

BORIS PRESHELKOV¹
ROSEN BORISOV²
RADOSLAV KARTOV³
MILAN BLAGOJEVIĆ⁴

A STUDY OF DETERMINING SAFE DISTANCES BETWEEN CERAMIC INFRARED GAS HEATERS AND COMBUSTIBLE MATERIALS

^{1,2,3}Academy at The Ministry of the Interior in Sofia, Fire Safety and Civil Protection Faculty
⁴University of Nis, Faculty of occupational safety

¹*bpreshelkov@abv.bg*

²*r_borisov_23@abv.bg*

³*r_kurtov@abv.bg*

⁴*milan.fax@gmail.com*

Abstract: *This is a study of determining the safe distances between combustible materials and ceramic infrared gas heaters. It contains general information about infrared heating, information about the experimental set-up and the results of the study.*

Key words: infrared gas heaters, safe distances.

INTRODUCTION

An infrared heater uses wavelengths of infrared light to generate heat. Infrared light is not visible to the naked eye because it is not part of the spectrum of light you can see. Unlike traditional heaters, infrared does not heat the air; it heats objects, which then warm the air by contact. Infrared heaters are efficient and cost-effective, though they are not ideal for heating an entire home since they only heat objects in their direct vicinity. They are most commonly used in large open spaces, like warehouses or garages, as a means to offset the loss of heat from large open doors [3, 4, 6, 7, 8, 9, 12].

Safety

For better safety keep infrared heaters at least three feet away from any combustible material. The majority of the body of the heater stays cool and does not present a burning hazard. While it is thought that the radiation from infrared heaters is dangerous, there is no scientific evidence that infrared rays are damaging without ultraviolet light.

According to the Infrared Heaters website, infrared heaters are one of the safest forms of heating sources. Infrared heaters are powered by a variety of fuel, including propane, electricity and natural gas.

The Infrared Heater Safety Council (IHSC) reports infrared heaters should be kept a safe distance from combustible materials, such as paper, wood and fabrics. The risk of fire can be reduced by following instructions for the safe distance to place heaters from combustible materials usually found in the manufacturer's manual [5].

Installation

Proper installation of infrared heaters can reduce the risk to the safety of an operator or property. The IHSC reports installation of heating equipment following

construction codes and guidelines can reduce the risk of leaks, improper heating ignition and fire [5].

Materials

Some of the polymeric materials - low density polyethylene, polystyrene, polyvinyl chloride etc., began to lose its beneficial properties when heated to temperatures higher than 60 °C. Therefore the research is accepted as critical temperature of 60 °C [1].

Use

Infrared heaters are used under different circumstances than central air heaters which make up the majority of heaters in modern housing. Infrared heaters give direct heat vs. central air heaters, which heat the air within a room; therefore, infrared heating is useful in a variety of circumstances, such as within open rooms or outside. The major disadvantage of infrared heaters is that they are relatively useless in heating anything outside of the direct area around the heater. Since they only provide direct heat on objects around them, it is difficult to use a single heater to heat an entire household.

Infrared heaters offer more localized options for heating areas around homes and businesses. A large automotive repair shop can use these heaters at each lift where a mechanic works, rather than attempting to heat the entire shop. The same principle applies to heating an outdoor patio [2,5].

Safety regulations

This type of heating appliances are becoming growingly popular in Bulgaria hence new safety regulations are required, similar to the ones In NFPA 54 ANSI Z223.1-2002 National Fuel Gas Code 2002 Edition. Below is an extract from that code[10]:

9.18 Infrared Heaters.

9.18.1 Support. Suspended-type infrared heaters shall be fixed in position independent of gas and electric

supply lines. Hangers and brackets shall be of noncombustible material. Heaters subject to vibration shall be provided with vibration-isolating hangers.

9.18.2 Clearance. The installation of infrared heaters shall meet the following clearance requirements:

- (1) Listed heaters shall be installed with clearances from combustible material in accordance with their listing and the manufacturers' instructions.
- (2) Unlisted heaters shall be installed in accordance with clearances from combustible material acceptable to the authority having jurisdiction.
- (3) In locations used for the storage of combustible materials, signs shall be posted to specify the maximum permissible stacking height to maintain required clearances from the heater to the combustibles.

9.18.3 Combustion and Ventilation Air.

9.18.3.1 Where unvented infrared heaters are used, natural or mechanical means shall be provided to supply and exhaust at least 4 ft³/min/1000 Btu/hr. (0.38 m³/min/kW) input of installed heaters.

9.18.3.2 Exhaust openings for removing flue products shall be above the level of the heaters [10].

EXPERIMENTAL SET-UP

A series of experimental trials is required for determining and defining the safety regulations for the use of Infrared Gas Heaters.

An experimental set-up was created in order to conduct the test trials. The set-up consisted of infrared gas heater, 28 ceramic test samples placed around the heater at different distances, LPG supply system and pyrometer for measuring the surface temperature of the samples[11].



Figure 1. Photos of the experimental set-up

During the experimental trials we have used infrared heaters which vary in power. The duration of each trial

varies depending on the time it takes for the sample temperature to stabilize.



Figure 2. Photos of the experimental set-up

At the end of each trial temperature and distance values are collated in a Microsoft Excel file. Upon completion of all trials the data for each sample is extracted, analyzed and presented in a chart format as shown below.

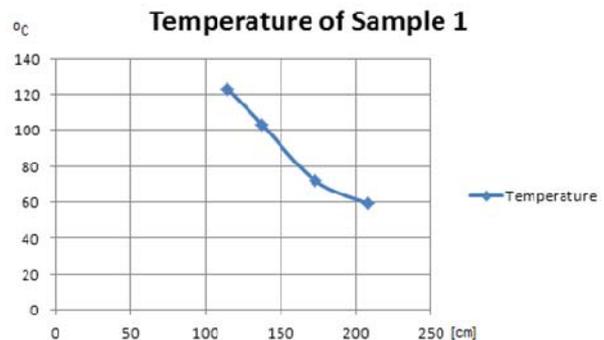


Figure 3. Temperature graph for Sample 1

The individual graphs for each sample are then used for the creation of temperature fields of area surrounding the infrared gas heater.

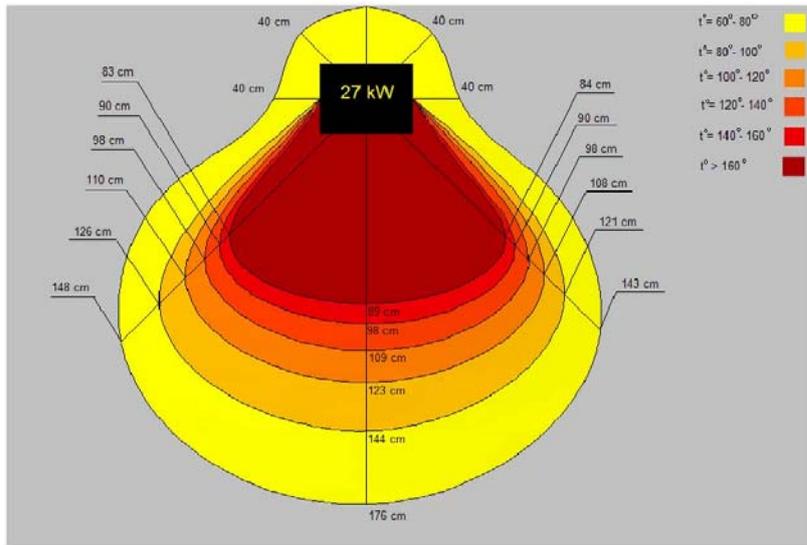


Figure 4. Horizontal Temperature Field at the height of the Infrared Heater

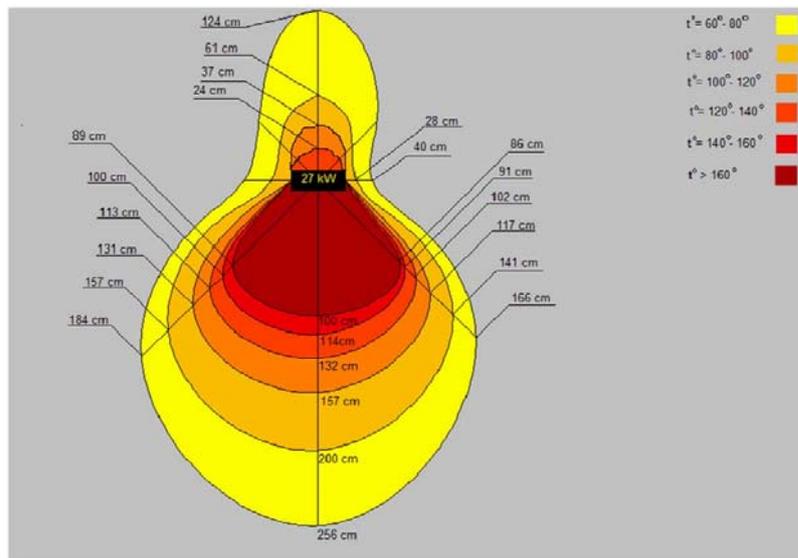


Figure 5. Vertical Temperature Field from a frontal perspective

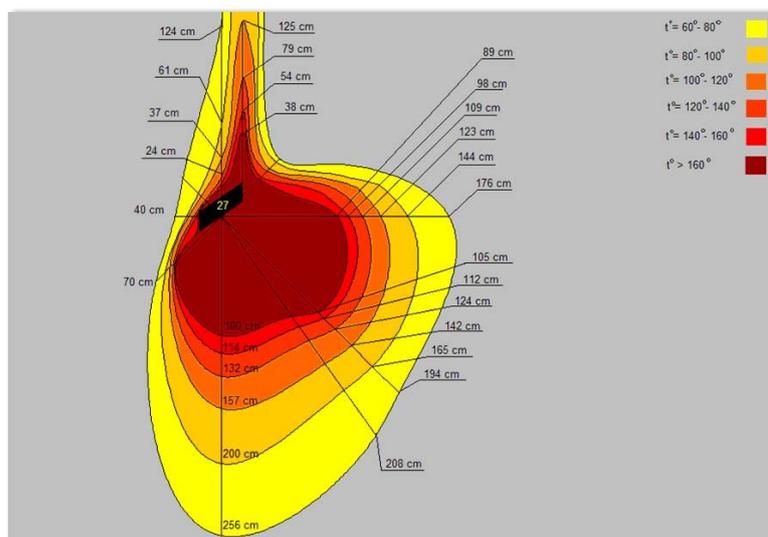


Figure 6. Vertical Temperature Field from a sideways perspective

The experimental trials allow as understand the correlation between the power of the Infrared Heater and the sample temperature.

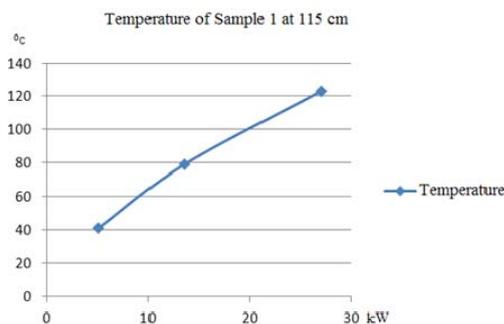


Figure 7. The correlation between the power of the Infrared Heater and the sample temperature.

CONCLUSION

1. As per literature on the topic the safe maximum temperature is considered to be 60°C.
2. Infrared Gas Heaters shall be installed only in high, well ventilated premises and in accordance with the manufacturers’ safety instructions.
3. The minimum safe distances to combustible materials shall be as per the ones in the table.

Table1. The minimum safe distances to combustible materials

Power	Above - A	Side distance- B	Below - C
- 14 kW	110 cm	30 cm	200 cm
14 - 27 kW	130 cm	30 cm	250 cm

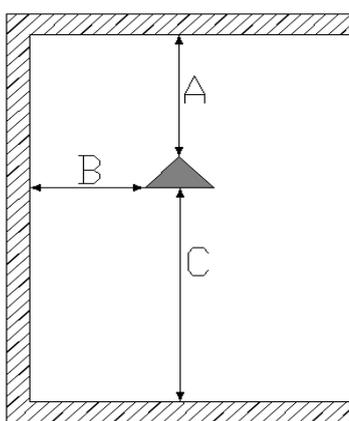


Figure 8. Safety distances

REFERENCES

- [1] Ts. Tsenov: “Construction materials”, Albatros, 1996, Sofia
- [2] <http://web.need.bg/sbm-bg/index.html> - “CBM – Bulgaria“
- [3] Gaz de France, „ Le Gaz Naturel Dans le Locaux Tertiaries de Grand Volume“, Design Media – 1995
- [4] Health and Safety Executive – “Incidents relating to the supply and use of flammable gas” - 2005/06 - 2009/10
- [5] Infrared Heater Safety Council, “Heating safely with gas-fired infrared heaters” – 2008
- [6] Jennifer Flynn, “Natural Gas and LP-Gas Home Structure Fires”, January 2010
- [7] Jennifer Flynn, “Natural Gas and LP-Gas Structure Fires in Properties Other Than Homes”, August 2007
- [8] John R. Hall, “HOME FIRES INVOLVING HEATING EQUIPMENT”, September 2010
- [9] Kenneth J. Tremblay, “Selected Published Fire Incidents Involving Gas Heaters”, November 2006
- [10] National Fire Protection Association, NFPA 54 ANSI Z223.1–2002 National Fuel Gas Code 2002 Edition
- [11] Trotec, “Operating manual TP9”
- [12] Williams S., “About Infrared Heaters

BIOGRAPHY

Boris Preshelkov was born in Razlog, Bulgaria, in 1970. He received a master degree as engineer of Fire and Emergency Safety from the Academy of Ministry of the Interior, Faculty of Fire Safety and Civil Protection.



His main areas of research include Fire danger of the radiant heat flux, Fire safety of buildings etc. He is currently working as an assistant professor at the Faculty of Fire Safety and Civil protection at the Academy of Ministry of the Interior.