Appendix 1: Condition Survey Templates

Source: Albert Thumann, as used in Natural Resources Canada, Energy Auditing Guide

In this checklist and those that follow, points are awarded in each category according to the guidelines that follow; the maximum that can be accumulated for each system is as indicated in the table (i.e. maximum possible for windows is 10; the actual total is compared to this maximum to comparatively assess the priority for action.)

Windows

Date: _____

Auditor: _____

Comments:

No.	Max Points = 10 / Location	Storms	Solar Protection	Tight Fit	Minor Infiltration	Major Infiltration	Cannot be Opened	Can Be Opened	Weather Stripped						Total Points
		2	2	2	1	0	3	0	1						

WINDOW RATING INSTRUCTIONS

2 points	if the window has storm windows adequate for cold weather protection. The storm windows must fit tightly and block the wind from entering around the window.
2 points	if the window has protection from the direct sun during warm weather. Solar protection can be part of the building design such as overhang, awnings or physical shields. Protection can also be tinted or reflective film applied to the windows, double-glazed windows, solar screening or trees blocking out direct sunlight.
2 points	for a tight fitting window. A window is tight fitting if the infiltration will not be detected around the window during a windy day. The window must fit well and all caulking must be in place. Weather-stripping will contribute to a tight fit.
1 point	if the wind has some infiltration around the window. The window should fit fairly well and not be loose and rattle.
0 points	if infiltration can be felt to a large degree. The window is loose in the frame and caulking is missing or in poor condition.
3 points	if the window is designed so physically it cannot be opened.
0 points	if it can be opened, it will be opened to "regulate" room temperature.
1 point	if window is weather-stripped all around and the weather-stripping is in good condition.

Exterior Doors

Date: _____ **Auditor:** _____ **Comments:**		**Air Lock**	**Door has closer**	**Closer has no Hold-Open**	**Closer has a Hold-Open**	**Snug Fit**	**Average Fit**	**Loose Fit**	**Weather-strip 4 Edges**	**Weather-strip Jamb Head**	**No Weather-strip**	**Wind Screens or Other**			**Total Points**
No.	**Max Points = 10** **Location**	2	1	1	0	2	1	0	2	1	0	1			

DOOR RATING INSTRUCTIONS

This section applies to all doors that open to the outside and all doors that open to an unconditioned space such as warehouses and storerooms.

2 points	if door is part of an air-lock system.
1 point	if door has a closer which may be either spring, air or hydraulic.
1 point	if door closer does not have a hold-open feature.
0 points	if door closer has a hold-open feature.
2 points	if door fits snugly into the door frame with no loose condition and where no infiltration exists around the edges.
1 point	if door is an average fit and can be slightly rattled in the frame and has a slight infiltration around the edges.
0 points	if door is loose in the frame and infiltration exists.
2 points	if weather-stripping exists on all four edges and is in good condition. (Thresholds with elastic or fibre to close the space and astragals on double doors are considered weather-stripping.)
1 point	if weather-stripping exists on jambs and head only.
0 points	if no weather-stripping exists or if it exists and is in poor condition.
1 point	if door is protected from outside wind. This can be building design, wind screen or shrubbery.

Appendix

Ceilings

Date: _____ **Auditor:** _____ **Comments:**		**Drop Ceiling**	**Insulated Drop Ceiling**	**Insulated Regular Ceiling**	**Space not Mech. Vented**	**All Panels in Place**	**Panels Broken**	**Panels Missing**							**Total Points**
No.	**Max Points = 6** / **Location**	1	1	1	1	2	1	0							

CEILING RATING INSTRUCTIONS

1 point	if a drop ceiling exists.
1 point	if insulation exists above ceiling on top floor below roof or mechanical space
1 point	if space above drop ceiling is mechanically vented. Natural draft is not considered mechanical venting.
2 points	if all panels are in place and in good condition, no broken or missing panels are present.
1 point	if panels are broken or in poor condition.
0 points	if panels are missing or removed and out of place.

Exterior Walls

Date: _____

Auditor: _____

Comments:

No.	Max Points = 7 / Location	Insulated	Not Insulated	Solar Protection	Watertight	Cracked or Broken	Open to Noncondition. Space								Total Points
		3	0	2	2	1	0								

WALL RATING INSTRUCTIONS

3 points	if wall is designed to resist outside temperature differential. Insulation is present to substantially change heat transfer time.
0 points	if wall is merely a physical separation without adequate insulating qualities.
2 points	if outside wall surface has solar protection such as light finish, is heavily shaded or has physical sun screens.
2 points	if surfaces of walls are in good repair and not damaged.
1 point	if inside is in average condition with a few small cracks in the surface and smaller plaster sections missing.
0 points	if wall has openings to unconditioned space; i.e. plumbing or duct openings not closed.

Appendix

Roofs

Date: _____ **Auditor:** _____ **Comments:**		**Dry Insulation**	**Wet Insulation**	**Reflective Surface**	**Ventilation Under Roof**	**No Leaks**	**Small Leaks**	**Many Leaks**							**Total Points**
No.	**Max Points = 6** / **Location**	2	0	1	1	2	1	0							

ROOF RATING INSTRUCTIONS

2 points	if roof insulation is in dry condition.
0 points	if roof insulation is in poor condition, wet, aged, brittle, cracked, etc., or if no insulation exists.
1 point	if roof has a reflective surface; this may be the type of material used or the colour and condition of surface (gravel, etc.).
1 point	if mechanical ventilation exists between roof and ceiling below. This should be properly sized so adequate air flow exists.
2 points	if no leaks exist in the roof.
1 point	if minor leaks exist.
0 points	if there are many leaks.

Storage Areas

Date: _____ **Auditor:** _____ **Comments:**		**Not Conditioned**	**Door Closed**	**No Windows**	**One Window**	**Two or More Windows**	**Used as Designed**	**Not Used as Designed**							**Total Points**
No.	**Max Points = 6** **Location**	1	1	2	1	0	2	0							

STORAGE AREA RATING INSTRUCTIONS

1 point	if area is not temperature controlled.
1 point	if the doors are kept closed.
2 points	if there are no windows in the area.
1 point	if one window is in the area.
0 points	if two or more windows are in the area.
2 points	if area is used as it was designed.
0 points	if area is used for storage but designed for other usage.

Shipping and Receiving Areas

Date: _____ **Auditor:** _____ **Comments:**		**Weather Protection Good**	**Weather Protection Average**	**Weather Protection Poor**	**Individual Stalls**	**One Large Area**	**Doors Closed**	**Doors Opened**	**Not Temperature Conditioned**	**Temperature Conditioned**					**Total Points**
No.	**Max Points = 6** / **Location**	3	1	0	1	0	1	0	1	0					

SHIPPING AND RECEIVING AREA RATING INSTRUCTIONS

3 points	if the shipping and receiving area is well protected from outside temperature.
1 point	if the shipping and receiving area is reasonably protected from outside air entry.
0 points	if the shipping and receiving area has no protection from the ambient. This would be an open area directly exposed to the outside conditions.
1 point	if individual truck stalls exist so the unused areas can be closed.
0 points	if one large area exists and the entire dock must be exposed if a single truck is loaded or unloaded.
1 point	if the doors are closed when not in use.
0 points	if the doors are left open as a matter of convenience.
1 point	if the area does not receive conditioned air.
0 points	if the area receives conditioned air.

Lighting

Date: _____

Auditor: _____

Comments:

No.	Max Points = 10 / Location	No Decorative Lighting	Light Work Area	Light Entire Room	Diffusers Good	Diffusers Average	Diffusers Poor	Reflection Good	Reflection Average	Reflection Poor	Source Appropriate	Source Not Appropriate	Lights Vented	Lights Turned Off	Illumination Adequate	Excessive Illumination	Total Points
		1	1	0	2	1	0	2	1	0	1	0	1	1	1	0	

Lighting level measurements can be made with small, low-cost portable light meters that are available in a variety of lux ranges (the lux is the unit of illuminance, where one lux is equal to one lumen per square meter; the lumen is the unit of measure for the light emitted by a source.) Portable light meters have a typical accuracy of ±15%; therefore, care needs to be taken that they are used in accordance with operating instructions.

Guidelines for recommended levels of illumination are provided in Table 1.

Table A.1: I.E.S. Recommended Levels of Illumination for Different Classes of Visual Task

Class of Visual Task	Examples	Illumination (lux)
Public Areas with Dark Surroundings	Lobbies	20 – 50
Simple Orientations for Short Temporary Visits	Corridors; Storage Rooms	50 – 100
Working Spaces where Visual Tasks are only Occasionally Performed	Waiting Rooms	100 – 200
Visual Tasks of High Contrast and Large Size	Conference Rooms; Printed Material; Typed Originals; Ink Handwriting; Rough Industrial Work	200 – 500
Visual Tasks of Medium Contrast or Small Size	Engineering Office; Medium Pencil Handwriting; Poorly Printed or Reproduced Material; Medium Industrial Work	500 – 1000
Visual Tasks of Low Contrast or Very Small Size Detail	Hard Pencil Handwriting on Poor Quality Paper; Faded Copies; Difficult Industrial Work	1000 – 2000
Visual Tasks of Low Contrast and Very Small Size over a Prolonged Period	Fine Industrial Work; Difficult Inspection	2000 – 5000
Very Prolonged and Exacting Visual Tasks	Extra-fine Work	5000 – 10000
Very Special Visual Tasks of Extremely Low Contrast and Small Size	Surgical Procedures; Sewing	10000 – 20000

*Source: Energy Management Series No. 2, **Lighting**, Natural Resources Canada*

ILLUMINATION RATING INSTRUCTIONS

1 point	if extensive decorative lighting has been eliminated where used for reasons of appearances (not security, walkway lighting and other necessities).
1 point	if lighting has been arranged to illuminate only the work area.
0 points	if lighting has been designed to illuminate the entire room to a working level.
2 points	if light fixture diffuser is clean and clear.
1 point	if diffuser is slightly yellowed or dirty.
0 points	if diffuser is noticeably yellowed or dust is visible. This restriction can amount to 10% or more of the light flux being transmitted.
2 points	if fixture internal reflective surface is in good condition (the paint is reflective and clean).
1 point	if the fixture internal reflective surface gives dirt indication on clean white cloth.
0 points	if the reflective surface is yellowed and dull.
1 point	if the light source (T8, HPS, MH, LED Exit Lamps) are appropriate for the application
0 Points	if an inappropriate light source is used.
1 Point	if lights are properly vented 80 the heat can escape to ceiling space, providing that ceiling space is ventilated to prevent heat build-up.
1 point	if lights are turned off when area is not occupied.
1 point	if illumination level is adequate for designed usage.
0 points	if area is "over illuminated" for designed usage.*
0 points	if two or more lamps have blackened ends or are glowing without lighting.

Food Areas

Date: _____

Auditor: _____

Comments:

No.	Max Points = 15 / Location	Equipment Turned Off	Equipment Left On	Refrigeration Doors closed	Refrigeration Doors Ajar	Faucets not Leaking	Faucets Leaking	Access Doors Closed	Good Vent Hoods	Average Vent Hood	Poor Vent Hood	Adequate Ventilation	Refrigeration Equip. Good	Refrigeration Equip. Average	Refrigeration Equip. Poor	Heat Recovery System	Total Points
		2	0	1	0	1	0	3	2	1	0	1	2	1	0	3	

FOOD AREA RATING INSTRUCTIONS

2 points	if the food preparation equipment is only energized when actually needed. This Includes, but is not limited to, ovens, warmers, steam tables, delivery equipment and coffee urns.
0 points	if equipment is turned on and left on all day.
1 point	if refrigerator and freezer doors are kept tightly closed.
0 points	if refrigerator and freezer doors can be left ajar.
1 point	if faucets and valves are in good condition and not leaking.
0 points	if faucets and valves are leaking. Leaks may be external or internal in the system.
3 points	if doors between kitchen area and other areas are kept closed.
2 points	if adequate vent hoods are used over heat-producing equipment.
1 point	if some vent hoods are used over heat-producing equipment
0 points	if no or inadequate vent hoods are used.
1 point	if ventilation air supply is adequate to remove most of the heat produced by the kitchen equipment.
2 points	if refrigerator equipment is in good repair, seals are good, condenser is clean, air passage over condenser is clear.
1 point	if refrigeration equipment is in average condition, dust and dirt exist on condensers but the air flow is not restricted, door gaskets seal an around although they may have lost some resiliency.
0 points	if refrigeration equipment is in poor condition, a large collection of dust and dirt on the condenser or the fins may be bent to restrict air flow, door gaskets do not seal all around, are brittle, broken or missing.
3 points	if heat-recovery systems are utilized. These can be applied to the exhaust air, the hot waste water or on the refrigeration equipment.

Heating and Boiler Plant

Date: _____ Auditor: ____ Comments:		Insulation Good	Insulation Average	Insulation Poor	Flanges Insulation	No Leaks	Some Leaks	Many Leaks	Automatic Controls	Std Operating procedure	Steam Meter	Fuel Meter	Make-Up Water Meter	Preventative Maintenance	Fix as Required	Energy Recovery	Economizer Controls	Total Points
No.	**Max Points = 15**	2	1	0	2	2	1	0	1	1	1	1	1	1	0	3	2	
	Location																	

HEATING SYSTEM (GENERATION) RATING INSTRUCTIONS

2 points	if the insulation is in good condition with no broken or missing sections. The insulation must not be wet, crumbly or cracked.
1 point	if insulation is in average condition with small sections broken or missing. The insulation must not be wet or crumbly.
0 points	if insulation is in poor condition with sections missing, broken, wet, crumbly or cracked.
2 points	if flanges, valves and regulators are insulated with removable lagging.
2 points	if the steam system has no leaks.
1 point	if the steam system has minor leaks around valve packing, shaft seals, etc.
0 point	if the steam system has many leaks, valves, regulators and traps have dripping leaks, steam plumes, etc.
1 point	if boiler combustion controls are automatic.
1 point	if definite standard operating procedures are used. These should be written and posted near the boiler control panel.
1 point	if each boiler has an individual steam flow meter.
1 point	if each boiler has an individual make-up water meter.
1 point	if each boiler has an individual fuel flow meter.
1 point	if a definite preventive maintenance schedule is followed.
0 points	if equipment is maintained or repaired only when it breaks down.
3 points	if an energy recovery system is used. This may be a heat exchanger of water to water, an air wheel or any of several types in common use.
2 points	if heat generation is controlled by a system using an economizer system by comparing inside and outside temperature.

Heat Distribution

Date:_____ Auditor:_____ Comments:		Insulation Good	Insulation Average	Insulation Poor	Flanges Insulation	No Leaks	Some Leaks	Many Leaks	Control Good	Control Average	Control Poor	Standard Op. Procedure	Preventative Maintenance	Fix as Required	Condition as Required	Minimum Fresh Air	Zone Control Good	Zone Control Average	Zone Control Poor	Total Points
No.	**Max Points = 14**	2	1	0	2	2	1	0	2	1	0	1	1	0	1	1	2	1	0	
	Location																			

HEATING SYSTEM (DISTRIBUTION) RATING INSTRUCTIONS

2 points	if insulation is in good condition with no broken or missing sections. The insulation must not be wet, crumbly or cracked.
1 point	if insulation is in average condition with small sections broken or missing. The insulation must not be wet, crumbly or cracked.
0 points	if insulation is in poor condition with sections missing, broken, wet, crumbly or cracked.
2 points	if flanges, valves and regulators are insulated with removable lagging.
2 points	if the steam system has no leaks.
1 point	if the steam system has minor leaks around valve packing, shaft seals, etc.
0 points	if the steam system has many leaks, valves, regulators and traps have dripping leaks, steam plumes, etc.
2 points	if the control system to each area is adequate. The control system shall maintain the temperature in each room close to the thermostat setting.
1 point	if the control system to each area is only a general control without the ability to control each room.
0 points	if the control system has little or no control over the area temperature. Also included here is a control system that allows the heating and cooling systems to oppose each other in the same general area.
1 point	if definite standard operating procedures are used. These should be written and posted.
1 point	if a definite preventive maintenance schedule is followed.
0 points	if equipment is maintained or repaired only when it breaks down.
1 point	if the area is conditioned only when occupied. This will apply especially to auditoriums, work rooms, hobby shops, TV rooms, etc.
1 point	if the ventilation system controls provide for a minimum fresh air volume for a healthy environment rather that a fixed fresh air volume.
2 points	if the zone control is good and certain areas can be secured when not in use or require less temperature conditioning.
1 point	if the zone control only allows general areas to be secured when conditions dictate.
0 points	if zone control cannot be secured without securing a large general area.

Cooling Plant

Date: _____ Auditor: _____ Comments:		Insulation Good	Insulation Average	Insulation Poor	Flanges Insulated	Standard Op. Procedures	Ind. Power Meter	Preventative Maintenance	Fix as Required	Energy Recovery	Outside Air Used (Free Cool)	Enthalpy Control (T & RH)			Total Points
No.	**Max Points = 12** / **Location**	2	1	0	1	1	1	1	0	3	2	1			

COOLING SYSTEM (GENERATION) RATING INSTRUCTIONS

2 points	if the insulation is in good condition with no broken or missing sections. The insulation must not be wet, crumbly or cracked. Closed cell insulation will be considered average condition because of deterioration that occurs in this type of material.
1 point	if insulation is in average condition with small sections broken or missing. The insulation must not be wet or crumbly. The outside shell of open cell insulation must be intact with only minor breaks.
0 points	if insulation is in poor condition with sections missing, broken, wet, crumbly or cracked.
1 point	if flanges and valves are insulated.
1 point	if definite standard operating procedures are used. These should be written and posted near the control panel.
1 point	if unit has an individual watt-hour meter so the real-time power consumption can be determined.
1 point	if a definite preventive maintenance schedule is followed.
0 points	if equipment is maintained or repaired only when it breaks down.
3 points	if an energy recovery system is used. This may be a heat exchanger of water to water, an air wheel or any of several types in common use.
2 points	if outside air is utilized to help condition areas that require cooling even on cold days.
1 point	if the fresh air ratio is regulated by comparing inside requirements with outside temperatures

Cooling Distribution

Date:_____ Auditor:_____ Comments:		Insulation Good	Insulation Average	Insulation Poor	Flanges Insulation	Standard Op. Procedure	Control Good	Control Average	Control Poor	Preventative Maintenance	Fix as Required	Condition as Required	Constant Conditioning	Zone Control Good	Zone Control Average	Zone Control Poor			Total Points
No.	**Max Points = 11**	2	1	0	2	1	2	1	0	1	0	1	0	2	1	0			
	Location																		

COOLING SYSTEM (DISTRIBUTION) RATING INSTRUCTIONS

2 points	if the insulation is in good condition with no broken or missing sections. The insulation must not be wet, crumbly or cracked. "Closed cell" insulation will be considered average condition because of deterioration that occurs in this type of material.
1 point	if insulation is in average condition with small sections broken or missing. The insulation must not be wet, crumbly. The outside shell of "open cell" insulation must be intact with only minor breaks.
0 points	if insulation is in poor condition with sections missing, broken, wet, crumbly or cracked.
1 point	if flanges and valves are insulated.
1 point	if definite standard operating procedures are used. These should be written and posted near the control panel.
2 points	if the control system to each area is adequate. The control system maintains the temperature in each room close to the thermostat setting.
1 point	if the control system to each area is only a general control without the ability to control each room.
0 points	if the control system has little or no control over the area temperature. Also included here is a control system that allows the heating and cooling systems to oppose each other in the same general areas.
1 point	if a definite preventive maintenance schedule is followed.
0 points	if equipment is maintained or repaired only when it breaks down.
1 point	if the area is conditioned only when occupied. This will apply especially to auditoriums, work rooms, hobby shops, TV rooms, etc.
0 points	if the area is conditioned all the time regardless of occupancy.
2 points	if the zone control is good and certain areas can be secured when not in use or require less temperature conditioning.
1 point	if the zone control only allows general areas to be secured when conditions dictate.
0 points	if zone control cannot he secured without securing a large general area.

Electrical Power Distribution

Date: _____ **Auditor:** _____ **Comments:**		**Recording Meter**	**Usage Pattern**	**Power Co. Coordination**	**Power Peak Warning**	**Power Demand Limited**	**Standard Op. Procedure**	**Preventative Maintenance**	**Fix as Required**	**90% Power Factor**					**Total Points**
No.	**Max Points = 10** **Location**	2	1	1	1	1	1	1	0	2					

ELECTRICAL POWER DISTRIBUTION RATING INSTRUCTIONS

2 points	for operation of a recording ammeter.
1 point	for hourly electrical usage pattern of building being determined.
1 point	for study of electrical requirements with the Power Company staff.
1 point	for installation of a power peak warning system.
1 point	for analysis to eliminate power peak demands.
1 point	if a definite standard operating procedure is used. This shall be written and posted near the control panel.
1 point	if definite preventive maintenance schedule is followed.
0 points	if equipment is maintained or repaired only when it breaks down.
2 points	for overall system Power Factor of 90 percent or above at main service.

Hot Water Service

Date: _____ **Auditor:** _____ **Comments:**		**Insulation Good**	**Insulation Average**	**Insulation Poor**	**No Faucet Leaks**	**Faucet Leaks**	**Standard Op. Procedure**	**Preventative Maintenance**	**Fix as Required**	**DHW Temperature < 60C**	**Process HW Temp Optimized**				**Total Points**
No.	**Max Points = 8 / Location**	2	1	0	1	0	1	1	0	1	2				

HOT WATER SERVICE RATING INSTRUCTIONS

2 points	if the insulation is in good condition with no broken or missing sections. The insulation must not be wet, crumbly or cracked.
1 point	if insulation is in average condition with small sections broken or missing. The insulation must not be wet or crumbly.
0 points	if insulation is in poor condition with sections missing, broken, wet, crumbly or cracked.
1 point	if faucets and valves are in good repair.
0 points	if faucets and valves leak externally or internally.
1 point	if definite standard operating procedures are used. These should be written and posted.
1 point	if a definite preventive maintenance schedule is followed.
0 points	if equipment is maintained or repaired only when it breaks down.
1 point	if the DHW temperature is set less that 60C
2 point	if process hot water temperatures have been optimized for the particular requirement.

Water Service

Date: _____ **Auditor:** _____ **Comments:**		**No Faucet Leaks**	**Faucet Leaks**	**Standard Op. Procedures**	**Preventative Maintenance**	**Fix as Required**	**No Equip. Use Water Once**	**Equipment Off**							**Total Points**
No.	**Max Points = 5** / **Location**	1	0	1	1	0	1	1							

WATER SERVICE RATING INSTRUCTIONS

1 point	if faucets and valves are in good repair.
0 points	if faucets and valves leak externally or internally.
1 point	if definite standard operating procedures are used. These should be written and posted.
1 point	if a definite preventive maintenance schedule is followed.
0 points	if equipment is maintained or repaired only when it breaks down.
1 point	if there is no equipment that uses once-through cooling water and discharges to sewer.
1 point	if water-consuming equipment is turned off when not in use.

Compressed Air

Date: _____ **Auditor:** _____ **Comments:**		**No Outlet Leaks**	**Outlet Leaks**	**Compressors Sized**	**Compressors on Demand**	**Standard Op. Procedure**	**Preventative Maintenance**	**Fix as Required**	**Supply Pressure Minimized**	**Air quality appropriate**	**Controls prevents Blow-Off**				**Total Points**
No.	**Max Points = 8** / **Location**	1	0	1	1	1	1	0	1	1	1				

COMPRESSED AIR SERVICE RATING INSTRUCTIONS

1 point	if outlets and valves are in good repair.
0 points	if outlets and valves leak externally or internally.
1 point	if compressors are properly sized to shave peak demands.
1 point	if additional compressors are brought on line as demand requires and not run continuously.
1 point	if definite standard operating procedures are used. These should be written and posted.
1 point	if a definite preventive maintenance schedule is followed.
0 points	if equipment is maintained or repaired only when it breaks down.
1 point	if the compressor discharge (supply) air pressure has been minimized for application.
1 point	if a the air quality (dew point, temperature, cleanliness) is appropriate, not better than required,
1 point	if, for centrifugal compressors the controls prevent blow-off of air.

Process Heating

Date: _____ **Auditor:** _____ **Comments:**		**Flue Gas Waste Heat**	**High Temp. Areas Insulated**	**Insulation Poor**	**Exhaust Process Air**	**Standard Op. Procedure**	**Combustion Efficiency**	**Preventative Maintenance**	**Fix as Required**						**Total Points**
No.	**Max Points = 6** / **Location**	1	2	0	1	1	1	1	0						

PROCESS HEATING RATING INSTRUCTIONS

1 point	if the flue gas waste heat from processing equipment is extracted to heat relatively low temperature makeup, process and space heating water.
2 points	if all high-temperature piping, ovens, dryers, tanks and processing equipment are covered with suitable insulating material. The insulation must not be wet, crumbly or cracked.
0 points	if insulation is in poor condition with sections missing, broken, wet, crumbly or cracked.
1 point	if definite standard operating procedures are used. These should be written and posted near the control panel.
1 point	if gas-heated equipment is checked for combustion efficiency on a regular basis.
1 point	if a definite preventive maintenance schedule is followed.
0 points	if equipment is maintained or repaired only when it breaks down.

Appendix

Checklist Template

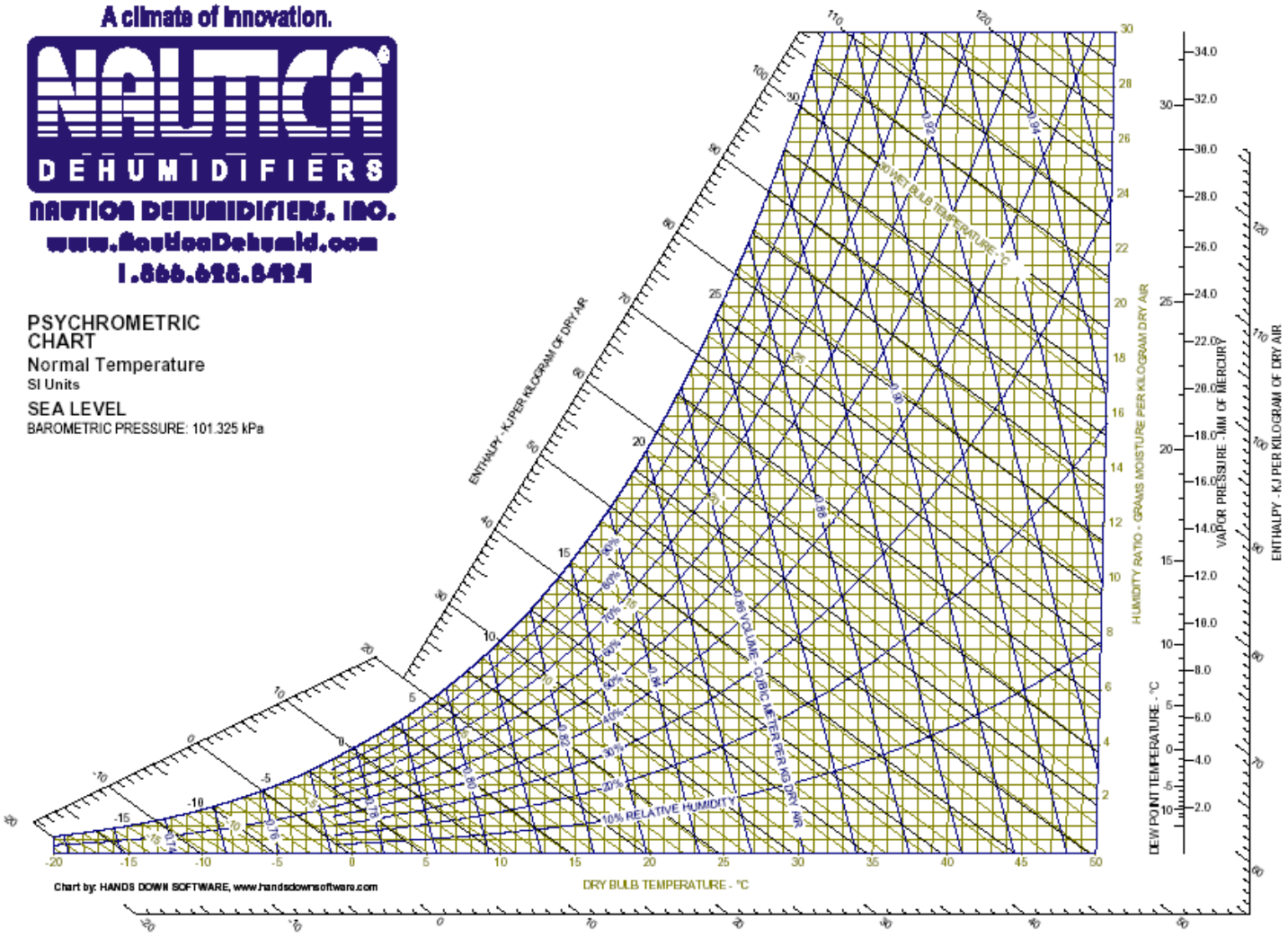
Date: _____ **Auditor:** _____ **Comments:**																		**Total Points**
No.	**Max Points = P** **Location**																	
Total Points for Section																		
Rating for Boiler Plant Systems = $\frac{(\ 100\ x\ \text{Total Points}\ )}{\text{Number of Items}\ x\ P}$																		

References

Handbook of Energy Audits, Albert Thummann, 3rd Edition, Chapter 10, The Fairmont Press, Inc. Lilburn GA, 1991

CIPEC Energy Efficiency Planning and Management Guide, Lom & Associates, Natural Resources Canada, 2002

Appendix 2: Psychrometric Chart



Appendix 3: Properties of Steam

SATURATED STEAM TABLES

Gauge Pressure bar	Absolute Pressure bar	Temperature °C	Specific Enthalpy			Specific Volume Steam (V_g) m^3/kg
			Water (h_f) kJ/kg	Evaporation (h_{fg}) kJ/kg	Steam (h_g) kJ/kg	
	0.05	32.88	137.82	2423.7	2561.5	28.192
	0.10	45.81	191.83	2392.8	2584.7	14.674
	0.15	53.97	225.94	2373.1	2599.1	10.022
	0.20	60.06	251.40	2358.3	2609.7	7.649
	0.25	64.97	271.93	2346.3	2618.2	6.204
	0.30	69.10	289.23	2336.1	2625.3	5.229
	0.35	72.70	304.30	2327.2	2631.5	4.530
	0.40	75.87	317.58	2319.2	2636.8	3.993
	0.45	78.70	329.67	2312.0	2641.7	3.580
	0.50	81.33	340.49	2305.4	2645.9	3.240
	0.55	83.72	350.54	2299.3	2649.8	2.964
	0.60	85.94	359.86	2293.6	2653.5	2.732
	0.65	88.01	368.54	2288.3	2656.9	2.535
	0.70	89.95	376.70	2283.3	2660.0	2.365
	0.75	91.78	384.39	2278.6	2663.0	2.217
	0.80	93.50	391.66	2274.1	2665.8	2.087
	0.85	95.14	398.57	2269.8	2668.4	1.972
	0.90	96.71	405.15	2265.7	2670.9	1.869
	0.95	98.20	411.43	2261.8	2673.2	1.777
	1.00	99.63	417.46	2258.0	2675.5	1.694
0	1.013	100.00	419.04	2257.0	2676.0	1.673
0.05	1.063	101.40	424.9	2253.3	2678.2	1.601
0.10	1.113	102.66	430.2	2250.2	2680.4	1.533
0.15	1.163	103.87	435.6	2246.7	2682.3	1.471
0.20	1.213	105.10	440.8	2243.4	2684.2	1.414
0.25	1.263	106.26	445.7	2240.3	2686.0	1.361
0.30	1.313	107.39	450.4	2237.2	2687.6	1.312
0.35	1.363	108.50	455.2	2234.1	2689.3	1.268
0.40	1.413	109.55	459.7	2231.3	2691.0	1.225
0.45	1.463	110.58	464.1	2228.4	2692.5	1.186
0.50	1.513	111.61	468.3	2225.6	2693.9	1.149
0.55	1.563	112.60	472.4	2223.1	2695.5	1.115
0.60	1.613	113.56	476.4	2220.4	2696.8	1.083
0.65	1.663	114.51	480.2	2217.9	2698.1	1.051
0.70	1.713	115.40	484.1	2215.4	2699.5	1.024
0.75	1.763	116.28	487.9	2213.0	2700.9	0.997
0.80	1.813	117.14	491.6	2210.5	2702.1	0.971
0.85	1.863	117.96	495.1	2208.3	2703.4	0.946
0.90	1.913	118.80	498.9	2205.6	2704.5	0.923
0.95	1.963	119.63	502.2	2203.5	2705.7	0.901

Gauge Pressure bar	Absolute Pressure bar	Temperature °C	Specific Enthalpy			Specific Volume Steam (V_g) m^3/kg
			Water (h_f) kJ/kg	Evaporation (h_{fg}) kJ/kg	Steam (h_g) kJ/kg	
1.00	2.013	120.42	505.6	2201.1	2706.7	0.881
1.05	2.063	121.21	508.9	2199.1	2708.0	0.860
1.10	2.113	121.96	512.2	2197.0	2709.2	0.841
1.15	2.163	122.73	515.4	2195.0	2710.4	0.823
1.20	2.213	123.46	518.7	2192.8	2711.5	0.806
1.25	2.263	124.18	521.6	2190.7	2712.3	0.788
1.30	2.313	124.90	524.6	2188.7	2713.3	0.773
1.35	2.363	125.59	527.6	2186.7	2714.3	0.757
1.40	2.413	126.28	530.5	2184.8	2715.3	0.743
1.45	2.463	126.96	533.3	2182.9	2716.2	0.728
1.50	2.513	127.62	536.1	2181.0	2717.1	0.714
1.55	2.563	128.26	538.9	2179.1	2718.0	0.701
1.60	2.613	128.89	541.6	2177.3	2718.9	0.689
1.65	2.663	129.51	544.4	2175.5	2719.9	0.677
1.70	2.713	130.13	547.1	2173.7	2720.8	0.665
1.75	2.763	130.75	549.7	2171.9	2721.6	0.654
1.80	2.813	131.37	552.3	2170.1	2722.4	0.643
1.85	2.863	131.96	554.8	2168.3	2723.1	0.632
1.90	2.913	132.54	557.3	2166.7	2724.0	0.622
1.95	2.963	133.13	559.8	2165.0	2724.8	0.612
2.00	3.013	133.69	562.2	2163.3	2725.5	0.603
2.05	3.063	134.25	564.6	2161.7	2726.3	0.594
2.10	3.113	134.82	567.0	2160.1	2727.1	0.585
2.15	3.163	135.36	569.4	2158.5	2727.9	0.576
2.20	3.213	135.88	571.7	2156.9	2728.6	0.568
2.25	3.263	136.43	574.0	2155.3	2729.3	0.560
2.30	3.313	136.98	576.3	2153.7	2730.0	0.552
2.35	3.363	137.50	578.5	2152.2	2730.7	1.544
2.40	3.413	138.01	580.7	2150.7	2731.4	0.536
2.45	3.463	138.53	582.8	2149.2	2732.0	0.529
2.50	3.513	139.02	585.0	2147.6	2732.6	0.522
2.55	3.563	139.52	586.9	2146.3	2733.2	0.515
2.60	3.613	140.00	589.2	2144.7	2733.9	0.509
2.65	3.663	140.48	591.3	2143.3	2734.6	0.502
2.70	3.713	140.96	593.3	2141.9	2735.2	0.496
2.75	3.763	141.44	595.3	2140.5	2735.8	0.489
2.80	3.813	141.92	597.4	2139.0	2736.4	0.483
2.85	3.863	142.40	599.4	2137.6	2737.0	0.477
2.90	3.913	142.86	601.4	2136.1	2737.5	0.471
2.95	3.963	143.28	603.3	2134.8	2738.1	0.466

Gauge Pressure bar	Absolute Pressure bar	Temperature °C	Specific Enthalpy			Specific Volume Steam (V_g) m^3/kg
			Water (h_f) kJ/kg	Evaporation (h_{fg}) kJ/kg	Steam (h_g) kJ/kg	
3.00	4.013	143.75	605.3	2133.4	2738.7	0.461
3.10	4.113	144.67	609.1	2130.7	2739.8	0.451
3.20	4.213	145.46	612.9	2128.1	2741.0	0.440
3.30	4.313	146.36	616.4	2125.5	2741.9	0.431
3.40	4.413	147.20	620.0	2122.9	2742.9	0.422
3.50	4.513	148.02	623.6	2120.3	2743.9	0.413
3.60	4.613	148.84	627.1	2117.8	2744.9	0.405
3.70	4.713	149.64	630.6	2115.3	2745.9	0.396
3.80	4.813	150.44	634.0	2112.9	2746.9	0.389
3.90	4.913	151.23	637.3	2110.5	2747.8	0.381
4.00	5.013	151.96	640.7	2108.1	2748.8	0.374
4.10	5.113	152.68	643.9	2105.7	2749.6	0.367
4.20	5.213	153.40	647.1	2103.5	2750.6	0.361
4.30	5.313	154.12	650.2	2101.2	2751.4	0.355
4.40	5.413	154.84	653.3	2098.9	2752.2	0.348
4.50	5.513	155.55	656.3	2096.7	2753.0	0.342
4.60	5.613	156.24	659.3	2094.5	2753.8	0.336
4.70	5.713	156.94	662.3	2092.3	2754.6	0.330
4.80	5.813	157.62	665.2	2090.2	2755.4	0.325
4.90	5.913	158.28	668.1	2088.1	2756.2	0.320
5.00	6.013	158.92	670.9	2086.0	2756.9	0.315
5.10	6.113	159.56	673.7	2083.9	2757.6	0.310
5.20	6.213	160.20	676.5	2081.8	2758.3	0.305
5.30	6.313	160.82	679.2	2079.8	2759.0	0.301
5.40	6.413	161.45	681.9	2077.8	2759.7	0.296
5.50	6.513	162.08	684.6	2075.7	2760.3	0.292
5.60	6.613	162.68	687.2	2073.8	2761.0	0.288
5.70	6.713	163.27	689.8	2071.8	2761.6	0.284
5.80	6.813	163.86	692.4	2069.9	2762.3	0.280
5.90	6.913	164.46	695.0	2067.9	2762.9	0.276
6.00	7.013	165.04	697.5	2066.0	2763.5	0.272
6.10	7.113	165.60	700.0	2064.1	2764.1	0.269
6.20	7.213	166.16	702.5	2062.3	2764.8	0.265
6.30	7.313	166.73	705.0	2060.4	2765.4	0.261
6.40	7.413	167.29	707.4	2058.6	2766.0	0.258
6.50	7.513	167.83	709.7	2056.8	2766.5	0.255
6.60	7.613	168.38	712.1	2055.0	2767.1	0.252
6.70	7.713	168.89	714.5	2053.1	2767.6	0.249
6.80	7.813	169.43	716.8	2051.3	2768.1	0.246
6.90	7.913	169.95	719.1	2049.5	2768.6	0.243

Gauge Pressure bar	Absolute Pressure bar	Temperature °C	Specific Enthalpy			Specific Volume Steam (V_g) m^3/kg
			Water (h_f) kJ/kg	Evaporation (h_{fg}) kJ/kg	Steam (h_g) kJ/kg	
7.00	8.013	170.50	721.4	2047.7	2769.1	0.240
7.10	8.113	171.02	723.6	2046.1	2769.7	0.237
7.20	8.213	171.53	725.9	2044.3	2770.2	0.235
7.30	8.313	172.03	728.1	2042.6	2770.7	0.232
7.40	8.413	172.53	730.4	2040.8	2771.2	0.229
7.50	8.513	173.02	732.5	2039.2	2771.1	0.227
7.60	8.613	173.50	734.7	2037.5	2772.2	0.224
7.70	8.713	174.00	736.8	2035.9	2772.7	0.222
7.80	8.813	174.46	738.9	2034.2	2773.1	0.219
7.90	8.913	174.93	741.0	2032.6	2773.6	0.217
8.00	9.013	175.43	743.1	2030.9	2774.0	0.215
8.10	9.113	175.88	745.2	2029.3	2774.5	0.212
8.20	9.213	176.37	747.2	2027.6	2774.8	0.210
8.30	9.313	176.83	749.3	2026.1	2775.4	0.208
8.40	9.413	177.27	754.3	2024.5	2775.8	0.206
8.50	9.513	177.75	753.3	2022.9	2776.2	0.204
8.60	9.613	178.20	755.3	2021.3	2776.6	0.202
8.70	9.713	178.64	757.2	2019.7	2776.9	0.200
8.80	9.813	179.08	759.2	2018.2	2777.4	0.198
8.90	9.913	179.53	761.1	2016.6	2777.7	0.196
9.00	10.013	179.97	763.0	2015.1	2778.1	0.194
9.10	10.113	180.41	765.0	2013.5	2778.5	0.192
9.20	10.213	180.83	766.9	2012.0	2778.9	0.191
9.30	10.313	181.26	768.7	2010.5	2779.2	0.189
9.40	10.413	181.68	770.6	2009.0	2779.6	0.187
9.50	10.513	182.10	772.5	2007.5	2780.0	0.185
9.60	10.613	182.51	774.4	2006.0	2780.4	0.184
9.70	10.713	182.91	776.2	2004.5	2780.7	0.182
9.80	10.813	183.31	778.0	2003.1	2781.1	0.181
9.90	10.913	183.72	779.8	2001.6	2781.4	0.179
10.00	11.013	184.13	781.6	2000.1	2781.7	0.177
10.20	11.213	184.92	785.1	1997.3	2782.4	0.174
10.40	11.413	185.68	788.6	1994.4	2783.0	0.172
10.60	11.613	186.49	792.1	1991.6	2783.7	0.169
10.80	11.813	187.25	795.5	1988.8	2784.3	0.166
11.00	12.013	188.02	798.8	1986.0	2784.8	0.163
11.20	12.213	188.78	802.3	1983.2	2785.5	0.161
11.40	12.413	189.52	805.5	1980.5	2786.0	0.158
11.60	12.613	190.24	808.8	1977.8	2786.6	0.156
11.80	12.813	190.97	812.0	1975.1	2787.1	0.153

Gauge Pressure bar	Absolute Pressure bar	Temperature °C	Specific Enthalpy			Specific Volume Steam (V_g) m^3/kg
			Water (h_f) kJ/kg	Evaporation (h_{fg}) kJ/kg	Steam (h_g) kJ/kg	
12.00	13.013	191.68	815.1	1972.5	2787.6	0.151
12.20	13.213	192.38	818.3	1969.9	2788.2	0.149
12.40	13.413	193.08	821.4	1967.2	2788.6	0.147
12.60	13.613	193.77	824.5	1964.6	2789.1	0.145
12.80	13.813	194.43	827.5	1962.1	2789.6	0.143
13.00	14.013	195.10	830.4	1959.6	2790.0	0.141
13.20	14.213	195.77	833.4	1957.1	2790.5	0.139
13.40	14.413	196.43	836.4	1954.5	2790.9	0.137
13.60	14.613	197.08	839.3	1952.0	2791.3	0.135
13.80	14.813	197.72	842.2	1949.6	2791.8	0.133
14.00	15.013	198.35	845.1	1947.1	2792.2	0.132
14.20	15.213	198.98	848.0	1944.6	2792.6	0.130
14.40	15.413	199.61	850.7	1942.3	2793.0	0.128
14.60	15.613	200.23	853.5	1939.8	2793.3	0.127
14.80	15.813	200.84	856.3	1937.4	2793.7	0.125
15.00	16.013	201.45	859.0	1935.0	2794.0	0.124
15.20	16.213	202.04	861.7	1932.7	2794.4	0.122
15.40	16.413	202.64	864.4	1930.4	2794.8	0.121
15.60	16.613	203.21	867.1	1928.0	2795.1	0.119
15.80	16.813	203.79	869.7	1925.7	2795.4	0.118
16.00	17.013	204.38	872.3	1923.4	2795.7	0.117
16.20	17.213	204.94	874.9	1921.2	2796.1	0.115
16.40	17.413	205.49	877.5	1918.9	2796.4	0.114
16.60	17.613	206.05	880.0	1916.7	2796.7	0.113
16.80	17.813	206.61	882.5	1914.4	2796.9	0.111
17.00	18.013	207.17	885.0	1912.1	2797.1	0.110
17.20	18.213	207.75	887.5	1909.9	2797.4	0.109
17.40	18.413	208.30	889.9	1907.7	2797.6	0.108
17.60	18.613	208.84	892.4	1905.5	2797.9	0.107
17.80	18.813	209.37	894.8	1903.4	2798.2	0.106
18.00	19.013	209.90	897.2	1901.3	2798.5	0.105
18.20	19.213	210.43	899.6	1899.1	2798.7	0.104
18.40	19.413	210.96	902.0	1896.9	2798.9	0.103
18.60	19.613	211.47	904.3	1894.8	2799.1	0.102
18.80	19.813	211.98	906.7	1892.6	2799.3	0.101
19.00	20.013	212.47	909.0	1890.5	2799.5	0.100
19.20	20.213	212.98	911.3	1888.4	2799.7	0.0986
19.40	20.413	213.49	913.6	1886.6	2799.9	0.0976
19.60	20.613	213.99	915.8	1884.3	2800.1	0.0967
19.80	20.813	214.48	918.1	1882.2	2800.3	0.0958

Gauge Pressure bar	Absolute Pressure bar	Temperature °C	Specific Enthalpy			Specific Volume Steam (V_g) m^3/kg
			Water (h_f) kJ/kg	Evaporation (h_{fg}) kJ/kg	Steam (h_g) kJ/kg	
20.00	21.013	214.96	920.3	1880.2	2800.5	0.0949
20.50	21.513	216.15	925.8	1875.1	2800.9	0.0927
21.00	22.013	217.35	931.3	1870.1	2801.4	0.0906
21.50	22.513	218.53	936.6	1865.1	2801.7	0.0887
22.00	23.013	219.65	941.9	1860.1	2802.0	0.0868
22.50	23.513	220.76	947.1	1855.3	2802.4	0.0849
23.00	24.013	221.85	952.2	1850.4	2802.6	0.0832
23.50	24.513	222.94	957.3	1845.6	2802.9	0.0815
24.00	25.013	224.02	962.2	1840.9	2803.1	0.0797
24.50	25.513	225.08	967.2	1836.1	2803.3	0.0783
25.00	26.013	226.12	972.1	1831.4	2803.5	0.0768
26.00	27.013	228.15	981.6	1822.2	2803.8	0.0740
27.00	28.013	230.14	990.7	1813.3	2804.0	0.0714
28.00	29.013	232.05	999.7	1804.4	2804.1	0.0689
29.00	30.013	233.93	1008.6	1795.6	2804.2	0.0666
30.00	31.013	235.78	1017.0	1787.0	2804.1	0.0645
31.00	32.013	237.55	1025.6	1778.5	2804.1	0.0625
32.00	33.013	239.28	1033.9	1770.0	2803.9	0.0605
33.00	34.013	240.97	1041.9	1761.8	2803.7	0.0587
34.00	35.013	242.63	1049.7	1753.8	2803.5	0.0571
35.00	36.013	244.26	1057.7	1745.5	2803.2	0.0554
36.00	37.013	245.86	1065.7	1737.2	2802.9	0.0539
37.00	38.013	247.42	1072.9	1729.5	2802.4	0.0524
38.00	39.013	248.95	1080.3	1721.6	2801.9	0.0510
39.00	40.013	250.42	1087.4	1714.1	2801.5	0.0498
40.00	41.013	251.94	1094.6	1706.3	2800.9	0.0485
42.00	43.013	254.74	1108.6	1691.2	2799.8	0.0461
44.00	45.013	257.50	1122.1	1676.2	2798.2	0.0441
46.00	47.013	260.13	1135.3	1661.6	2796.9	0.0421
48.00	49.013	262.73	1148.1	1647.1	2795.2	0.0403
50.00	51.013	265.26	1160.8	1632.8	2793.6	0.0386