

January 20, 2015

CL4 Inc.
487 Baker Street
London, ON
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Attn: Mr. Larry Whitty

Re: Engineering Evaluation of Emergency Generator Metallic Fuel Pipe Fire Protection System

Introduction

QAI Laboratories conducted an engineering evaluation for CL4 Inc. The objective of the evaluation was to determine if the CL4 Fire * - Fire Protective Thermal Insulation - protection system for metallic fuel pipe, will provide a 2 Hour fire resistance rating.

The requirement that addresses the protection of emergency generator fuel supply lines is CSA Standard 282-09 *Standard for Emergency Electrical Power Supply for Buildings*. The intent of the requirement is that the emergency generator will remain in operation to supply power for emergency lighting and other life safety systems in the event of a fire that damages the main power supply to the building. A 2 Hour fire rating is required for the protection of the fuel supply lines. This requirement did not consider that there is no test method or standard that has been developed to specifically address how to determine the fire resistance rating of a fuel line protection system. In addressing the requirement one must consider the primary objective, which is to keep the fuel supply intact so the generator can continue to operate. When the fuel line passes through a fire compartment, the protection system needs to ensure that the fuel remains cool enough that it does not boil. If the fuel boils then the fuel flow will be stopped as a result of vapour lock. The length of pipe and the fuel flow rate shall be considered as the fuel will eventually reach the boiling point of 370 °F when the pipe run is exposed to fire in a fire compartment.

The standard time temperature curve for fire exposure used for building construction and materials is defined in the fire test standards referenced by the building Codes as follows; ASTM E 119, NFPA 251, and CAN/ULC S101. The same time/temperature curve is used in all test methods that address fire resistance expressed as an hourly rating. It is appropriate to use the same exposure curve when evaluating the generator fuel supply pipe fire resistance.



Discussion

The CL4 Fire*- fire protective thermal insulation - protection system for fuel lines was evaluated in a fire test using the fire exposure of CAN/ULC S101, ASTM E 119 and NFPA 251. A length of pipe passed through the furnace, and was insulated using the CL4 protection system. For safety reasons water was used to flow through the pipe at a slow rate so that the temperature rise of the water could be recorded for the 2 Hour fire exposure duration. This data resulted in the determination of heat flux factors that were then used in a mathematical model to determine the temperature increase in flowing fluid within the pipe, depending on pipe size. Length of pipe exposed to the fire condition and fluid type (eg. water, diesel fuel etc.) The design on the following page was developed based on the outcome of the analysis. The installation method was modified by increasing the overall protection system thickness providing a conservative outcome that is less sensitive to installation quality.

Conclusion

The evaluation of the CL4 Fire*- Fire Protective Thermal Insulation for fuel supply metallic piping using two layers of insulation wrap with joints staggered as shown in the enclosed design, will provide up to 2 hours of fire resistance. The fire resistance design ensures that for the specified metallic pipe diameter, and maximum length that passes through a fire compartment, the diesel fuel will not boil, so that the fuel supply to the emergency power supply generator is maintained for up to 2 Hours of fire exposure, as required by CSA 282-09.

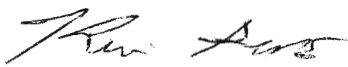
Signatures

Reported By:



Mike van Geyn, A.Sc.T.

Reviewed By:



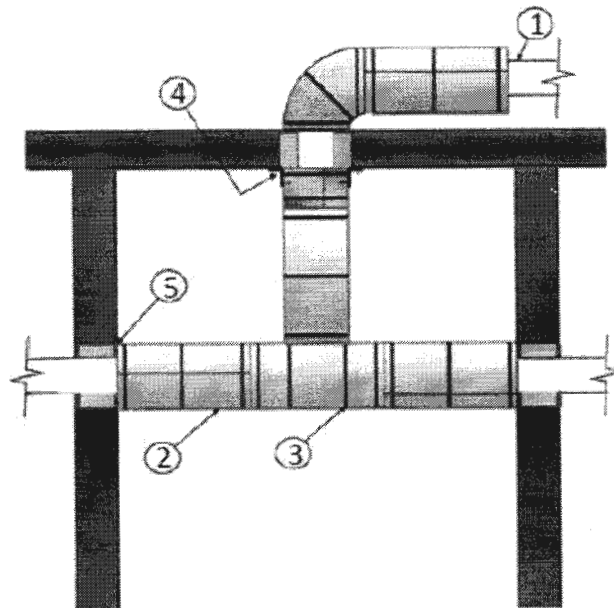
Kevin Saito, P. Eng.

CL4 Inc. Reference Number PPI 12001

FUEL LINE PROTECTION SYSTEM

CL4 Inc. System Design for Maintaining Fuel Flow for 1 and 2-Hours:

System fire tested to CAN/ULC S101-07 and ASTM E119-08a time/temperature curve a



- 1. Metal Fuel Supply Pipe** such as Diesel Generator Supply Lines – Schedule 40 Steel, Cast iron or Copper in sizes from $\frac{3}{4}$ " to 3" Nominal Pipe Size. Fuel supply lines not specifically required to maintain 2 Hour operation of an emergency generator, are not subject to the length limitations.



2. Table of Pipe Sizes and Fire Exposed Length

Pipe Size (in)	Maximum pipe length (ft) based on 1 layer of CL4FIRE 'Blue' Insulation	Maximum pipe length (ft) based on 2 layer of CL4FIRE 'Red' Insulation
¾	L = 132 x Fuel Flow Rate (GPM)	L = 188 x Fuel Flow Rate (GPM)
1	L = 103 x Fuel Flow Rate (GPM)	L = 148 x Fuel Flow Rate (GPM)
1 ¼	L = 78 x Fuel Flow Rate (GPM)	L = 115 x Fuel Flow Rate (GPM)
1 ½	L = 67 x Fuel Flow Rate (GPM)	L = 100 x Fuel Flow Rate (GPM)
2	L = 52 x Fuel Flow Rate (GPM)	L = 80 x Fuel Flow Rate (GPM)
2 ½	L = 44 x Fuel Flow Rate (GPM)	L = 69 x Fuel Flow Rate (GPM)
3	L = 35 x Fuel Flow Rate (GPM)	L = 56 x Fuel Flow Rate (GPM)

Note: The above table describes the maximum length of fuel supply line that limits the temperature rise of the fuel to 370 °F (Boiling temperature of No 2 Diesel Fuel). An application is to maintain fuel supply to emergency generators for two hours when the fuel supply pipe passes through a fire compartment.

3. Pipe Protection System

CL4 Fire *- Fire Protection Thermal Insulation applied in two layers.

Insulation shall be installed with seams tightly butted. Interior layer of insulation can be temporary installed using filament tape. Minimum 3/8" diameter steel threaded hanging supports are allowed to extend through the insulation but the opening must be snugly sealed with insulation or filled with ½" depth of a listed firestop caulking to a maximum opening size of ¼". Outside joints should be sealed with foil tape having Flamespread/Smoke Developed Ratings of maximum 25/50 in accordance with ASTM E-84 or CAN/ULC S102 for additional integrity. CL4FIRE* may be installed in the longitudinal direction if desired. Alternately, 3 continuous wraps or staggered joint wraps of ½" thick *CL4FIRE Plenum Insulation can be substituted per single layer requirement of standard CL4FIRE*



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3. $\frac{1}{2}$ " wide stainless steel banding installed 1 $\frac{1}{2}$ " away from abutting insulation joints and maximum 12" apart.
4. CL4FIRE® material that tightly abuts the ceiling assembly must be secured within 4" below the ceiling height through the installation of minimum 2 weld pins installed maximum 4" apart around the pipe. Pins are attached to 4" wide sheet metal that is steel banded to the bare pipe using a minimum of 2 bands installed 1 above and 1 below the insulation pins. Alternately, the insulation may be supported by equally spaced steel 'L' shaped brackets fastened to the substrate with steel fasteners and supporting the CL4FIRE insulation with minimum 1" long impaling pins or screws.
5. CL4FIRE insulation must snugly abutt or extend through any listed firestop system on both sides of a concrete or gypsum floor or wall assembly.