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Domestic Hot Water Tanks as Space Heating Appliances

Technical Series 90-226

Key Messages

- With today's more energy efficient northern houses, the DHW load is beginning to exceed the space heating load. This opens the potential to use the DHW heater for both space and water heating.
- Advantages:
  - DHW tanks are less expensive to buy, install and maintain than boilers
  - DHW tanks use less space
  - Suitable for use with both hydronic and forced air distribution systems
- Disadvantages:
  - energy costs may be higher because DHW heaters are less efficient than boilers
- In Yellowknife, 3 DHW tanks in use for 6 years were examined and showed only typical wear for their age.
- The study recommended that CSA Standard B-140-12 be revised to approve DHW tanks as combined space and water heaters and that manufacturers improve the efficiency and lifespan of the equipment.

Introduction

Significant reductions in space heating loads have occurred with the move towards energy efficient housing. When the Northwest Territories Housing Corporation (NWTHC) upgraded the insulation levels in their residential units, they found the domestic hot water load was beginning to exceed the space heating load. Since half of their inventory is heated with hydronic systems, the Corporation received a temporary Code exemption to test the use of hot water tanks for both types of heating requirements.

Hot water tanks are less expensive to buy, install and maintain than boilers, so a study was commissioned to investigate the potential for using domestic hot water (DHW) tanks as both a space heating and domestic hot water appliance. At the time of commissioning the study, the NWTHC had installed 40 to 50 systems. In order to install additional systems, a revision to the existing code would have to be approved by the

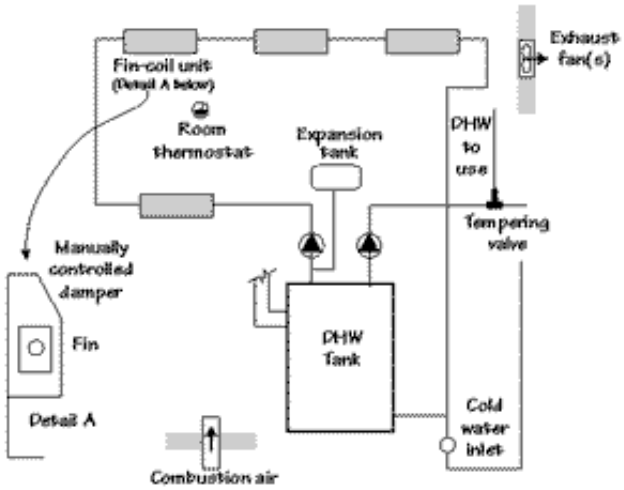
Canadian Standards Association. Before proceeding with a revision request, NWTHC wanted to check the condition of the existing systems in order to gauge the life expectancy of tanks in continuous use, and to determine the effect of premature deterioration on the cost effectiveness of this type of system.

The objectives of the study were to:

1. Review the relevant codes and standards to determine the impediments to approving DHW tanks as combination space and hot water appliances.
2. Analyze the cost effectiveness of utilizing DHW tanks as space heating appliances in the Northwest Territories.
3. Dissect DHW tanks which had been serving as combination appliances for several years and assess their state and condition.

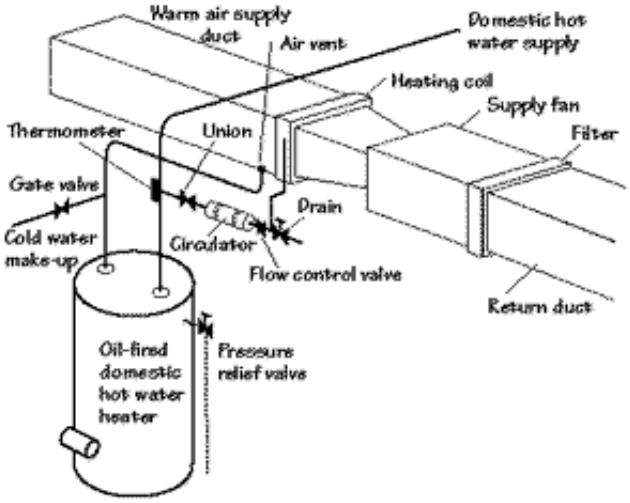
System Configurations

Figure 1 illustrates a hydronic domestic hot water and space heating system. The DHW tank takes the place of the boiler in a conventional hydronic heating system. Two heating distribution loops circulate hot water from the DHW tank to fin coil units for space heating, and to house faucets and appliances for domestic use.



Enlarged Image

The DHW tank can be used in another system configuration to provide space heating as shown in Figure 2. This system consists of the oil-fired DHW tank and heater, a fan and a heating coil. When the room thermostat calls for heat, it starts the heat circulator and the supply air fan. Hot water from the heater is circulated to the heating coil and back to the heater. The supply fan heats the building by blowing room air through the coil. The domestic hot water is supplied by the heater in the conventional fashion.



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Although the forced air DHW heating system has seen only limited application in the North, it is easy to install and takes up very little floor area because the fan and coil are normally suspended from the ceiling. The cost compares favourably with other standard systems.

Codes and Standards

The study found that there was a clear distinction in codes and standards with reference to appliances serving as domestic hot water appliances and those providing space heating. Historically, boilers were deemed the appliance of choice for space heating because of their higher efficiencies and ability to meet the typical heating requirements of the house. In addition, because boilers are designed to run continuously over extended periods, several safety features have been built into their design. Until recently, there has been no strong motivation for the approval of DHW tanks as space heating appliances. Recently, the use of DHW tanks as auxiliary heating appliances has become popular in Alberta. As a result, there is pressure in Alberta to develop a guideline for installing DHW units for this application.

Cost Effectiveness

Several factors must be considered when choosing and costing a heating system. These include:

- the cost for initial system purchase
- the cost to transport the system to the site
- the cost to install the system
- equipment efficiency and operating costs
- the cost to maintain the system including availability of parts and qualified repair personnel
- replacement frequency and costs
- how much space the system requires.
- dispersed structures, or

Equipment Costs
Domestic hot water tanks are less expensive to purchase, and because they are lighter than a boiler or furnace system they are cheaper to ship. The hot water tanks also require less floor space which can impact the

cost of construction. The initial costs for a DHW heating system in the Yellowknife area are approximately $2,225 (1989 $s) less than the costs for a conventional boiler system. These costs include:

	BOILER	DHW TANK
Capital Cost	$4,334	$2,324
Installation Cost	300	160
Shipping Cost	120	45
Total	$4,754	$2,529

Energy Costs
Boilers are about 79% efficient, while domestic hot water heaters are about 58% efficient. From the analysis of fuel consumption records, and taking into account the difference in efficiencies between boilers and DHW tanks, it appears that the use of the boiler could save about $360/year in energy costs over the DHW tank. A simple payback of six years is required to recover the initial capital investment for the boiler system.

Maintenance Costs
Maintenance costs are affected by the level of expertise required to make repairs or replacement. Parts for domestic hot water tanks are readily available and can easily be shipped and installed. However, repairs to any system will be costly if a specially trained technician must be brought to site from any distance.

In a 410 house sample, over a ten month period NWTHC estimated the average cost for maintenance was $280/unit. The breakdown of this cost is as follows:

Boiler maintenance cost	$242/unit
Furnace maintenance cost	298/unit
DHW tank maintenance cost	90/unit

The figure for the domestic hot water tank applies to conventionally utilized tanks and includes maintenance costs on other large household appliances.

Inspection Findings and Conclusions

Three domestic hot water tanks that had been in service for six years for both hot water and space heating were investigated. The two-storey houses that these units served are located in Yellowknife and have approximately 120 square metres of living area. Insulation values for the floor, walls and ceiling of these houses are RSI 7, RSI 4.7 and RSI 10 respectively. The homes have no basements, being elevated off the ground and supported on piles.

The houses are heated with oil-fired domestic hot water tanks which

service two zones. Each zone has a radiant baseboard loop of 27 to 30 metres in length. There are a total of ten radiant baseboard elements extending 17.5 metres along the exterior wall.

Two of the tanks were cut open at the mid-line and inspected by local authorities. The third tank was sent to the manufacturer for a complete examination. A section of adjacent piping was also removed and inspected. The water from the Yellowknife area was tested for corrosive qualities as this could play a significant role in the deterioration of the hot water tank.

The following components of the tank were closely inspected: anodes, steel tank, glass liner, thermostat, fire pot, flue baffle and electrodes.

All of these components showed signs of typical wear for their service age, but were deemed to be in good condition.

There was a 3 to 5 mm (0.1 to 0.2 in.) build-up of rust-coloured sediment on the bottom of the tank. The siphon hole, pressure relief valve and the thermostat were clear of sediment. Pipe sections of each of thin gauge radiant line and standard gauge copper line were inspected and showed no wear or sediment build-up. The water supply of Yellowknife, although considered corrosive, did not seem to have a significant effect on the tanks.

Recommendations

It was recommended that the Canadian Standards Association be approached to revise CSA B-140.12 titled "Oil Fired Service Water Heaters". As of March 1995, oil-fired domestic hot water heaters have not been approved for space heating.

Manufacturers of domestic hot water tanks should make design improvements in the area of efficiency and life span of the tanks. Side wall venting should also be incorporated into future designs.

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