

# **Fuel Oil Heating Installation Inspection Report #2 July 2008**

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**Prepared for the:**

**Yukon Housing Corporation**

**Prepared by:**

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**Executive Summary** NRG Resources Inc. conducted 51 inspections of oil-burning appliances and supply tanks in Whitehorse and Haines Junction between July 21 and July 29, 2008 on behalf of Yukon Housing Corporation. The inspections were conducted to determine the level of compliance with the B139 *Installation Code for Oil-Burning Equipment* and to identify safety and efficiency issues and their possible solutions.

The inspection survey identified 316 infractions of the B139 Code of which 152 were considered to be significant concerns that either posed an imminent hazard (7 cases or 14%) or could reasonably be expected to develop into a problem in the future. The average number of code infractions per site was 6.2 and the average number of significant infractions was 3.0 per site.

The July 2008 inspection results are similar to three previous inspection surveys conducted by NRG Resources and Yukon Housing in 2007 and April 2008. The inspection of 152 sites in the three previous surveys found that the average number of code infractions per site was 5.0 and the average number of significant infractions was 2.7 per site (14 imminent hazard cases or 9%).

All four surveys provide significant evidence that a large percentage of oil-burning equipment installations in the Yukon are not properly installed or maintained in accordance with the minimum standards established in the *B139 Installation Code for Oil-burning Equipment*.

It is worth noting that the two 2008 surveys were the first to investigate the state of oil burning installations outside of Whitehorse. The fourteen sites inspected in outside Whitehorse had a higher number of infractions per site (8.5) as well as a higher number of significant infractions (4.3/site) and a higher percentage of imminent hazards (14%). Lack of maintenance was a major cause of the problems found at sites outside of Whitehorse; home owners in Haines Junction indicated that there were no Oil Burner Mechanics available to service and maintain their appliances.

Only 4 of the 51 sites surveyed in July 2008 provided any indication that the installation or servicing of the appliances was conducted by licenced Oil Burner Technicians. Although these 4 sites were not problem-free, they did have a lower number of infractions per site (3.8) compared to the average of 6.2 at sites not installed or maintained by licenced technicians.

The current survey confirms the recommendations made in the previously submitted 2007 report entitled "*Recommendations to Improve the Safety and Efficiency of Oil-burning Equipment Installation and Maintenance in the Yukon*".

**Current Survey Procedure** The inspection sites were selected by Yukon Housing Corporation from a list of home owners who responded to an advertisement concerning the inspection program. The selection criterion was primarily a “first call – first chosen” basis.

All 51 inspections were conducted by Rod Corea from NRG Resources Inc with the assistance of Craig Olsen. The inspections were conducted between July 21 and 29, 2008 along with one conducted in Dawson City in November 2008 by Craig Olsen.

The inspection forms developed by NRG Resources and approved by Yukon Housing were employed to record the inspection results. Blank copies of these forms are found in Appendix A and the completed forms for each site are found in Appendix B.

Only a visual inspection of the oil-burning appliances, supply tanks, and supply lines was conducted at each site. No adjustments or changes to the equipment were made during the inspection. Combustion analyses were conducted on 52 of the 58 appliances inspected. The appliances that were not tested would have required significant changes to the appliances to conduct the tests.

The owner or occupant was in the house at the time of the inspection. A summary of the inspection findings was provided verbally to the owner/occupant at the time of the inspection along with a copy of the combustion test print-out. Any safety or efficiency concerns were discussed with the owner/occupant. Where corrective action was warranted, the owner/occupant was advised to have a qualified heating contractor of their choice conduct the work.

Copies of the completed inspection checklists were mailed to each homeowner along with a cover letter identifying and discussing the major safety and efficiency issues. Copies of these documents are found in Appendix C.

**Inspection Criteria** **The inspection criteria regarding code compliance was the B139 Code in effect at the time of the installation.**

This criteria required reference to four editions of the B139 Installation Code for Oil Burning Equipment, namely: B139-1976 (in effect from 1976 to 1991); B139-M91 (in effect from 1991 to 2000); B139-00 (in effect from 2000 to 2006); and the current B139-04 in effect in the Yukon since April 2006). Installations dating from before 1976 have all been upgraded in some way and therefore were judged by the Code in effect at the approximate time of the upgrade.

Four exceptions were made to the above inspection criteria regarding reference to the Code in effect at the time of the installation. In all three cases (listed below) the current Code requirements were employed to identify the infraction since the condition poses a potential hazard that should be corrected even though it technically is in compliance with the Code at the time of installation. The four exceptions were:

1. The slope of the tank toward the outlet.
  - Although this requirement only appears in the B139-04 edition, it has been required by manufacturer's instruction in compliance with the S602 tank Standard since the early 1990's. Significant corrosion can occur inside the tank due to the collection of water and sludge when the tank is sloped away from the outlet.
2. The height of a tank fill pipe shall be at least one meter (3') above grade.
  - Again, this requirement only appears in the B139-04 edition. However, the corrosion problems posed by snow or water entering a tank warrant the identification of this poor installation practice as a code infraction.
3. Piping, valves, or filters shall not extend below the tank foundation.
  - Although this requirement only appears in the B139-04 edition, it has been required by manufacturer's instruction since the early 1990's. Since piping, valves, or filters that extend below the tank foundation could snap off as the tank settles, it is reasonable and responsible to identify this problem as a code infraction.
4. Piping and tubing shall not be buried in cement unless installed in a duct.
  - This requirement was explicitly made in the B139-00 edition but previous code requirements to protect oil lines from corrosion could be interpreted as prohibiting this practice. The potential for corrosion and leakage warrants the identification of this poor installation practice as a code infraction.

**Combustion Efficiency Criteria** **The criteria for judging whether the combustion efficiency of an appliance was “acceptable”** was the guideline established in Canada’s Energy Efficiency Act and Regulations which requires oil-fired furnaces with an input of  $\leq 225,000$  Btuh to have an efficiency of 78% or greater.

The combustion setup requirements established by the B139 Code and the appliance manufacturer’s certified instructions were also factored into the assessment as to whether the efficiency of an appliance was “acceptable”. Inefficient appliances (i.e. <78%) were not considered to be an infraction of the B139 Code unless they were in non-compliance with the combustion setup requirements of the B139 Code or the manufacturer’s certified instructions.

**Code Infraction Reporting Criteria** **The criteria for identifying the code infractions found during the survey can be characterized as reasonable and practical.** Not all code infractions found during the inspections are identified. Only those code infractions that could reasonably be considered as safety or efficiency issues are identified on the individual inspection reports found in Appendix C and summarized on the table found in Appendix B.

Minor code infractions that could not affect the safety or efficiency of the installation are not identified in this report. For example, the B139-1996 Code and the B139-M91 Code both required that a tank vent pipe terminate at least seven feet above grade. The B139-00 and B139-04 editions of the Code only require the vent pipe to terminate 150mm (6”) above the fill pipe.

The recent code requirements were employed to identify infractions related to vent pipe termination since the technical or legal requirement to comply with the code in effect at the time of installation would “clutter” the report with inconsequential infractions that might obscure the important safety and efficiency issues identified in the survey.

**In regards to underground storage tank (UST) requirements,** the 2004 edition of the B139 Code is the first fuel oil code that has no requirements regarding the installation, maintenance, or removal of underground tanks. Currently, USTs must only comply with the National Fire Code of Canada and the CCME Environmental Code. The same is true for aboveground tanks with a capacity greater than 2500L.

For the purpose of this report, the requirements for underground tank installations from previous editions of the B139 Code were employed since the 5 sites with USTs inspected during this survey pre-date the current B139 Code.

- Code Infraction Reporting Criteria (continued)** The Code infractions summarized on the table found in Appendix B are separated into two categories as follows:
1. Significant Code Infractions: These are code infractions that were considered to be safety concerns that either posed an imminent hazard or could reasonably be expected to develop into a problem in the future.
  2. Minor Code Infractions: These are code infractions that were considered to be worth identifying since they should have been corrected during installation or maintenance of the appliances. However, they should not pose a problem under “normal” conditions.

- Types of Sites and Equipment Inspected** All of the 51 sites inspected were single family dwellings. The ages of the buildings ranged from the 1960s to early 2008. Forty-two of the sites were in Whitehorse (or vicinity), two were in Golden Horn, two were at Marsh Lake, one was in Dawson City, and four were in Haines Junction.

The types and age range of equipment inspected are listed below:

Appliance Type	Total	1960 to 1979	1980 to 1989	1990 to 1999	2000 to 2005	2006 to 2008
Forced air furnace	44	8	8	13	9	6
Boiler	6	1		3	1	2
Combo Water heater/Space heater	1				1	
Water heater	2				2	
Space heater	5				3	2
Aboveground Indoor tank	9	2		4	3	
Aboveground Outdoor tank	40	3	1	7	16	13
Underground tank	5	2	1	2		
Total Appliances	58	9	8	17	17	8
Total Tanks	54	7	2	13	19	13

**General  
Overview of  
Inspection  
Results**

The inspection of 28 sites in Whitehorse and Haines Junction with oil-burning equipment found a large number of code infractions and efficiency concerns as listed in the table in Appendix B and summarized below.

- None one of the 51 sites completely complied with the B139 Installation Code for Oil-Burning Equipment. This was a new installation.
- Code infractions related to the oil tank and supply lines were found at all of the sites.
- Code infractions related to the appliances and venting systems were found at all but two of the sites.
- A total of 316 contraventions of the B139 Code were found at the 51 sites. This constitutes an average of 6.2 code infractions per site.
- 148 or 47% of the total number of code infractions were related to the tank and supply lines. As such, the average number of code infractions per site related to the tank and supply lines was 2.9. A focused discussion of these code infractions is provided in the next section of this report (pages 7 and 8).
- 168 or 53% of the total number of code infractions were related to the appliances and venting systems. This represents an average of 3.3 code infractions per site related to the appliance and venting system. More information regarding these code infractions is provided on pages 9 to 11 of this report.
- 7 of the 51 sites (14%) were considered imminent hazards posing a hazard to life or property if not addressed immediately. In all cases, the owners or occupants were advised about these problems. More information regarding these code infractions is provided on the summary table in Appendix B.
- 44 of the 51 sites (86%) had at least one significant code infraction. A total of 152 significant code infractions were identified. A “significant” code infraction is defined on page 4 of this report.
- 21 of the 51 appliances (40%) tested for proper combustion were found to be inefficient and/or in non-compliance with the code requirements related to combustion set up.
- 20 of the 51 sites (39%) were not being maintained annually as required by Section 14 of the B139 Code.
- Proof that the technician who recently installed or serviced the installation was a licenced Oil Burner Mechanic was found at only four of the sites.

**Discussion of the Tank Inspection Results** As noted above, the inspection of 51 sites with 54 oil supply tanks identified 148 code infractions related to the oil tanks and supply lines. This represents an average of 2.9 code infractions per site related to the oil supply systems. All of the 51 sites inspected (i.e. 100%) had at least one code infraction related to the tanks and supply lines.

60 (41%) of these 148 code infractions were considered to be “significant” in that they either posed an imminent hazard (3 of the 7 such cases) or could reasonably be expected to develop into a problem in the future.

The following is a complete list of the types of infractions related to the oil tanks and supply lines as identified on the summary table in Appendix B and the individual inspection forms in Appendix C. Infractions are listed in order of importance with those considered “significant” identified in bold print.

Type of infraction	Number of sites with this infraction	Code Reference	Comments
<b>Signs of oil leakage</b>	4	14.2.2	Two cases of dripping oil on outside tank and two cases of weepage from indoor tank.
<b>Improper material used for oil line</b>	1	8.3.1.1	Plastic hose used for oil supply line.
<b>Oil lines cemented in or under floor</b>	4	8.3.5	See Note #4 on page 3
<b>Tank not sloped toward outlet.</b>	20	6.3.9.2 (c)	See Note #1 on page 3
<b>Piping at tank is improper.</b>	6	6.3.9.2	See Note #3 on page 3
<b>Single wall underground lines used after 2000</b>	2	8.3.2.1.2	2000 edition of B139 required the use of double-walled underground piping. These new installations did not comply.
<b>Tank not protected from corrosion or physical damage</b>	2	6.5.4 (a)	Both cases involved visibly rusted outside ASTs in need of painting.
<b>Oil lines not protected from physical damage</b>	3	8.3.1.5	All three cases of unsupported tubing under strain.
<b>Filter location improper.</b>	9	3.10.2	Code requires filters to be indoors wherever feasible.
<b>Tank improperly supported</b>	15	6.3.8	Three cases used wooden blocks for no good reason.

**Discussion of  
the Tank  
Inspection  
Results  
(continued)**

Type of infraction	Number of sites with this infraction	Code Reference	Comments
<b>Fill and vent pipe terminate inside the building</b>	3	6.8.5 and 6.9.1.5	In one case a carport was closed in recently but owner plans to move tank or vent it to the outdoors soon. Two other cases were oil drums indoors.
<b>Tank vent too small</b>	1	6.9.1.2	The vent on this tank was reduced to 3/4"
<b>Oil line components not rated for 1000°F</b>	1	8.1.1	Filter was not rated for 1000°F and was not equipped with a fusible link valve
<b>Abandoned UST</b>	1	Fire Code	Fire Code requires the removal of disused USTs
<b>Unapproved tank</b>	2	6.2.1.1	Both cases are oil drums used to supply furnaces in garages.
Tank vent does not terminate above fill	5	6.9.1.6	Code requires vent to terminate at least 6" above fill
No seismic restraint on aboveground tank	35	6.3.1.1	4 of these sites are considered significant infractions since the tanks were elevated
Tank vent or fill pipe terminates within 2' of opening	1	6.8.6 (b) 6.9.1.7 (d)	This is a nuisance problem since oil odours may enter building during fill operations.
No Rating Plate on Tank	8	6.2.1.1	5 of these cases were on pre-1980 tanks. Lack of approval may indicate that tanks were not built to a Standard.
Fill and/or vent pipe too close to ground	3	6.8.6 (c) 6.9.1.7(b)	See Note #2 on page 3
Improper support of oil lines	1	8.3.1.5	Code requires minimum space between line supports.
UST not cathodically tested or maintained	5	Fire Code	Fire Code requires the maintenance and testing of USTs
No level gauge in tank	1	6.10.2	Gauge allows for troubleshooting
Tank within 5' of property line	2	6.5.4 (b)	In both cases the tanks were between 1 to 4 feet of the property line
Improper clearances around tank	6	6.3.4 to 6.3.6	The 2004 edition of the Code requires specific clearances around oil tanks for inspection.
Excessive tubing located outdoors	4	8.3.1.6	Excessive runs of tubing outdoors may cause oil supply problems

**Discussion of Appliance Inspection Results** As noted on page 6, the inspection of 51 sites with 58 appliances identified 168 code infractions related to the appliances and venting systems. This represents an average of 3.3 code infractions per site related to the appliances and venting systems. All but two of the 51 sites inspected (i.e. 96%) had at least one code infraction related to the appliances and their venting systems.

92 (55%) of these 168 code infractions were considered to be “significant” in that they either posed an imminent hazard (6 of the 7 such cases) or could reasonably be expected to develop into a problem in the future.

The following is a complete list of the types of infractions related to the appliances and venting systems as identified on the summary table in Appendix B and the individual inspection forms in Appendix C. Infractions are listed in order of importance with those considered “significant” identified in bold print. The 7 cases that were considered as imminent hazards are identified in the summary tables in Appendix B

Type of infraction	Number of sites	Code Reference	Comments
<b>Flue gases leaking indoors</b>	3	4.2.1 4.2.5.3	All three cases involved improperly joined vent connectors (2 positive pressure). All were considered significant but not imminent hazards
<b>Appliance significantly modified</b>	3	3.1.1	All three were considered imminent hazards. Two were in garages and one was common-vented with an unapproved wood stove.
<b>Combustion tests results do not meet requirements of the Code and/or manufacturer</b>	25	5.1 5.2.2 5.2.3 5.2.5	Two cases were considered imminent hazards due to the VERY high smoke levels Numerous problems including - Dirty heat exchanger - High CO or smoke readings - Insufficient or excessive draft readings - 8 appliances never had a flue gas analysis  25 out of 51 appliances tested constitute a 49% non-compliance rate.
<b>Common venting with unapproved wood appliance</b>	2	4.1.4	In one case (103 Quill St., Haines Junction) co-venting of the oil furnace was considered an imminent hazard. In the other case the wood furnace was approved for use with an electric furnace but not an oil furnace.
<b>Combustion air damper device improperly installed</b>	3		In two cases the newly installed device closed when the furnace started. In all three cases, the devices were not interlocked with the burner as required by the Code.

**Discussion of Appliance Inspection Results (continued)**

Type of infraction	Number of sites	Code Reference	Comments
<b>Sidewall vent installation does not meet requirements of the Code &amp;/or manufacturer</b>	6	4.3	In five cases, improper vent material or joint compound was used which caused some flue gas leakage indoors. One case was a side wall vent termination too close to grade level. Fewer installations with sidewall vent systems were inspected during this survey compared to the previous surveys which found numerous problems with sidewall vents.
<b>Appliance too close to combustibles</b>	3	7.1.1	All 3 cases involved storage of material too close to the appliance. One was considered significant.
<b>Vent and/or vent connector too close to combustibles</b>	12	4.2.5.5 (f)	Six of these infractions were considered significant.
<b>Installation of vent liner in chimney or factory vent does not meet Code &amp;/or manufacturer's requirements</b>	18	4.2.2.5.1 4.2.2.9	Infractions included: - No base-tee on liner - No base-tee on L-Vent - No chimney cap - Improper vent material employed
<b>Vent connector improperly installed or maintained</b>	8	4.2.5	Infractions included: - Vent sections not securely joined - Insufficient slope toward vent - Improper vent material employed One case was considered an imminent hazard due to the history of the furnace.
<b>Vent and/or vent connector too large</b>	16	4.2.2.4	6 of these 16 infractions were considered significant. 9 of these installations were completed after 2000.
<b>Barometric damper improperly installed</b>	10	4.2.7.1 4.2.7.3	Infractions included: - Damper not level and vertical - Damper stuck closed - Damper not installed (4 cases) Nine of these cases were considered significant infractions.
<b>Return air opening too close to furnace</b>	4	14.3.2	All 4 of these infractions were considered significant. This condition may starve the burner of air or cause flue gas spillage.
<b>Electrical wiring does not meet Code requirements</b>	1	3.7	Emergency disconnect switch in wrong location or missing

**Discussion of  
Appliance  
Inspection  
Results  
(continued)**

Type of infraction	Number of sites	Code Reference	Comments
<b>Appliances not maintained annually</b>	18	14.2.1	Annual maintenance was not conducted on 20 of the 45 sites that required annual maintenance (6 of the 51 sites had appliances that were recently installed). This represents a 45% non-compliance rate.  6 of these infractions were considered significant since the appliances had either never been maintained or showed obvious signs of problems due to lack of maintenance.
<b>No air supply or improperly sized air supply to appliances</b>	16	4.4.2.1	4 of these 16 infractions were considered significant since they were in confined spaces or in newer, more tightly constructed houses.
<b>Safety controls not properly installed or not functioning</b>	3	3.1.1	In two cases high limits were missing and in the third case the high limit was not functioning properly.
Appliance retrofitted with unapproved burner.	5	3.1.1	All cases involved upgrades to older burners and controls. Although Codes prior to 1991 allowed this activity under strict guidelines, it is worth highlighting as a minor infraction since it affects the approval of an appliance as discussed in the next row.
No rating plate on appliance	2	3.1.1	This 1960's vintage boiler had no signs of a rating plate having ever been installed. The lack of a rating plate calls into question whether the appliance was tested and approved to a recognized safety standard.
Pressure relief on boiler improperly installed	1		

## Conclusions and Comparisons

The July 2008 inspection survey of 51 oil heating equipment installations in the Yukon identified 316 infractions of the B139 Code of which 152 were considered to be significant concerns that either posed an imminent hazard (7 cases) or could reasonably be expected to develop into a problem in the future. The average number of code infractions per site was 6.2 and the average number of significant infractions was 3.0 per site.

Based on the writer's experience (see Appendix D for details), the number and nature of the infractions indicate that a significant portion of oil heat users are not aware of the legal and practical need for annual maintenance of oil-burning equipment and that the oil heating industry is not responding responsibly to self-regulation as required in the Yukon. Although there are good installations, technicians, and contractors, a large number of oil heating installations are in non-compliance with minimum safety and efficiency standards.

Based on discussions held with home owners, oil burner technicians, and heating contractors while conducting the inspections and during various courses in the Yukon, there is a general lack of knowledge of code requirements and practical issues related to the safety and efficiency of oil burning equipment.

Those discussions have also indicated that the lack of incentive, consequences, and/or opportunity to become licenced as Oil Burner Mechanics are important factors in regards to this general lack of knowledge. The lack of consequences for not complying with the code requirements has been identified by a number of technicians, contractors, and users as a major cause of the problems found at new and old installations.

**The major safety and efficiency issues identified by this survey and listed in order of importance are:**

- 1. Lack of maintenance.**
- 2. No indication that the installers or service technicians are trained and qualified as licenced Oil Burner Mechanics.**
- 3. 40% of the appliances were improperly set up for safe, efficient combustion.**
- 4. Oversized and improperly installed vents.**
- 5. Clearance to combustible material is not maintained.**
- 6. Aboveground tanks not installed properly to prevent internal corrosion or damage to outlet piping.**

- 7. Aboveground tanks not secured to prevent toppling or damage due to a seismic event even though Whitehorse is listed as an earthquake zone.**
- 8. Lack of monitoring of underground tanks for leakage and corrosion.**
- 9. Appliances and tanks without rating plates indicating that they have not been tested and approved to recognized standards.**

I trust that this report meets with your approval. Please do not hesitate to contact me to discuss any of the issues raised in this report.

NRG Resources Inc. is committed to assisting the Yukon in its goal to achieve safer, more efficient oil-burning equipment installations.

Yours Sincerely,



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