USAF Built Infrastructure Inventory and Assessments Manual

Appendix for HVAC (D30)

July 2017

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I. Overview

This manual covers the inventory and assessment process for the "HVAC (D30)" building system and components. Please see the SMS Playbook Manual for additional information including:

- BUILDER™ Sustainment Management System Concepts
- Overview of ASTM E 1557 UNIFORMAT II Standard Classification for BUILDER™
- BUILDER™ Inventory Overview
- BUILDER™ Assessment Overview
- BUILDER™ Remote Entry Database (BRED™)
- Working with Web-Based BUILDER™
- Quality Assurance
- Site Visit Preparation and Execution
- Site Visit Safety

A. D30 HVAC Description

1. UNIFORMAT II definition

- Heating Ventilation and Air Conditioning (HVAC) systems generates, distributes, and controls energy, fluids and air to associated equipment and spaces within a building in order to maintain environmental conditions (humidity, temperature, air exchanges, etc.). The HVAC system may serve an entire building or a part of a building. The system is designed to support the function/mission of the building and for comfort and safety of the occupants.

2. Major components

- Energy Supply (D3010): This subsystem provides a source of fuel/energy (other than electrical) for the heating and cooling systems in the building. The inventory components are those not owned and operated by a utility provider such as the local gas company or through a lease with a propane tank provider. This subsystem is not required to be inventoried and assessed but may be accomplished at the base's discretion.
- Heat Generating Systems (D3020): This subsystem provides the heating for the building and may include boilers, furnaces and fuel fired unit heaters.
- Cooling Generating Systems (D3030): This subsystem provides the cooling for the building and may include chillers, cooling towers and condensing units. Please note, while D303002 includes Rooftop Units, these are also found under D303002 Direct Expansion Systems and D304008 Air Handing Units.
- Distribution Systems (D3040): This subsystem distributes heated and cooled air/water/steam in the building. Components include humidifiers, dehumidifiers, water treatment, piping, fans, air handling equipment and pumps.
- Terminal & Package Units (D3050): This subsystem provides unitary heating and cooling units and includes unit heaters, package units and heat pumps.
- Controls and Instrumentation (D3060): This subsystem includes equipment and devices to monitor and control the HVAC system, such as Direct Digital Controls (DDC), pneumatics, thermostats, timers, sensors and control valves.
- Other HVAC Systems & Equipment (D3090): This grouping captures additional unique or specialized HVAC equipment including burner assemblies. This subsystem is not required to be inventoried and assessed but may be accomplished at the base's discretion.

3. Lifecycle characteristics

HVAC systems and components provide reliable service when properly designed, installed, serviced and maintained. These systems typically have a service life of 10 -40 years. Some components such as piping systems, ductwork and industrial boilers can remain in service beyond 40 years if properly maintained. These systems and components show relatively slow rates of deterioration, but can accelerate if issues such as improper design/construction, improper service/maintenance, improper alterations, overloading, improper water/chemical treatment, corrosion, etc. are not addressed appropriately. HVAC systems are to be assessed using the Direct Condition Rating (DCR) method considering observed defects.

One of the most common problems with HVAC systems is that over time building mission, equipment and occupancy change. These changes often require HVAC system alterations, additional loads, new or changed services, and equipment additions which can result in overloaded/under loaded systems, mechanical/HVAC code/safety issues, damaged components and outdated HVAC as-built drawings. Since BUILDER™ SMS considers the age of HVAC equipment, the Assessor should not consider this factor in the Direct Condition Rating. Equipment should only be scored on its operability.

Another common problem is that HVAC components are subject to corrosion/deterioration due to their circulation of steam, water and air through the systems. Also, several USAF bases are located in a coastal environment which accelerates the deterioration of components and subcomponents exposed to the weather due to corrosion.

Do not consider age in the Direct Condition Rating. Age is incorporated in the BUILDER™ SMS software.

II. Inventory

A. General D30 Inventory Guidance

This section presents common UNIFORMAT II D30 HVAC inventory component sections found across USAF installations as a guide for entering into the BUILDER™ SMS or BRED™ software. Inventory items are arranged by BUILDER™ SMS system with Equipment Category, Component Subtype, Quantity and Inventory Notes. Currently BUILDER™ SMS has a pseudo UNIFORMAT II level V where equipment could be placed in several different categories. BUILDER™ SMS is a constantly evolving product but until level V is refined this manual will be the guide to strive for consistency across the Air Force. Section VI (D30 UNIFORMAT II Minimum Component Reference Table) provides a complete listing of the BUILDER™ SMS inventory required to be inventoried and assessed by the USAF for D30.

NOTE: Bases may elect to inventory and assess other interior construction Component Sections. Inventory and assessment is required by the current AFCAMP Playbook as project support documentation for consideration in the project prioritization process.

It is critical to confirm the year installed (default from Real Property Assets Database (RPAD)) or to estimate the year installed for each component. BUILDER™ SMS uses the Install Date, life cycle degradation curves and assessment observations to establish Condition Index (CI) for each Component Section. If the assessor suspects the RPAD default date is not accurate or an addition or renovation has taken place, check the RPAD record for year renovated or check local as-built or renovation drawings to help determine the year installed. Estimated Install Dates decrease the Expected Service Life significantly. Every effort should be made to establish an Install Date and avoid the use of estimated.

If this is an initial assessment and no HVAC inventory has previously been entered into BUILDER™ SMS, an

inventory is required. Most HVAC components inventoried for USAF buildings are visible with exception of piping and ductwork components. When HVAC components are not visible (or an area of the building is not accessible), as-built drawings should be used to identify and quantify the HVAC components. If as-built drawings are not available, the assessor may use experience to make an assumption for the HVAC component types and quantities based on similar construction, consultation with local staff and other resources such as http://www.inspectapedia.com or http://www.webhvac.com/. Often manufacturer websites will have extensive product information available which can help the assessor determine age, equipment type, capacity and model.

BRED™ currently has an inventory data field "NOT Energy Efficient: Yes/No" used by Defense Logistics Agency (DLA). The field is not currently used by the Air Force. The checkbox is currently just a "flag" to let DLA know a more thorough Level 2 Energy Audit is suggested. The Standard Report simply checks if any sections in the building were flagged. If a section is flagged, the report suggests the building receive a Level 2 Energy Audit and estimates a cost for the audit based on the facility square footage. The flag appears in the report under "Efficiency and Obsolescence."

The remainder of this section provides photo examples of the most common USAF HVAC inventory items categorized by major components, and accompanied with appropriate material/equipment category, component type and quantity from the BRED™ drop down menus. This information is supplemented with general and specific inventory hints as a guide for data entry by the assessor.

B. Inventory D3010 Energy Supply

HVAC energy supply Component Section inventory for the USAF includes any based-owned energy/fuel storage systems associated with the building used for heating and cooling. In some cases, this may include a central energy supply serving a small building complex such as a group of dormitories or administrative buildings. **Inventory of D3010 Energy Supply is optional for USAF.** Typical energy supply components on USAF bases are:

1. Equipment Category: D301001 Oil Supply System

Component Subtype: General

Inventory Notes:

- Obtain data from nameplate
- Data may also be available from CEIE tank records
- Do not inventory if provided by vendor under lease
- Section Name required
- Optional for USAF

2. Equipment Category: D301002 Gas Supply System

Component Subtype: Fuel storage tank

Inventory Notes:

- Obtain data from nameplate
- Data may also be available from CEIE tank records
- Do not inventory if provided by vendor under lease
- Optional for USAF

3. Equipment Category: D301002 Gas Supply System

Component Subtype: Gas Meter

Inventory Notes:

- Photo shows typical gas meter
- Do not inventory if provided by vendor under lease
- Optional for USAF

4. Equipment Category: D301090 Other Energy Supply

Component Type: Thermal Storage Tank

Inventory Notes:

- Photo shows Ice Storage System
- Collect pertinent information on major components and enter as individual details under one section
- Optional for USAF

C. Inventory D3020 Heat Generating Systems

HVAC heat generating system Component Section inventory includes boilers used to produce either domestic water, heating water, or steam and furnaces. Typical heat generating systems components on USAF bases are:

1. Equipment Category: D302001 Boilers

Component Subtype: Gas, Hot Water

Inventory Notes:

- Inventory by – Fuel type, Steam or Hot Water, MBH, fire tube or water tube, etc.
- Data plates may be on the interior of panels
- Data can be obtained from annual inspection reports

2 Equipment Category: D302001 Boilers

Component Subtype: Gas/Oil, Fire Tube

Inventory Notes:

- Inventory similar to 1., above

4. Equipment Category: D302001 Boilers

Component Subtype: Gas, Pulse

Inventory Notes:

- Inventory similar to 1., above
- Often called “condensing boilers”

5. Equipment Category: D302002 Furnace

Component Subtype: Gas

Inventory Notes:
- Fuel may be Electric, Gas, Oil or Solid fuel
- Obtain MBH capacity if possible

6. Equipment Category: D302003 Fuel Fired Unit Heaters

Component Subtype: Gas

Inventory Notes:
- May be free standing or ceiling hung
- Can be grouped under one section with or without individual details for each unit or each unit entered as independent section
- Vent should be visible on building exterior

7. Equipment Category: D302004 Auxiliary Equipment

Component Subtype: Boiler or Chemical Feedwater

Inventory Notes:
- Optional for USAF

8. Equipment Category: D301001 Boilers Component Subtype: Expansion Tank Inventory Notes: • Optional for USAF	

D. Inventory D3030 Cooling Generating Systems

These systems and components provide chilled water for building cooling. This equipment will typically be found associated with larger buildings. An important inventory hint is to identify the type of compressor. Typical cooling generating systems components on USAF bases are:

1. Equipment Category: D303001 Chilled Water Systems Component Subtype: Chiller, Centrifugal Inventory Notes: • Ascertain chiller type – Absorption, Centrifugal, Reciprocating, Rotary Screw, Scroll and if Air or Water cooled • Determine unit tonnage by deciphering model number	

2. Equipment Category: D303001 Chilled Water Systems Component Subtype: Chiller, Reciprocating, Air Cooled Inventory Notes: • Ascertain chiller type – Absorption, Centrifugal, Reciprocating, Rotary Screw, Scroll and if Air or Water cooled • Determine unit tonnage by deciphering model number	

3. Equipment Category: D303001 Chilled Water Systems

Component Subtype: Rotary Screw

Inventory Notes:

- Ascertain chiller type – Absorption, Centrifugal, Reciprocating, Rotary Screw, Scroll and if Air or Water cooled
- Determine unit tonnage by deciphering model number

4. Equipment Category: D303001 Chilled Water Systems

Component Subtype: Scroll

Inventory Notes:

- Ascertain chiller type – Absorption, Centrifugal, Reciprocating, Rotary Screw, Scroll and if Air or Water cooled
- Determine unit tonnage by deciphering model number

5. Equipment Category: D303001 Chilled Water Systems

Component Subtype: Cooling Tower, Galvanized

Inventory Notes:

- Units grouped by material constructed Fiberglass, Galvanized, or Stainless Steel
- Units subdivided by tonnage

6. Equipment Category: D303001 Chilled Water Systems

Component Subtype: Cooling Tower, Stainless Steel

Inventory Notes:

- Units grouped by material constructed Fiberglass, Galvanized, or Stainless Steel
- Units subdivided by tonnage

7. Equipment Category: D303002 Direct Expansion System

Component Subtype: Condenser Air-Cooled

Inventory Notes:

- Determine unit tonnage by deciphering model number
- Ignore the refrigerant type in BUILDER™ SMS

E. Inventory D3040 Distribution Systems

Distribution equipment includes powered air and liquid moving equipment to distribute heating or cooling throughout the building. This equipment includes air separator, dehumidifier, ductwork, fire dampers, humidifier, VAV boxes, pumps, heat exchangers, vents, exhaust/ventilation/distribution fans, and condensate receivers. Other than boilers BUILDER™ SMS does not currently have steam equipment adequately identified. Steam heat exchangers and condensate pump/tank assemblies should be inventoried as D304002 Steam Distribution Systems. **Currently, piping and ductwork are optional to inventory for USAF.** Typical distribution systems components on USAF bases are:

1. Equipment Category: D304001 Air Distribution, Heating & Cooling

Component Subtype: Air Separator

Inventory Notes:

- Normally not easily accessible due to installed height

2. Equipment Category: D304001 Air Distribution, Heating & Cooling

Component Subtype: VAV Terminal

Inventory Notes:

- Subdivided by CFM, cooling only, hot water reheat, and fan powered
- Normally not easily accessible due to installation above ceilings

3. Equipment Category: D304002 Steam Distribution Systems

Component Subtype: General

Inventory Notes:

- Photo shows duplex condensate receiver with new pumps
- Input data into one section with details for tank and pumps if needed
- Section Name required

4. Equipment Category: D304003 Hot Water Distribution Systems

Component Subtype: Heat Exchanger, Plate Type

Inventory Notes:

- Usually not associated with chilled water
- Capacity could be greater than shown on placard due to installation of additional plates

5. Equipment Category: D304003 Hot Water Distribution Systems

Component Subtype: Heat Exchanger, Shell and Tube

Inventory Notes:

- Heating shop can provide information on internal condition

6. Equipment Category: D304003 Hot Water Distribution Systems and D304006 Chilled Water Distribution Systems

Component Subtype: Circulating Pump, End Suction

Inventory Notes:

- Record both pump and motor data in one section if required

7. Equipment Category: D304003 Hot Water Distribution Systems D304006 Chilled Water Distribution Systems

Component Subtype: Circulating Pump, Double Suction

Inventory Notes:

- Record both pump and motor data in one section if required

8. Equipment Category: D304007 Exhaust Systems

Component Subtype: Fan system, Roof Exhaust

Inventory Notes:

- CFM could be determined from as-built drawings if data plate has been painted or missing

9. Equipment Category: D304007 Exhaust Systems

Component Subtype: Fan System, Wall Exhaust

Inventory Notes:

- Data may be difficult to collect due to heights

10. Equipment Category: D304007 Exhaust Systems

Component Subtype: Industrial Exhaust System

Inventory Notes:

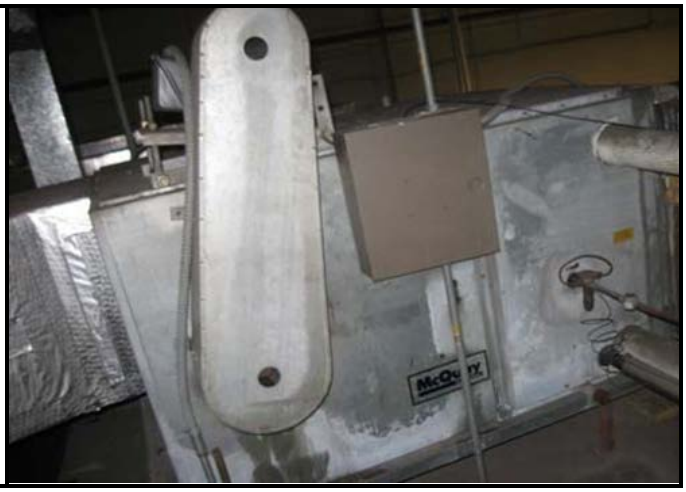
- Fan should be connected to an exhaust hood
- If only used for ventilation, record data under D305001 Unit Ventilators Fan System, Utility Set

11. Equipment Category: Air Handling Unit

Component Subtype: Central Station

Inventory Notes:

- Care should be taken to not shut down air flow while opening doors on units serving sensitive areas without notifying the facility manager



12. Equipment Category: D304008 Air Handling Units

Component Subtype: Field Fabricated

Inventory Notes:

- Care should be taken to not shut down air flow while opening doors on units serving sensitive areas without notifying the facility manager

13. Equipment Category: D304008 Air Handling Units

Component Subtype: Modular Station

Inventory Notes:

- Care should be taken to not shut down air flow while opening doors on units serving sensitive areas without notifying the facility manager

14. Equipment Category: D304008 Air Handling Units

Component Subtype: Rooftop

Inventory Notes:

- Care should be taken to not shut down air flow while opening doors on units serving sensitive areas without notifying the facility manager
- Rooftop configured units not always on roof
- Generally large CFM units

F. Inventory D3050 Terminal & Package Units

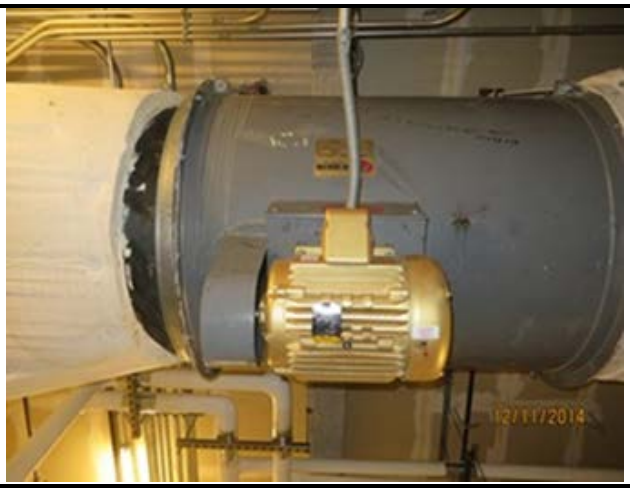
Terminal and Package units are normally units that are not part of a central system, often referred to as "unitary." Cooling units would be decentralized and have a compressor. Typical terminal and package unit equipment at USAF bases includes:

1. Equipment Category: D305001 Unit Ventilators

Component Subtype: Fan System Axial

Inventory Notes:

- Also can be centrifugal in-line, utility set and make-up air units
- Make-up air units can be confused with AHUs



2. Equipment Category: D305002 Unit Heaters

Component Subtype: Hydronic or Steam or Infrared

Inventory Notes:

- All units within a building can be grouped under one section with individual details, if required

3. Equipment Category: D305003 Fan Coil Units

Component Subtype: Cab Mount, Two Pipe

Inventory Notes:

- Units subdivided by cab mounted, duct mounted, or DX
- Also subdivided by four pipe or two pipe, tonnage and with or without electric heat

4. Equipment Category: D305004 Fin Tube Radiation

Component Subtype: Baseboard Heating

Inventory Notes:

- Data plates normally not available
- Can be grouped under one section with or without individual details

5. Equipment Category: D305005 Electric Heating

Component Subtype: Voltage and KW

Inventory Notes:

- Subdivided into 208-240 volt or 480 volt units and kW

6. Equipment Category: D305006 Package Units

Component Subtype: A/C Unit, Computer Room

Inventory Notes:

- Subdivided by air cooled or chilled water or glycol system
- Enter system components as one section with two detail

7. Equipment Category: D305006 Package Units

Component Subtype: A/C Unit, Split Systems w/ Air Cooled Condenser

Inventory Notes:

- Subdivided by tonnage
- Enter system components as one section with two details

8. Equipment Category: D305006 Package Units

Component Subtype: A/C Unit, Split Systems w/ Air Cooled Condenser

Inventory Notes:

- Residential style system not clearly identified in BUILDER™ SMS
- Heat pump may look exactly like air conditioner above
- Check labels to determine if system has electric heat
- Enter system components as one section with two details

9. Equipment Category: D305006 Package Units

Component Subtype: Evaporative Cooler

Inventory Notes:

- Mostly found in arid climates
- Also called swamp cooler

10. Equipment Category: D305006 Package Units

Component Subtype: A/C Unit, Thru-Wall

Inventory Notes:

- Commonly referred to as “hotel” units
- May be vertical in newer dormitory layout

11. Equipment Category: D305006 Package Units

Component subtype: Heat Pump, Water Source, Central Station

Inventory Notes:

- Indoor unit may look exactly like air handling unit or a split system AC

G. Inventory D3060 Controls and Instrumentation

Controls and instrumentation fall into two categories - pneumatic and digital. An air compressor will be associated with pneumatic controls. New buildings will most likely use digital controls. Typical controls and instrumentation systems components on USAF bases are:

1. Equipment Category: D306002 Electronic Controls

Component Subtype: DDC Controller

Inventory Notes:

- Currently all that is required is to identify the entire control system as one section under the "General" Level V Component
- Provide comments to the section to identify if the controls are connected to a common Energy Management Control System
- Components can be entered separately if needed

2. Equipment Category: D306003 Pneumatic Controls

Component Subtype: Pneumatic – Control Systems

Inventory Notes:

- Currently all that is required is to identify the entire control system as one section under the "General" Level V Component
- Provide comments to the section to identify if the controls are connected to a common Energy Management Control System
- Components can be entered separately, if needed

H. Inventory D3090 Other HVAC Systems and Equipment

This subsystem includes special mechanical systems that are not normally included as part of standard HVAC systems. This Component Section is optional for USAF but can be used to capture unique equipment.

III. Assessment

A. General D30 Assessment Guidance

HVAC component sections are assessed using Direct Condition Rating (DCR). Most HVAC component sections will be visible. When component/equipment sections cannot be safely accessed for visible inventory the assessment will be deferred until the next scheduled maintenance action. The assessor may enter the inventory data, but no assessment will be entered. In this case, BUILDER™ SMS will use the inventory, Year Installed and the software life cycle degradation curves to establish an Age-Based Rating Condition Index (CI).

When HVAC component/equipment are visible, they should be assessed. The on-site assessment is determined based on the assessor's observations compared to the Direct Condition Rating (DCR) Definitions chart (see next page) for major components D3010 (optional), D3020, D3030, D3040, D3050, D306, and D3090 (optional). The "Rating" reflects observed deterioration and repair requirements based on the chart (next page) and the assessor's professional judgment. When determining the "Rating", the assessor should consider the quantity and severity of conditions or distresses observed.

Under no circumstances should age be factored into a DCR or Distress Survey assessment. Ratings are based on condition, operability and/or survivability only. BUILDER™ SMS already factors in the age from the Install Date when BUILDER™ calculates Condition Index (CI).

The following conditions or events can accelerate HVAC component deterioration and should be considered by the assessor:

- Improper construction or installation
- Improper maintenance or service
- Weather exposure and/or coastal environment
- Damage or misuse
- Overloading
- Water or chemical treatment issues
- Corrosion
- Future maintainability (including availability of parts) If an otherwise operational component cannot be maintained in the future due to the non-availability of repair parts, the component should be rated no higher than "Amber +."

In the case of A/C and Refrigeration condensers, do not rate down due to use of R-22 as the refrigerant. There is no mandate to replace the equipment and a well-operated base refrigerant management plan will ensure R-22 is available through the remaining service life of the equipment. As individual units are replaced, the R-22 should be captured to maintain serviceability of remaining equipment using R-22 refrigerant.

Boiler and Unfired Pressure Vessel inspection and certification programs are performed in accordance with the Unified Facilities Criteria (UFC) 3-430-07. The UFC requires independent inspection/certification separate from assessments performed under the USAF BUILDER™ SMS program. The UFC inspections are normally performed by trained civilian staff or through a service contractor. The BUILDER™ SMS assessor should contact the base manager(s) responsible for the boiler and unfired pressure vessel inspection programs to confirm the inspection status, obtain inspection reports if needed, and discuss the overall condition of these components included in the BUILDER™ SMS assessment. The assessor should rely heavily on this information to assist in

determining the DCR using the DCR Definitions chart. **The assessor must provide an Inspection Comment for any Amber + or lower DCR or BUILDER™ calculated Distress Survey rating. Photographs documenting defects must be taken and attached to the assessment.**

Following the BUILDER™ SMS assessment, the assessor should inform the appropriate base manager of any new issues discovered.

NOTE: Red highlighted text is provided as an example of a lifecycle of typical components and should be adjusted as needed to represent other various components.

Direct Condition Rating (DCR) Definitions	
Rating	**Observation**
Green (+)	Fully Operational - Free of Known or Observable Defects Keep doing PM required to maintain warranty - no action required
Green	Fully Operational - Slight Deterioration or Minimal wear Keep doing PM - no action required
Green (-)	Fully Operational – Normal wear and/or serviceability defects Keep doing PM - need to start planning for rehabilitation
Amber (+)	Reduced Operation – Minor wear and/or serviceability defects Repairs could be accomplished and replacement planned within next eight to ten years (Investment of resources could extend life)
Amber	Reduced Operation – Moderate wear and/or serviceability defects Repairs could be accomplished and replacement planned within next six to seven years (Investment of resources could extend life)
Amber (-)	Reduced Operation – Significant wear and/or serviceability defects Repairs could be accomplished and replacement planned within next three to five years (Investment of resources could extend life)
Red (+)	Loss of Operation – Moderate wear and/or serviceability failure Repairs could be accomplished and replacement planned within next two years (Run to failure - further investment unwise)
Red	Loss of Operation – Significant wear and/or serviceability failure Repairs could be accomplished and replacement planned within the next year (Run to failure - further investment unwise)
Red (-)	Loss of Operation – Complete wear and/or serviceability failure Replacement needs to be planned immediately

Consideration should be given to deterioration and operational loss, along with level of repair. Total operational loss may occur due to some minor reason (e.g. failed switch, failed pump motor, etc.). In these cases, the overall component section condition may be "Green" when only a minor fix will correct the problem.

B. Common distresses observed in equipment:

1. Corrosion

Examples of typical Corrosion distress conditions include:

- Superficial surface rust = GREEN
- Holes/cracks in pans, piping, ducting and enclosures or tanks causing leakage = AMBER+
- Severe corrosion of components/equipment which will lead to complete failure = RED

2. Leakage

Examples of typical Leakage distress conditions include:

- Hot water vessel = AMBER/RED
- Steam pressure vessel = RED
- Normal leakage thru packing glands, vents or overflows = GREEN

3. Missing Guards, Grilles, Covers or Access Doors

Examples of typical Missing Guards, Grilles, Covers or Access Doors distress conditions include:

- AMBER or RED depending on risk of injury (notify customer service)
- Components/equipment exposed to weather/ external hazards (Notify CE)
- Operability is decreased = AMBER

4. Excessive/Non-Standard/Altered Wiring

Examples of typical Excessive/Non-Standard/Altered Wiring distress conditions include:

• AMBER or RED depending on risk of injury (notify customer service) • Exposure could lead to loss of operability • Potential indicator of problems	Need Photo

5. Excessive Vibration and Noise

Examples of typical excessive Vibration and Noise distress conditions include:

• Unusual and/or Excessive vibration/noise is an indicator a component/equipment could be out of alignment and/or balance • Condition could lead to premature failure	

6. Obstructions

Examples of typical Obstructions distress conditions include:

• Not factored into rating • Notify CE or Customer Service if condition is a safety hazard or performance is hindered	

7. Physical Damage

Examples of typical Physical Damage distress conditions include:

- Scored on effect to serviceability, function or likelihood of reoccurrence
- AMBER or RED if damage interfere with the function of the component/equipment
- GREEN if just aesthetic
- AMBER if repair can return component/equipment to full operability
- RED if it is not economical to repair and component/equipment must be replaced

8. Deteriorated Sub-Components

Examples of typical Deteriorated Sub-Components distress conditions include:

- AMBER or RED depending on degradation/loss of performance
- Sub-Components (e.g. tower/evaporator fill, air damper seals, drain pan, filters, etc.)

9. Improper Installation

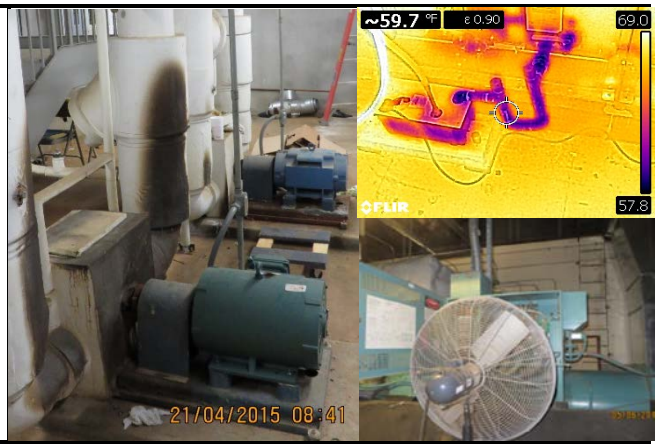
Examples of typical Improper Installation distress conditions include:

- Red if equipment movement could cause significant property damage or injury
- Amber if life expectancy of component/equipment is impacted
- Amber if operability or capacity impacted
- Makeshift repairs creating unsafe conditions = Red (Notify Customer Service)

10. Overheating

Examples of typical Overheating distress conditions include:

- Makeshift setups are good indicators of problems with components/equipment
- Thermal cameras if available can expose potential issues



11. Arc Flash Damage

Examples of typical Arc Flash Damage distress conditions include:

- Onetime repaired event or minor surface discoloration = Green
- Caused by associated equipment requiring repair = Red (Notify Customer Service)
- Present a hazard requiring immediately repaired = Red (Notify Customer Service)

IV. Inventory and Assessment General Information

A. BUILDER™ SMS Peculiarities

When making assessments age should not be considered. BUILDER™ SMS is a tool for planners to make decisions on when major repairs or replacement of equipment should occur. Environment, duty cycles, and accomplishment of Preventative Maintenance are the factors that will determine the service life of equipment. Honest assessments allow for the life cycle degradation curves to be adjusted forward or backward given the actual factors affecting a particular piece of equipment.

NOTES:

-Currently, UNIFORMAT II does not have a Level V list of equipment. The pseudo Level V list of equipment provided in BUILDER™ SMS is incomplete in some areas and completely missing in other areas. An example is Equipment Category D304002 Steam Distribution System does not provide for any equipment (heat exchangers, condensate pumps, steam traps, etc.).

-Equipment Category D303002 Direct Expansion System has an extensive listing of R-22 condenser equipment but does not provide choices for other refrigerants.

-When loading unknowns into BUILDER™ SMS, the assessor should make an attempt to select a similar piece of equipment with associated replacement cost and add a section Inventory Comment identifying the disparity and justifications of selection.

-BUILDER™ SMS does not currently include Heat Recovery equipment in inventory.

-If assessment "Rating" is AMBER + or below, an Inspection Comment to describe the reason must be entered. Photos of identified conditions must also be loaded. Regardless of DCR, if a significant localized issue needs to be highlighted, Inspection Comments should be entered, which may not necessarily impact the overall Component Section DCR. Inspection Comments should also be entered when subsequent assessments increase the CI to create a record and highlight the change.

B. Assessor Qualifications

The assessor should have specialized experience related to HVAC and building mechanical systems and be equivalent to a Journeyman, a V Level Technician or Mechanical Engineer. The assessor should be able to identify common HVAC system components, understand how they function/operate, and have experience planning or performing HVAC and mechanical systems maintenance, improvements or repairs.

C. Year Installed

In some cases, HVAC compotents may be re-used or replaced as an individual repair or partial replacement. In these cases components may have a different age compared to other components. Real Property construction/renovation/ installation dates should be confirmed. If the installation date cannot be confirmed, the component age must be estimated. Plate data is the first option, while the HVAC Shop personnel, building occupants or other facilities' staff may be able to provide some information. A review of IWIMS and ACES data may give an approximate age (assuming the equipment was new when installed). Facility additions, new wings or major renovations likely require identifying a separate HVAC section with a different age.

Information to determine age and capacity is often available on-line. A web search question can be used to find informational websites (e.g. How to read boiler model numbers http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/furnaces_boilers/fb_tsd_appendixg_0906.pdf is a useful website to decode model numbers)

D. Inventory/Assessment

Currently, the minimum HVAC component/equipment data that needs to be entered into BUILDER™ SMS to accomplish a facility inventory is the Section Name, Year Installed and size. Assessors should select the Level V component/equipment capacity that most closely matches or next higher capacity available from the pulldown menus. Avoid the selection of component General and Other as much as possible. Additional information and/or details about components/equipment can be entered into BUILDER™ SMS to meet the requirements of other data collection/tracking initiatives as directed.

Section naming convention should be developed for each base that will allow for easy identification during subsequent assessments. Each piece of equipment to be maintained under the Preventive Maintenance Task List (PMTL) program should be given a unique section name. Typical Section Names should also describe the major areas of the building include: 1FL, 2FL, BASEMENT, MEZZANINE, ROOF, WING "X", etc. Bar code numbers if available should be added on the Section Detail Tab.

Typical section names used to describe equipment designations such as:

- Air Handlers = AHU-1 (2nd fl SE)
- Outside Air Units = OAU-1 (Mech Rm S)
- Chillers (air/water cooled) = ACC-1 or WCC-1 (E)
- Boiler = BLR-1 (Mech Rm)
- Split DX = (with/interior AHU) DX-1 (S)
- Heat Pump (water/air source) = HP-AS-1 or HP-WS-1
- Mini Split = DX MAC-1
- Fan Coil Units = FCU-1
- Cooling Tower = CT-1
- Roof Top Unit = RTU-1
- Package Unit = PKG-AC-1
- Computer Room AC = CRAC-1
- Unit Heaters = UH-E-1 or UH-W-1 or UH-S-1
- Infrared Heaters = IR-1
- Heating and Ventilating Units = HV-1
- Pumps = CHWP-1 or HWP-1 or CWP-1
- Evaporative Cooler = ECU-1
- Large industrial ceiling fans

Not currently required to inventory:

- Ducts
- Piping
- VAV/Fan Powered/terminal boxes
- Motors
- Expansion Tanks
- Heat Exchangers
- Humidifiers
- VFDs
- Steam Traps
- Valves
- Kitchen exhaust units
- Filters
- Small bathroom exhaust fans
- Residential style ceiling fans
- Window A/C units
- Ceiling or floor vents, grilles, registers, diffusers, or fire dampers
- Non RPIE

Large Tank Volume: For large water heater tanks or storage tanks the volume can be calculated by measuring the length or height and the radius (1/2 the diameter) and using the following formula ∏ (3.142) x Radius2 x Length (or Height) / 7.48 (Gal/Ft3). A graphic calculator is available at: http://www.mathopenref.com/cylindervolume.html

Some manufacture model numbers will provide the capacity information in the middle (e.g. 2TWB0060A1000AA, "060" indicates 60000 BTU or 5 Ton cooling @ 12,000 BTUHs per Ton).

Check manufacturer websites such as www.trane.com, www.york.com, www.evapcom.com, www.rezspec.com for specific unit information if needed.

V. Inventory/Assessment Data Collection

Data collection sheets can be developed to aid in initial data collection. Re-inspection should run the Section Inventory Detail Report in BUILDER™ SMS as an aid in verifying and assessing the equipment. The BUILDER™ SMS detail tab contains data fields as shown below:

- ID Number (20 Alphanumeric)
- Model (20 Alphanumeric)
- Serial Number (30 Alphanumeric)
- Manufacturer (40 Alphanumeric)
- Location (40 Alphanumeric)
- Equipment Type (50 Alphanumeric)
- Equipment Make (30 Alphanumeric)
- Capacity (70 Alphanumeric)
- Date Manufactured PMTL
- Year Installed (4-digit) PMTL also wants month
- Control Type/Make (50 Alphanumeric)
- Warranty Date
- Warranty Company (50 Alphanumeric)
- Warranty Date 2
- Warranty Company 2 (50 Alphanumeric)

VI. D30 UNIFORMAT II Minimum Component Reference Table

The following table provides SMS MINIMUM inventory and condition assessment requirements. The table effectively provides a list of WHAT will be inventoried, WHERE within the SMS the component inventory will reside and HOW a component is to be condition assessed. The structure of the list is within UNIFORMAT II to be consistent with BUILDER™ SMS. Currently, all components are Direct Condition Rating assessed. Eventually, Distress Survey assessments may be conducted on selective components.

PM Inspection/Testing Directive column gives information on any Air Force applicable publication providing Preventative Maintenance (PM) actions that, once conducted, provides information on a component's condition assessment. PMTLs or other inspections may be considered a Distress type assessment in the future for some components.

Condition assessment frequency is not to exceed 5 years. Condition assessments conducted as part of a PMTL may be entered into SMS but should not be more often than an annual assessment.

AMP reflects the AMP to which the component is assigned:

F: Facility AMP

See Next Two Pages

D	SERVICES				DEFINITION						
Unf L1	Unf L2	Unf L3	WBS L4		Includes all methods of conveying, plumbing, HVAC, fire protection, and electrical.	In Builder/ Fueler/ Paver/ Railer/ Utility	PM Inspection/ Testing Directive	Insp/ Assess Freq	SMS Type Insp	Assessment Method	AMP/ Sub-AMP
	D30	HVAC			This system includes all equipment, distribution systems, controls, and energy supply systems required by the heating, ventilating, and air conditioning system.						
		D3020	*HEAT GENERATING SYSTEMS*		This subsystem includes steam, hot water, furnace, and unit heater systems. Fuels include coal, oil, gas and electric unless otherwise noted.						
			D302001	BOILERS	Assemblies include steam or hot water boilers, chemical feeders, air separators, pumps, heat exchangers, boiler feed units, etc. This assembly would also include fittings and specialties and the flue stack. The unit of measure at the assembly level is each system.	B	N/A	5 yr	Direct	Visual	F/M
			D302002	FURNACES	This is a system that heats air. Assemblies would include furnace and necessary fittings and specialties required for hook-up, including flue and stack. The unit of measure at the assembly level is each.	B	N/A	5 yr	Direct	Visual	F/M
			D302003	FUEL-FIRED UNIT HEATERS	Assemblies would include unit heaters and the energy supply system hook-up (other than electrical), including all necessary pipe, fittings, and specialties required for hook-up. Flue and stack, if required, are included in this assembly. The unit of measure at the assembly level is each.	B	N/A	5 yr	Direct	Visual	F/M
			D302004	AUXILIARY EQUIPMENT	Assemblies would include any other equipment associated with heat generating systems. The unit of measure at the assembly level is each. (Boiler Feedwater Tank, Chemical Feedwater, Feedwater Tank)	B	N/A	5 yr	Direct	Visual	F/M
		D3030	*COOLING GENERATING SYSTEMS*		Cooling generating equipment of the absorption, centrifugal, reciprocating, and direct expansion types.						
			D303001	CHILLED WATER SYSTEMS	Assemblies include condensers, compressors, chillers, pumps, cooling towers, etc., including fittings and specialties required for hook-up. The unit of measure at the assembly level is each.	B	N/A	5 yr	Direct	Visual	F/M
			D303002	DIRECT EXPANSION SYSTEMS	Assemblies include condensers, evaporators, compressors, heat pumps, and refrigerant piping. The unit of measure at the assembly level is each.	B	N/A	5 yr	Direct	Visual	F/M
			D303090	OTHER COOLING GENERATING SYSTEMS	Cooling generating systems not described by the assembly categories listed above. (Refrigeration compressor)	B	N/A	5 yr	Direct	Visual	F/M
		D3040	*DISTRIBUTION SYSTEMS*		This includes systems that distribute heated and cooled air, ventilating and exhaust air, hot and chilled water, steam, and glycol heating.						
			D304001	AIR DISTRIBUTION, HEATING & COOLING	Assemblies include heating coils, cooling coils, and fittings and specialties required for water hook-up. This assembly also includes duct heaters, filters, humidifiers, supply and return ductwork, dampers, fire dampers, supply and return grilles, registers and diffusers, turning vanes, sound traps, and all associated insulation. The unit of measure at the assembly level is MCFM.	B	N/A	5 yr	Direct	Visual	F/M
			D304002	STEAM DISTRIBUTION SYSTEMS	Assemblies include pipe and fittings, supports, wall and floor sleeves, and pipe insulation. The unit of measure at the assembly level is MBH.	B	N/A	5 yr	Direct	Visual	F/M
			D304003	HOT WATER DISTRIBUTION SYSTEMS	Assemblies include pipe and fittings, supports, wall and floor sleeves, and pipe insulation. The unit of measure at the assembly level is MBH.	B	N/A	5 yr	Direct	Visual	F/M
			D304005	GLYCOL DISTRIBUTION SYSTEMS	Assemblies include pipe and fittings, supports, wall and floor sleeves, and pipe insulation. The unit of measure at the assembly level is MBH.	B	N/A	5 yr	Direct	Visual	F/M
			D304006	CHILLED WATER DISTRIBUTION SYSTEMS	Assemblies include pipe and fittings, supports, wall and floor sleeves, and pipe insulation. The unit of measure at the assembly level is tons.	B	N/A	5 yr	Direct	Visual	F/M
			D304007	EXHAUST SYSTEMS	Assemblies include ductwork grilles, registers, diffusers, fans, and all associated work. The unit of measure at the assembly level is each system.	B	N/A	5 yr	Direct	Visual	F/M
			D304008	AIR HANDLING UNITS		B	N/A	5 yr	Direct	Visual	F/M

D	SERVICES				DEFINITION						
Unf L1	Unf L2	Unf L3	WBS L4		Includes all methods of conveying, plumbing, HVAC, fire protection, and electrical.	In Builder/ Fueler/ Paver/ Railer/ Utility	PM Inspection/ Testing Directive	Insp/ Assess Freq	SMS Type Insp	Assessment Method	AMP/ Sub-AMP
	D30	HVAC			This system includes all equipment, distribution systems, controls, and energy supply systems required by the heating, ventilating, and air conditioning system.						
		D3050	*TERMINAL & PACKAGE UNITS*		This category includes self-contained heating and cooling units.						
			D305001	UNIT VENTILATORS	Assemblies include the complete terminal unit and wall sleeve with all controls. (Centrifugal or Utility Fan Set, Make-Up Air Units)	B	N/A	5 yr	Direct	Visual	F/M
			D305002	UNIT HEATERS	Assemblies include the complete terminal unit and wall sleeve with all controls. (Hydronic, Infrared)	B	N/A	5 yr	Direct	Visual	F/M
			D305003	FAN COIL UNITS	Assemblies include the complete terminal unit and wall sleeve with all controls. (Cab Mount (2 or 4 pipe), duct mount (2 or 4 pipe), DX)	B	N/A	5 yr	Direct	Visual	F/M
			D305004	FIN TUBE RADIATION	Assemblies include the complete terminal unit and wall sleeve with all controls. (Baseboard Heating)	B	N/A	5 yr	Direct	Visual	F/M
			D305005	ELECTRIC HEATING	Assemblies include the complete terminal unit and wall sleeve with all controls.	B	N/A	5 yr	Direct	Visual	F/M
			D305006	PACKAGE UNITS	Assemblies include complete package units, with integral roof top curbs and all associated devices. A heating system can be selected from hot water, steam coil, or gas furnace and can be a single or multi-zone system. The unit of measure at the assembly level is each. (Computer room A/C units (Air Cooled, chill Water, Glycol, Water cooled), Package A/C Terminal (Fan Coil or terminal AC), Split System (thru-Wall, or Window A/C), Evaporative Coolers, Rooftop air Source heat Pumps, Duct Mount or Thru-Wall Heat Pumps, Water Source heat Pumps (Central Station or console), air cooled Package A/C (electric or HW Heat), Water cooled Package A/C (Electric or HW Heat) rooftop Units)	B	N/A	5 yr	Direct	Visual	F/M
		D3060	*CONTROLS & INSTRUMENTATION*		Includes devices such as thermostats, timers, sensors, control valves, etc., necessary to operate the system as designed.						
			D306001	HVAC CONTROLS	Includes devices such as thermostats, timers, sensors, control valves, etc., necessary to operate the total system. The unit of measure at the assembly level is each system.	B	N/A	5 yr	Direct	Visual	F/M
			D306002	ELECTRONIC CONTROLS	Direct Digital Control (DDC) system. Includes devices such as supervisory, standalone, input/output controllers, network communications. The unit of measure at the network level is each system.	B	N/A	5 yr	Direct	Visual	F/M
			D306003	PNEUMATIC CONTROLS	Assemblies includes ball and butterfly valves, actuators, high pressure chokes, valve positioners, sensors, regulators, etc.	B	N/A	5 yr	Direct	Visual	F/M
			D306004	INSTRUMENT AIR COMPRESSORS	Assemblies include air compressors, dryers, and distribution tubing, (only used with pneumatic control systems). The unit of measure at the assembly level is each.	B	N/A	5 yr	Direct	Visual	F/M