be used in conjunction with the OEM's equipment service manual to ascertain which systems, circuits or components are to be subsequently tested to fully diagnose the fault.

Location: The unit or subsystem or component within the HVACR system where a code is being generated. See §4.1 for the units/subsystems/components supported by this Standard.

Location Modifier: Within the context of this standard, the designation of a stage within a multi-stage component, or a multiple component, or a multiple circuit, or a specific position of (or within) a component. See §4.2 for the designations supported by this Standard.

Lubrication System: The components that allow the lubricant to be managed throughout an HVACR system – including oil pump, oil separator, oil filter, oil screen pressure differential valve(s), check valve(s), oil level regulator (mechanical or electronic) – and returned to the compressor.

Mode of Operation: The operating function of the equipment when the code is being reported. In the case of a heat pump system, various modes of operation and combinations of modes are possible; for example, heating, cooling, emergency heat, may be operating in conjunction with dehumidification, and humidification modes. See §4.3 for the Modes of Operation supported by this Standard.

Moisture Control System: A system, or components within a system, whose purpose is to control the moisture content of the conditioned air; this can be adding or removing moisture.

Operating Parameter: Refers to the name of the specific operating element that a diagnostic program detects may not be in conformity with proper operation or for which performance information is being provided. See §4.5 for the Operating Parameters supported by this Standard.

Performance Code: An alpha-numeric designator that indicates performance information as identified / stored / communicated by an on-board diagnostic system. The code provides operating characteristics of the system or component in terms of specific sensed / measured / calculated values such as amps, airflow, pressure, temperature, voltage, watts. The information is to be used in conjunction with the OEM's installation and service manuals to ascertain how the system is performing against OEM specifications.

Performance Descriptor: Indicates in what manner a specific Operating Parameter is directly or indirectly sensed / measured / calculated (a) as being outside the limits expected for properly operating HVACR equipment (i.e., a fault code), or (b) for which an a parameter's specific operating value is being provided (i.e., a performance code). See §4.6 for the Performance Descriptors supported by this Standard.

Power Production System: Any system whose purpose is to produce electrical power. This includes all the individual components, including but not limited to: generator, steam system including piping, fuel, combustion components, pumps, fans, storage cells, and wiring.

Process: The underlying system or subsystem activity that the code is referencing. HVACR systems are capable of undertaking multiple processes (e.g., air, refrigerant, water movements) simultaneously or sequentially. See §4.4 for the Processes supported by this Standard.

Refrigerant Movement System: Any system whose purpose is to transfer heat through the use of a refrigerant as a working medium. This includes all the individual components, including but not limited to: compressor, heating source, evaporator, condenser, refrigerant metering devices, and piping.

Water (or hydronic or fluid loop) Movement System: Any system whose purpose is to transfer heat through the use of water or a mixed water/glycol based medium. This includes all the individual components, including but not limited to: pumps, motors, fans, valves, and piping.

4.0 CODE FORMAT STRUCTURE

To be in compliance with this Standard, equipment manufacturers and suppliers shall convey fault codes and / or operating performance codes per the schema identified in this Standard.

- The fault code designation consists of two alpha digits, followed by a single digit that is either numeric or alpha, followed by five alpha digits, optionally followed by an OEM-assigned, OEM-proprietary, five (5) digit designator that can be alpha-only, numeric-only, or alphanumeric.
- The performance code designation consists of two alpha digits, followed by a single digit that is either numeric or alpha, followed by four alpha digits, followed by a "#" symbol, followed by five (5) numeric digits.

The assignment of the first eight (8) digits are determined by the area for that functionality; see §4.1 through §4.6. The assignment of the additional five (5) digits are per §4.7. For the two items that contain two alpha characters each (see §4.1 and §4.5), the second character is in lowercase. The code nomenclature schema is detailed below and is illustrated in Figure 1.

4.1 Location: The first and second digits detail the unit, subsystem or component level within the HVACR system associated with the encountered code.[1]

Unit level
Ah = air handler
Bs = boiler, steam
Bw = boiler, water
Ch = chiller
Cu = condensing unit*
Ct = cooling tower
Do = dedicated outdoor air system
Fu = furnace
Rt = rooftop unit
Sa = solar array
Ts = thermal storage

Subsystem level
Ed = electronic drive
Eu = economizer unit
Er = energy recovery (wheels, plates, liquid)
Rd = return duct
Sd = supply duct
Ve = ventilator (e.g., fan, ERV, HRV)

Component level
Ac = accumulator
Cc = coil, condenser*
Ce = coil, evaporator*
Co = compressor
Cr = capacitor, run

[1] The schema supports a unit that has a limited number of sensors or fault sensing capabilities (e.g., overall voltage, current, temperature, and pressure within a single package system); or subsystems (for increased differentiation) within that unit (e.g., an integrated economizer to a rooftop unit); or varied components (for deeper granularity if multiple sensing capabilities exist) within that unit.

Cs = capacitor, start
Db = damper, bypass
De = damper, exhaust
Dr = damper, return
Ds = damper, supply
Dz = damper, zone
Ec = expansion/metering device, condenser*
Ee = expansion/metering device, evaporator*
Fb = furnace burner
Fc = fan, condenser*
Fd = filter dryer
Fe = fan, evaporator
Fr = fan, return
Fx = fan exhaust
Fs = fan, supply (blower)
Hx = Heat exchanger (auxiliary)
Mb = motor, blower
Mc = motor, condenser*
Mi = motor, inducer
Mp = motor, pump
Pa = pump, absorber
Pc = pump, condenser*
Pe = pump, evaporator*
Pg = pump, generator
Pm = phase monitor
Re = receiver
Vb = valve, balancing
Vg = valve, gas
Vr = valve, reversing
Vs = valve, split condenser

* For naming consistency, when heat pumps are operating in the heating mode, evaporator and condenser components remain as defined in the cooling mode.

4.2 Location Modifier: The third digit denotes, as applicable, whether the code applies to a multiple stage (e.g., stage one of a two-stage compressor), to a multiple component (e.g., the second compressor), to a multiple circuit, or to a specific position within a unit or component (e.g., furnace burner 2). The default value is "–" when there are only single stages, units, or positions.

4.2.1 Number Usage: The numerical numbers of "1 through 9" shall be used to indicate the first ("1"), second ("2"), third ("3") … through ninth ("9") of such stages, components, circuits, or positions to be addressed.

4.2.1 Letter Usage: When there are ten (10) or more stages, components, circuits, or positions to be addressed, the uppercase letters of "A through Z" shall be used to indicate the tenth ("A"), eleventh ("B"), twelfth ("C") … through thirty-fifth ("Z") for same.

4.3 Mode of Operation: The fourth digit details the function (mode of operation) that the HVACR equipment is operating in when the code is generated:

A = auxiliary / emergency heating mode
C = cooling mode
D = dehumidification mode
E = economizer mode
F = defrost mode
H = heating mode
M = humidification mode
P = purge mode
U = utility demand response power reduction mode
R= reheat mode
V = ventilation mode
X = exhaust
– = no information provided

4.4 Process: The fifth digit relates to the underlying HVACR process / system to which the code applies:

A = air movement/system
C = combustion system
F = fuel movement / system
I = ignition system
L = lubricant/oil movement system
M = moisture control system
P = power production system
R = refrigeration movement/system
W (or H) = water (or hydronic loop) movement/system
– = no information provided

4.5 Operating Parameter: The sixth and seventh digits relate to the element that is directly, or indirectly, sensed / measured / calculated within the HVACR system. For grouping convenience, these operating parameters are listed below by 'operational elements', 'combustion elements' and 'tertiary' elements:

Operational Elements

Cl = charge level
Ec = electrical current (e.g., amps)
Fv = flow volume (e.g., cfm, gpm)
Mo = moisture (%, ppm, etc.)[2]
Pe = power, electrical (e.g., watts)
Pr = pressure (e.g., psia for refrigerant, iwc. for air)
Rh = relative humidity (e.g., %)
Sc = subcooling (e.g. ºF or ºC)
Sh = superheat (e.g. ºF or ºC)
Te = temperature (e.g. ºF or ºC)
Ve = flow velocity (e.g., fpm or lps)
Vo = voltage (e.g., V)

Combustion Elements

Cm = carbon monoxide (CO) concentration (e.g., ppm)
Ff = flame failure
Fr = flame rollout

[2] Depending on component/location, said moisture could be present within the refrigerant or the lubricant (ppm), or could be in the form of free water as in condensate in a drain pan.

No = nitrogen oxide (NOx) concentration (e.g., ppb)
Ox = oxygen (O_2) concentration (e.g., %)

Other Elements
Ca = capacity (e.g., mBTU/hr output)
Cb = Control Board
Cc = communications / controls
Cd = carbon dioxide (CO_2) concentration (e.g., ppm)
Co = composition
Ef = efficiency (%)
Lk = leak
Mr = mass flow rate (e.g., lbs/hr)
Rs = rotational speed (e.g., RPM; revolutions per minute)
Sm = smoke concentration (e.g., ppm)
Sp = sound pressure (dBa)
Vi – Vibration (E.g., Hz)

Note: For the Processes identified in §4.4, not all of the §4.5 Operating Parameters apply.

4.6 Performance Descriptor: The eighth digit characterizes the operating performance of the system; either by indicating how an Operating Parameter is out of tolerance, or by indicating that an operating value for a specified Operating Parameter is being provided.

4.6.1 Alpha-designation: When the eighth digit is a letter, said letter details what is incongruous with the Operating Parameter when the code is encountered:

C = closed[3]
D = detected
G = grounded
H = high
L = low
N = no signal
O = open[4]
P = polarity
R = out of expected range
S = shorted
T = tripped
X = lockout / manual reset
Y = lockout / automatic reset

Note: For the Operating Parameters identified in §4.5, not all of the §4.6 Performance Descriptors apply.

4.6.2 #-designation: When the eighth digit is the "#" symbol, it identifies that the value shown in digits nine through thirteen is a directly, or indirectly, sensed / measured / calculated operating value for the Operating Parameter indicated in §4.5 above (see also §4.7.2).

= sensed / measured / calculated operating value

[3] 'Closed' is related to the sensor or relay. "Normally open" is considered the non-fault condition.
[4] 'Open' is related to the sensor or relay. "Normally closed" is considered the non-fault condition.

4.7 Additional Coding: Digits nine (9) through thirteen (13) are reserved for coding that provides additional information.

4.7.1 OEM Proprietary Information: When the eighth digit is an alpha character per §4.6.1, the value provided by digits nine (9) through thirteen (13) contains optional, OEM-proprietary information that is created by the equipment manufacturer.[5] When such additional coding is provided, it is to be separated from the first eight (8) characters by the use of a slash ("/"). When additional OEM proprietary information is not provided for fault codes, then digits nine (9) through thirteen (13) shall each be a lowercase "x"; or, at the OEM's option, the fault code is simply truncated to the first eight (8) digits.

4.7.2 Performance Operation: When the eighth digit is the "#" symbol per §4.6.2, the value provided by digits nine (9) through thirteen (13) is the directly, or indirectly, sensed / measured / calculated value for the Operating Parameter indicated in §4.5.[6] When such value is provided, there is no slash ("/") after the eighth (8th) character. It is permissible to use the plus ("+") and minus ("-") signs when indicating numerical values as well as to include a decimal point.

5.0 CODE DESCRIPTIVE LABELS

5.1 Users of this Standard have the discretion to apply plain-language descriptive labels associated with the §4.0 codes. These plain-language descriptive labels are to[7]:

a. Use the wording as shown in Figure 1, roughly in the order that the schema is ordered.
b. Utilize full words or industry-recognized abbreviations.

5.2 When plain-language labels are used, the code associated with the label(s) shall be included.

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[5] These optional digits, when provided, allow the OEM to communicate more detailed information or other information related to the fault situation. Such additional details can include proprietary information to further characterize the fault, the fault location, fault assessment, or to detail information related to such aspects as variable-speed motor control settings, variable refrigerant flow, etc.

[6] These digits are in the units (e.g., for airflow, CFM or L/S) that are consistent in the manner that the OEM provides supporting engineering data.

[7] See Appendix A for examples of plain-language fault code descriptors, as well as plain-language performance code descriptors, written per the §5 requirements.

APPENDIX A | ILLUSTRATIVE EXAMPLES OF SCHEMA USE

[This Appendix is not part of the Standard. It is merely informative and does not contain requirements necessary for conformance to the Standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ACCA or ANSI.]

The intent of this Standard is that, to the extent that HVACR equipment and components communicate information regarding a fault situation or an operating performance metric, said information is identified by a standardized code as derived by the naming schema identified in Section 4.0.

A.1 Fault Code Examples: For illustrative purposes, the table below provides representative example fault codes for varied HVACR applications that are in accordance to this standard, along with a plain-language descriptive label for same; truncated to the first 8 digits. It is recognized that multiple system faults can be encountered due to a single system problem inducing responses from varied sensors[8] or due to multiple system problems related or unrelated to each other.

1	2	3	4	5	6	7	8	9	10	11	12	13
Component (location)		Component Modifier	Mode of Operation	Process	Operating Parameter		Performance Descriptor	Reserved for OEM usage (optional)				
C	u	–	C	R	P	r	H	x	x	x	x	x
Condensing Unit, in the Cooling Mode, Refrigerant Pressure High [Cu-CRPeH]												
C	t	2	C	W	F	v	R	x	x	x	x	x
Cooling Tower 2, in the Cooling Mode, Water Flow Out of Expected Range [Ct2CWFvR]												
E	v	–	C	A	T	e	L	x	x	x	x	x
Evaporator, in the Cooling Mode, Air Temperature Low [Ev-CATeL]												
A	h	–	A	A	T	e	T	x	x	x	x	x
Air Handler, in the Auxiliary Mode, Air Temperature Tripped [Ah-AATeT}												
S	d	1	H	A	P	r	R	x	x	x	x	x
Supply Duct 1, in the Heating Mode, Air Pressure Out of Expected Range [Sd1HAPrR]												

A.2 Performance Code Examples: For illustrative purposes, the table below provides representative example performance codes for varied HVACR applications that are in accordance to this standard, along with a plain-language descriptive label for same.

1	2	3	4	5	6	7	8	9	10	11	12	13
Component (location)		Component Modifier	Mode of Operation	Process	Operating Parameter		Performance Descriptor	Sensed / Measured / Calculated Operating Value for the indicated Parameter				
A	h	–	C	A	F	v	#	0	1	2	6	0
Air Handler, in the Cooling Mode, Air Flow is 1260 [Ah-CAFv#01260]												
S	d	1	H	A	T	e	#	0	0	1	2	2
Supply Duct 1, in the Heating Mode, Air Temperature is 122 [Sd1HATe#00122]												
E	v	–	C	R	T	e	#	-	5	3	•	8
Evaporator, in the Cooling Mode, Refrigerant Temperature is -53.8 [Ev-CATe#-53.8]												
E	v	–	F	R	P	r	#	0	0	4	2	5
Evaporator, in the Defrost Mode , Refrigerant Pressure is 425 [Ev-FRPr#00425]												
S	d	1	H	A	P	r	#	0	2	5	•	5
Supply Duct 1, in the Heating Mode, Air Pressure is 25.5 [Sd1HAPr#025.5]												

[8] An example of a single problem causing multiple fault codes is: a clogged air filter in the indoor air handler results in a return air low pressure fault, low airflow fault, out-of-range air temperature sensor fault, low refrigerant temperature fault, low air handler amp draw fault, etc.

APPENDIX B | GLOSSARY

[This Appendix is not part of the Standard. It is merely informative and does not contain requirements necessary for conformance to the Standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ACCA or ANSI.]

As a convenience to the user, this Glossary provides descriptions for common, industry-recognized, industry-applied terms. These terms and definitions are not unique to this standard; they are common HVACR equipment and component terminology. See Section 3 of this Standard for terms whose definitions are unique to this Standard.

ACCA: Air Conditioning Contractors of America (www.acca.org).

Airflow: Volumetric flow rate for ducted flow, or for the flow through primary heating and cooling equipment, supply outlets, returns, etc...

CFM: Cubic Feet per Minute (IP unit for volumetric airflow).

L/S: Liters per Second (SI unit for volumetric airflow).

Air Handler: An equipment cabinet that contains a blower (and other devices, such as coils and filters) that moves air through the air distribution system. (Note: A forced air furnace provides the similar air movement function.)

Amps (A): A unit for measuring the rate at which electric current flows.

Boiler, Steam: Vessel in which a liquid is pressurized and heated to produce a pressurized vaporization/steam.

Boiler, Water: Vessel in which a liquid is pressurized and heated without vaporization.

Carbon Dioxide (CO_2): A colorless, odorless gas produced by burning carbon and organic compounds and by respiration. It is naturally present in air (approximately 0.03 percent) and is absorbed by plants in photosynthesis. It can also be used as a heat transfer fluid in refrigeration equipment.

Carbon Monoxide (CO): Carbon monoxide (CO) is a poisonous, odorless and colorless gas which is created whenever a fossil fuel (such as wood, gasoline, coal, natural gas, kerosene, etc.) is burned.

Chiller: A machine that removes heat from a liquid via a vapor-compression or absorption refrigeration cycle. This liquid can then be circulated through a heat exchanger to cool equipment, or another process stream (such as air or process water).

Closed: Not open. As it relates to flow of a fluid - not allowing flow through a valve. As it relates to electricity – when a switch is closed, flow of electricity is enabled.

Combustion*: Chemical process of oxidation that occurs at a rate fast enough to produce heat, and usually light, either as a glow or flame.

Communication: The imparting or interchange of data or information within the system, as well as to outside communication hubs and devices.

Compressor: In refrigeration, the machine that compresses the cool refrigerant into a hot, high pressure gas so it can give off heat to the air or water being passed through a condenser.

Condenser: The device that exhausts the heat from a refrigeration system. The refrigerant turns from a gas into a liquid in the condenser, and is ready to begin the refrigeration cycle again. Condensers can be air-cooled, water cooled or a combination of both, called evaporative condensers or fluid coolers. Condensers may also be single circuited, multi-circuited, or split circuited.

Condensing Unit: A package of refrigeration equipment generally consisting of a compressor, condenser (heat exchanger), condenser fan, controls, and associated hardware.

Control*: Device for regulation of a system or component in a normal and safe operation, manual or automatic. If automatic, the implication is that it is responsive to changes of pressure, temperature, etc.

Cooling Tower: A device which uses evaporative cooling to lower the temperature of water flowing through it.

Damper: A manually operated blade or louver or automatic throttling device used to adjust or block the airflow through a duct run, equipment cabinet, supply outlet, return grille or vent or chimney.

Bypass: A damper used in zone systems to relieve excess pressure in the air distribution system caused when one zone closes and the air flow exceeds the design static pressure of the open zone. These dampers usually employ a counter weighted arm that opens at a certain pressure (barometric bypass damper) or an air pressure sensor that opens the damper with a motor (motorized bypass damper).

Exhaust: Any blocking device placed in an exhaust ductwork to control the flow of air.

Return: Any blocking device placed in the return air ductwork to control the flow of air.

Supply: Any blocking device placed in the supply air ductwork to control the flow of air.

Zone: A damper used in zone systems to control the airflow into rooms or spaces.

Dedicated Outdoor Air System: The components within an HVACR system which facilitate or initiate bringing outside air into the conditioned space.

Economizer: A unit, or mode of operation, that captures heat and transfers a portion of that heat to another medium, thereby, increasing system efficiency.

Economizer Mode: When an economizer unit, whether as a stand-alone or as a component within a mechanical system, is being utilized to capture and redirect heat.

Economizer Unit: Comes in many different forms to recover heat from many different mediums; air, flue, water, and refrigerant.

Evaporator: The component of a refrigeration system in which the refrigerant absorbs heat and vaporizes. Usually a coil arranged from pipes or tubing and plates or fins. For air conditioners the evaporator coil is always in the indoor unit. For heat pumps the evaporator is the indoor coil in the summer, and reverses to the outdoor coil in the winter.

Expansion Device: A metering device that controls the flow of refrigerant to the evaporator. The device can be as simple as a sized orifice or tube that restricts the refrigerant flow. The mechanical valve version uses a sensing bulb attached to the refrigeration suction line, the bulb can sense temperature changes of the refrigerant leaving the evaporator coil. Based on the temperature of the leaving refrigerant the valve restricts or expands to ensure maximum heat transfer within the evaporator by optimizing refrigerant flow. The electronic valve version utilizes a temperature sensor placed in the airstream of the evaporator coil and in conjunction with an algorithm through an electronic controller opens and closes the valve to maintain a preset coil superheat.

Feet per Minute (FPM): The measurement of a fluid's (gaseous or liquid) velocity as it travels in piping or duct.

Flame Rollout: Burner flames discharge outside of the combustion chamber and possibly into the occupied space outside of a combustion appliance's cabinet.

Furnace*: 1. Part of a warm air heating system in which energy is converted to heat; **2.** Enclosed chamber or structure in which heat is produced, as by burning fuel, or by converting electrical energy.

Gallons per Minute (GPM): The measurement of a volume of fluid (e.g. water, oil, etc.) through a pump, or a closed or open system.

Glycol: Water based fluid used for heat exchange. [Not classified as refrigerants because they do not change state when adding or removing heat.]

Grounded: Electrically connected to an electrical potential of zero volts, as referenced to the Earth.

Heat Exchanger: The component in a heating or cooling system that adds or removes heat to an air stream or water stream. Heating mode examples include: a combustion chamber, electric resistance coil, or a coil with hot water or refrigerant (heat pump). A cooling mode example is a coil with cold water or refrigerant.

Heat Exchanger, Auxiliary: In addition to condensers and evaporators, HVACR systems can have one or more additional heat exchangers (e.g., subcooler, liquid-suction heat exchanger, refrigerant economizers, heat reclaim, etc.) that are for varied purposes.

Heat Reclaim: The heat normally rejected by the condenser is used for beneficial heating purposes. The heat may be prioritized for hot water, or hot air for the store, or backroom.

High: Exceeding the system-designed degree or measure.

Humidity: Water vapor within a given volume, referenced to the air temperature within that volume.

HVAC: Heating, ventilating and air conditioning.

HVAC system*: A system that provides, either collectively or individually, the processes of comfort heating, ventilating, and/or air conditioning within, or associated with, a building.

HVACR: Heating, ventilating, air conditioning, and refrigeration.

Lockout: The ability to isolate and shut off – or disable – a system that has a fault so severe that running that system would be detrimental to human safety or the equipment's lifespan.

Low: Below the common degree or measure

Lubrication System: Components that provide a means to circulate lubricant/oil to those components within a system needing to reduce friction and/or heat.

Nitrogen Oxide (NOx): Any of several oxides of nitrogen (such as nitric oxide and nitrogen dioxide), most of which are produced in combustion and are considered to be atmospheric pollutants.

No Signal: Many electronic components require some means of communication. When the required signal is absent, it registers as a "no signal". For example, a pressure transducer relays a voltage or current signal to a communication board to advise the controller of its reading of pressure. When there is "no signal", this transducer circuit's lack of response implies that it is not functioning.

OEM: Original equipment manufacturer.

Open: Not closed. As it relates to flow of a fluid - allowing flow through a valve. As it relates to electricity – when a switch is open, electricity flow stops.

Out of expected range: The sensed value is within a unit's operating range (i.e., not high or low), but not correct for the operating conditions. It is used to indicate skewed values indicating poor performance of a circuit, component, sensor, or the system.

Oxygen: Oxygen is a chemical element with symbol "O" and atomic number of "8". It is a member of the chalcogen group on the periodic table and is a highly reactive nonmetal and oxidizing agent that readily forms oxides.

Polarity: 1. The relative orientation of poles; the direction of a magnetic or electric field. 2. The relative potential to earth ground of an electrical conductor.

Pressure: The force applied perpendicular to the surface of an object per unit area over which that force is distributed.

Receiver: A component of an air-conditioning or refrigeration equipment that is mounted in the liquid line between the condenser and the filter-dryer designed to hold the varying volume of liquid refrigerant resulting from changes in system operating conditions.

Refrigerant: **1.** In a refrigerating system, the medium of heat transfer which picks up heat by evaporating at a low temperature and pressure, and gives up heat on condensing at a higher temperature and pressure; **2.** (refrigerating fluid) Fluid used for heat transfer in a refrigerating system that absorbs heat at a low temperature and low pressure of the fluid and transfers heat at a higher temperature and a higher pressure of the fluid, usually involving changes of state of the fluid.

Relative Humidity: The percentage of moisture in the air measured against the amount of moisture the air could hold at a given temperature.

Return Duct: The conduit used to carry air from the conditioned space or the point of utilization back to the air handler.

Revolutions per Minute (RPM): A measure of the frequency of rotation, specifically the number of rotations around a fixed axis in one minute.

Sensor: A device that detects or measures a physical property. The specific input could be electrical, light, heat, motion, pressure, chemical, or other. Sensors may or may not include indication and/or recording capabilities.

Smoke: 1. The gaseous products of burning materials (especially of organic origin) made visible by the presence of small particles of carbon 2. A suspension of particles in a gas.

Subcooling: Heat rejection by refrigerant liquid. Sub cooling can be viewed as the temperature of the refrigerant below its condensing point at its immediate pressure. A small amount of sub cooling is necessary to prevent flash gas or bubbles in the liquid line which results in poor refrigerator performance. Additional sub cooling further increases refrigeration efficiency because: 1) there is less heat to be removed from the refrigerant in the evaporator and 2) condensing temperature (hence, discharge pressure) can be lowered. Two common methods of achieving sub cooling in supermarket refrigeration are ambient sub cooling and mechanical sub cooling (refrigerating the liquid). When utilizing refrigerants that are zeotropic (referring to the ASHRAE-designated "400" series family of refrigerants), subcooling is determined by measuring the refrigerant temperature in the liquid line minus the bubble point (i.e., refrigerant evaporation is just beginning) of that refrigerant at a given pressure.

Superheat: Heat absorbed by refrigerant vapor. Superheat can be viewed as the temperature of the refrigerant above its boiling point at its immediate pressure.

Evaporator - Evaporator superheat is calculated by taking the matching temperature from a temperature pressure chart for the pressure in the evaporator vs the actual temperature of the refrigerant on the outlet of the evaporator.

System – System superheat is calculated by taking the matching temperature from a temperature pressure chart for the pressure in the evaporator vs the actual temperature of the refrigerant on the inlet of the compressor.

Supply Duct: The conduit used to carry air from the air handler to the conditioned space or the point of utilization.

Temperature: A measure of heat intensity by the heat content of a substance, normally measured in degrees Fahrenheit (^{o}F) or Celsius (^{o}C).

Tripped: To trigger a mechanism based on a designed level of input, such as temperature or pressure. Generally used in conjunction with disabling the mechanism for safety reasons.

Valve, Gas: A valve used with gas-fired furnaces that controls the flow of natural gas or propane to the burners. Normally controlled by a thermocouple and/or electronic control.

Valve, Reversing: A valve used with heat pumps that reverses the function of the evaporator (indoor coil) and the condenser (outdoor coil) to changeover between heating and cooling cycles. Also called a Four-Way Valve.

Valve, Split Condenser: A three way valve or a pair of motorized ball valves that allows refrigerant flow through a doublewide condenser with each side operating independently of the other, and each having its own fan controls.

Voltage: Electric potential or potential difference expressed in volts.

Watts (W): 1. A unit of electrical power that reflects the work done or energy generated by one ampere induced by an EMF of one volt.

* Definition adapted from ASHRAE Terminology of Heating, Ventilation Air Conditioning & Refrigeration Second Edition 1991.