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The following pages will outline a case study, which shows the benefits in energy and cost savings of properly installed mechanical insulation.

Insulation is a proven means for conserving energy, reducing greenhouse gas emissions, increasing process productivity, providing a safer and more productive work environment, controlling condensation (which can lead to mold growth), supporting sustainable design technology and a host of other benefits.

Mechanical insulation does all of this, while providing a return on investment (ROI) rate, which is seldom rivaled. Despite the proven ROI, insulation is often overlooked and its benefits undervalued. Insulation is truly the lost or forgotten technology. Can you think of a more important time than now to think about how insulation can help you?

An insulation system is a technology, which needs to be engineered and maintained throughout the entire process. Several studies have estimated roughly 10 to 30 percent of all installed insulation is now missing or damaged.

The practice of not replacing or maintaining an insulation system in a timely and correct manner reduces the full benefits of insulation, and in return, decreases the ROI. In many cases, significant other issues - such as excessive energy loss, corrosion under insulation (CUI), mold development, increased cost of operations and reduced process productivity or efficiency - develop.

You can learn more on [www.MechanicalInsulatorsLMCT.com](http://www.MechanicalInsulatorsLMCT.com), where additional case studies can be viewed.

Please do not hesitate to contact me should you have any additional questions.  
Thank you,

Peter Ielimi

Executive Director  
Mechanical Insulators Labor Management Cooperative Trust



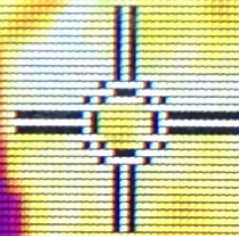
# SALAMANDER INSPECTIONS LTD

Mechanical Insulation Energy Audits

## Energy Audit

For Royal Tyrell Museum  
1500 – Dinosaur Trail  
Drumheller, Alberta

April 14, 2016



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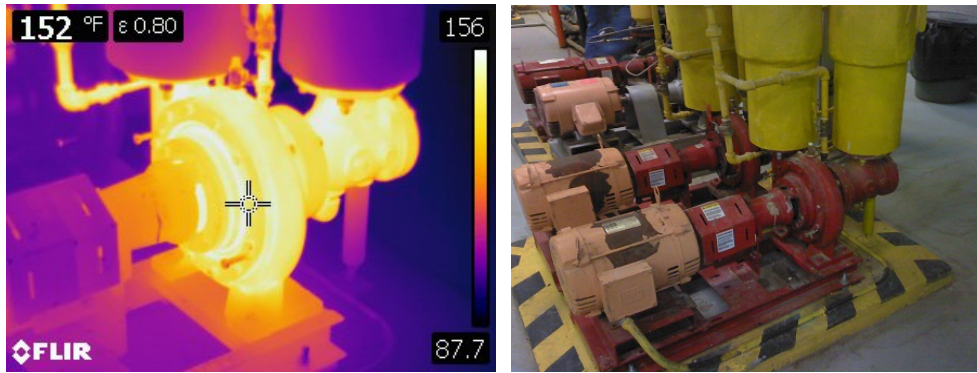
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Heating pumps located in the Boiler Room of the Royal Tyrell Museum

## About Salamander Inspections and the FLIR Thermographic Camera

Salamander Inspections Ltd. is a third party inspection service providing energy audits for mechanical insulation systems in the Commercial/Institutional sector. We are utilizing a state of the art FLIR thermographic camera to provide us with accurate measurements and photographs of heat loss and gain on mechanical systems within the scope of work determined by our clients.

This heating pump, as photographed by the FLIR camera uses sensors within the camera to show the heat radiating from the valve. The brighter the color the hotter the temperature of the object. The camera must be set up to filter out the ambient heat from surrounding objects to ensure that the temperatures are accurate. The camera then takes a thermal image as well as a digital picture for reference.

## Methodology

The audit was performed by systematically inspecting the condition of all mechanical systems within the scope of work. The type of system, condition, temperature and footage was recorded and used to determine outcomes that will be beneficial to the operation of the building. The areas targeted within the scope of work have been checked using a FLIR digital thermal imaging camera which shows clearly problem areas that may not be seen with the naked eye. The photographs clearly show the areas of concern which can be addressed by applying mechanical insulation products.

## Executive Summary

The Royal Tyrell Museum is located at 1500 N Dinosaur Trail, Drumheller Alberta and is a premier museum exhibiting prehistoric artifacts from the local area.

Salamander Inspections has performed an energy audit of the heating system within the Boiler Room and two separate Mechanical Fan Rooms. The purpose of the audit was to determine the current state of mechanical insulation applied to the systems. These are the two areas within our scope of work.



There are some areas where pumps, valves, heat exchanger and piping remain without insulation applied.

**We are pleased to tell you that if all areas within this report are addressed Royal Tyrell Museum will save 759 GJ per year saving \$3,039.52. The cost associated with the insulation of items contained within this report is \$7,104.46 with a ROI of approximately 2.33 years. *The insulation costs do not include the finish ie: PVC elbows or PVC finish. The ROI is determined by dividing the costs by the savings.***

**We have calculated from the 759 GJ savings a 37.7 Mt reduction of CO2 emissions. There will also be a reduction of NOx emissions from 7.73 Mt to .676 Mt per year.**

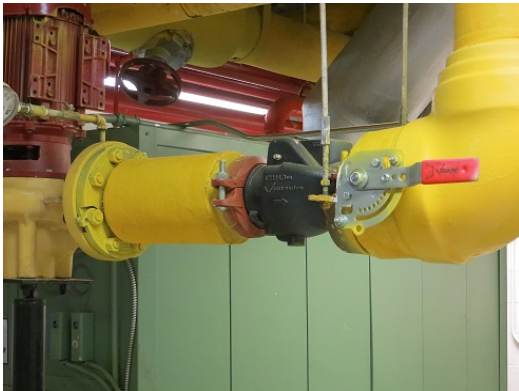
## Boiler Room

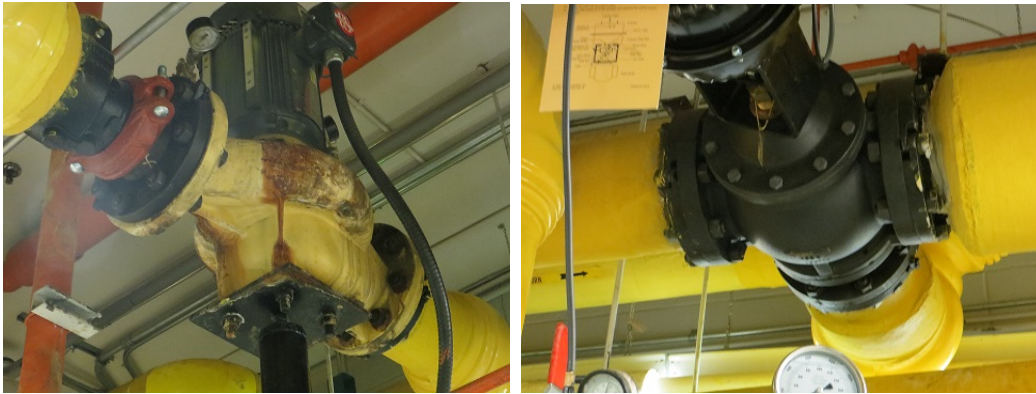
We have assessed the boiler room and found that the insulation applied to the mechanical systems is in good condition. However, there are some instances where pumps, valves and piping have no insulation applied and therefore, an opportunity to receive some savings is available. During the course of this inspection we counted at least (22) valves, (7) strainers, (10) pumps with numerous other areas which need to be insulated. There are areas where the pipe covering has broken down from leaks in the system or another means. This pipe covering has now some amount of which appears to be black mold forming on the cladding. **This boiler room comprises 98% of items contained on the 3e spreadsheet.**

The workmanship of the existing insulation is good but there are some bad practices that were followed when these materials were installed. There isn't a reason to not insulate valves, pumps, flanges and or fittings but to achieve cost savings at the time of construction or a specification which allowed these practices to take place. When maintenance has taken place there is evidence that insulation materials are not being replaced such as the piping off the domestic hot water tanks. We can now show that not insulating pipes hot or cold will cost money for the operation of the building and or repairs to equipment and piping. The report contains visual inspection of these systems utilizing thermographic analysis and conventional digital photographs for reference.







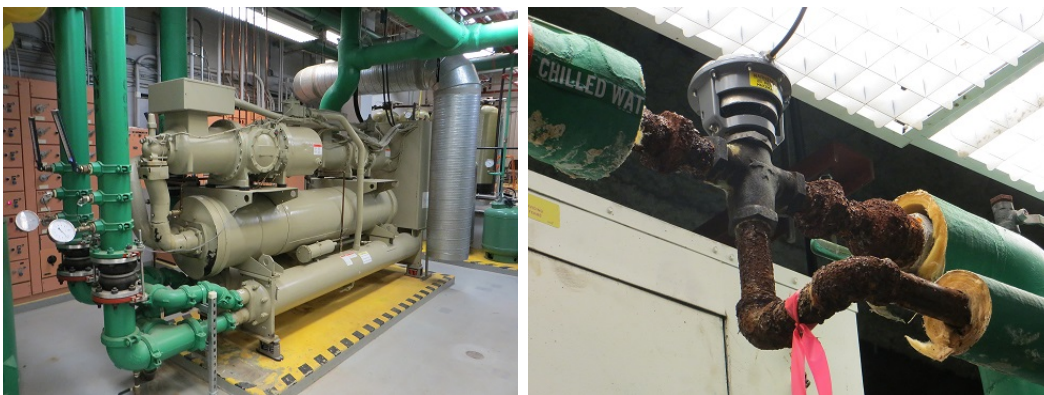


### **Condenser Water Piping**

During the inspection of the boiler room we noticed that the condenser water piping was not insulated. This type of system normally runs between 21 C and 32 C so we feel that there are savings to be had by insulating this system but ASHRAE 90.1 – 2010 suggests that insulating would be unnecessary because of the temperature range. If the temperature of this system goes above 40°C we would recommend insulating this system.

### **Chilled System**

Upon inspection of the chilled system within the boiler room we found 30 plus areas where what appears to be black mold on the surface of the canvas cladding. We have also seen there are areas where the insulation has been missing for some time and the piping has become corroded and will probably need to be replaced. It is our opinion that any area where the vapor barrier has been compromised that further inspection is done to ascertain the condition of the piping.





## Fan Room – 244.0

We have inspected the mechanical fan room and found the same experience of missing insulation on the valves, pumps and newly installed piping in fan room 244.0. The pictures show the valves, piping and heat exchanger head without insulation.



## Personnel Protection

We also would like to address the hazards that the hot exposed items present to personnel. The boiler rooms and fan rooms generally are tightly packed with equipment and piping systems operating up to 121°C, the systems and equipment which are not insulated leave many opportunities for employees and maintenance personnel to come in contact with these surfaces which can burn skin. Properly insulated systems and equipment eliminate the possibility of individuals coming into contact with these hot surfaces and will prevent accidental burns which will add value by individuals not having claims and or lost time incidents.



## Firestopping

During the course of our inspection wherever mechanical systems passed through walls we saw that the fire/smoke protection systems (firestopping) was damaged and incomplete in many areas. We highly recommend that this be further inspected and if necessary repaired or replaced so that the systems are integral.



The following is a list of calculations using energy calculators and the known cost of fuel. The heat loss number (BTU) is derived from the 3EPlus spreadsheet using the information gathered during the site visits, known temperatures, and the measurements of known missing and or damaged insulation.

### Energy Calculations

Royal Tyrell Museum	Heating system cycle @ 6600 hours operation	Boiler room and fan rooms
Heat Loss per hour	109,527 btu	
@24 hrs	2,628,648 btu	
@31 days	78,859,440 btu	
<b>total</b>	<b>83.20 GJ @ 1 month</b>	<b>5 months = 416 GJ</b>
Heat Loss per hour	109,527 btu	
@24hrs	2,628,648 btu	
@30 days	81,488,088 btu	
<b>total</b>	<b>85.97 GJ @ 1 month</b>	<b>4 months = 343.88 GJ</b>
	<b>total</b>	<b>759.88GJ</b>
	Cost of fuel	<b>&amp; \$ 4.00/GJ</b>
	<b>Savings per year</b>	<b>\$3,039.52</b>

## Insulation Materials

This is a list of materials needed to insulate areas noted during our inspection, these are used as input for the 3EPlus spreadsheet for heat loss calculations. The insulation costs are estimates only and should not be used as actual costs.

piping		1/2" iron @ 9 ft	\$15.93
piping		1" @ 3 ft	\$6.48
Piping		1 ½ " @ 15 ft	\$71.85
Piping		2" @ 89 ft	\$455.68
Piping		2 1/2" @ 3 ft	\$16.83
Piping		3" @ 33	\$201.30
Piping		4" @ 3 ft	\$21.12
Piping		6" @ 202 ft	\$1779.62
Piping		8" @ 14.33 ft	\$154.62
Piping		12" @ 4 ft	\$59.12
Elbows	24	6" @ 3 ft per elbow	\$211.44
Strainers	2	6" @ 11.16 ft	\$98.31
Valves	6	6" @ 33.48 ft	\$294.95
Pumps	2	8" @ 4 ft	\$43.16
Strainer	2	8" @ 11.94 ft	\$ 129.04
Valves	11	10" @ 6.38 ft	\$ 926.37
Tees	4	6" @ 9 ft	\$ 79.29
Tees	7	8" @ 9 ft	\$ 97.11
Tees	2	4" @ 6 ft	\$ 42.24
<b>Total materials cost</b>		<b>1 ½ wall material</b>	<b>\$4,704.46</b>
<b>Work days</b>		<b>7@ \$400 per day</b>	<b>\$2,800.00</b>
<b>Total materials &amp; labor</b>			<b>\$ 7,504.46</b>

The calculations from the spreadsheet indicate that if mechanical insulation were to be applied to all areas that are highlighted by this report energy cost savings would be realized. We also recommend that insulation be reapplied to equipment so as to increase its longevity and the time between service intervals.



## Recommendations and Conclusions

Upon consideration of all observed conditions and the information gathered from the 3EPlus program, we recommend that all areas identified within this report be insulated or repaired. We also recommend that **Best Practices** be followed when applying insulation to these items as any deviation from applying insulation will reduce any potential savings. For example, we know that the elimination of canvas can shorten the lifespan of fiberglass with an ASJ finish because of the lack of a protective cladding system. We also recommend using removable insulating pads where necessary or feasible. This will allow maintenance to take place by removing the insulation pad whenever maintenance needs to take place.

If all areas are addressed, you will receive:

- 1) Reduction of heat loss - **1,125 GJ**
- 2) Cost savings derived through properly insulated piping, valves, strainers and equipment - **\$4,500**
- 3) Potential savings on maintenance costs for equipment
- 4) Elimination of personal protection hazards

## Disclosure

We have no relevant financial or non-financial relationships to disclose.

## Limitations

We have used information provided to us from various sources but information such as operational heating cycles and cooling cycles are based on conversations with maintenance personnel.

## Disclaimer

Results stated in this report are estimated and based upon the data supplied or determined during the audit process. Only the previously agreed to areas have been included in this report. These results are not covered by warranty nor are they guaranteed. The results are intended to portray a reasonable estimate of potential energy savings and emissions reduction with the use of an upgraded and maintained insulation system.

Please contact the undersigned should you have questions about this report.

Best regards,

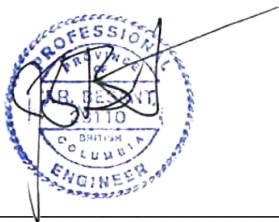
Report prepared by:  
Salamander Inspections



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Bob Barter (Project Coordinator)

Reviewed by:  
Besant and Associates Engineers Ltd.



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Jeff Besant, MBA, P.Eng.



## PHOTOGRAPHS