# SPECIFICATIONS ON HOW TO CHOOSE AND USE FLAME SENSORS

## SUPERVISION FLAME DETECTION CIRCUIT

All our flame detection systems utilize either an electrode or UV scanner as flame sensor. The flame sensor circuit has a voltage of 300 Vac to which a direct current component must be added during flame detection. The input circuit adequately filters the continuous voltage and amplifies its signal in order to pilot either mechanical or optical couplers which interface the detection system to the control circuit. These circuits are always independent to guarantee maximum operational safety and protection from electromagnetic fields.

The flame sensor is powered by the two signal power lines obtained from a transformer-separator allowing the flame sensor to operate either on 115V or 230Vac. Moreover it solves the problems of the phase-to-neutral and phase-to-phase systems. The flame sensor has no power line.

## FLAME SENSOR LINES

Due to the low voltage of flame sensors, some measures must be taken to limit the precariousness of the flame detection system. Here are some principles to follow to obtain better results:

- Quite short cable lengths should be aimed at, standard cable length being between 10 to 20 meters. If longer cables are absolutely required follow the following instructions carefully. UV-tubes allow for a little longer cables. 30 to 40 meter long cables do not cause problems. Over 100 meter long cables are not common, therefore specific trials should be made in operating conditions to test their efficiency.

- Cables should be laid in pipes and sheathes as far away as possible from other leads and power cords. Pipes and sheathes should be metallic and earthed, according to directives. If there are many detection lines it is better not to group too many different leads in the same pipe; it is better to use more than one pipe or spacer.

- Unipolar cables should be used, because they are best insulated (>50 MW @ 300V-50Hz) and have lower capacities. Any leakage path may affect the ionization current, attaining the same value. Heat-resistant, insulating, though not impregnating material should be used. The cable size is not significant, nevertheless a diameter of over 1 $mm^2$ is recommended and complies with the directives concerning flame sensors. Shielded cables are not recommended; multipolar cables must not be used.

- The ignition device may affect flame detection, therefore high voltage cables to spark plugs or spark electrodes should be as short as possible. Spark electrodes should be installed as far away as possible from flame rods. The two circuits should be independent.
  Inverting the connections on the primary side of the ignition transformer may be useful, especially when a decrease in the ionization current occurs during ignition. Systems using one electrode for ignition and detection do not have this kind of problems.

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## MAX. RECOMMENDED LENGTHS FOR FLAME SENSOR LINE AND INSULATING MATERIAL

| MATERIAL | MAX. LENGTH (m) | TEMP. (°C) |
|---|---|---|
| PVC (polyvinyl chloride) | | |
| VINOFLEX-VESTOLIT-HOSTALIT-VINNOL | < 50 | - 50 + 105 |
| PE (polyethylene) | | |
| LUPOLEN-HOSTALEN-VESTOLEN | < 100 | - 70 + 80 |
| PA (polyamid) | | |
| NYLON-RILSAN | * | - 55 + 105 |
| PP (polypropylene) | | |
| HOSTALEN PP-NOVOLEN-VESTOLEN | < 100 | - 10 + 90 |
| PTFE (polytetrafluorethylene) | | |
| TEFLON-FUON-HOSTAFLON | < 100 | - 100 + 260 |
| PVF 2 (polyvinylfluorid) | | |
| KYNAR | * | - 30 + 150 |
| EFTE (copolymer of PTFE) | | |
| TEFZEL | < 100 | - 100 + 150 |
| PCTFE (ECTFE polychlortrifluorethylene) | | |
| HALON-POLIFLUORON | < 100 | - 40 + 150 |
| PI (polyamid) | | |
| KAPTON | < 80 | - 90 + 275 |
| PUR (polyurethan) | | |
| VULKOLLAN-CAPROLAN-DESMOPAN | * | - 60 + 90 |
| PS (polystyrene) | | |
| NOVODUR-LURAN-HOSTYREN-VESTYREN | < 100 | - 0 + 65 |
| SiR (silicone rubber) | | |
| SILOPREN-SILIKON | < 100 | - 60 + 180 |
| SBR (styrene butadiene rubber) | | |
| BUNA | < 20 | - 30 + 60 |
| IIR (butyl rubber) | | |
| ENJAY-BUTYL | < 40 | - 60 + 100 |
| CR (polichloroprene) | | |
| NEOPRENE-BAYPREN | * | - 40 + 60 |
| CSM | | |
| HYPALON | * | - 30 + 100 |
| ethylene polymer and vinyl acetate | | |
| LEVAPRENE | < 20 | - 0 + 120 |

* ABSOLUTELY DISCOURAGED

## DETECTION THROUGH ELECTRODE

An electrode (in KANTAL or GLOBAR) immersed in the flame may be used as a flame sensor for flame detection in gas systems in order to exploit the ionizating effect of the flame.
The intensity of the ionization current generally increases in connection to the gas calorific power and to the flame temperature.
Another very important factor is the air/gas ratio: an excess of gas produces very low signals; an excess of air produces moderately high signals.
Those who want to calibrate the burner by controlling the flame signal (only through an electrode) will obtain best results by adjusting the air so as to increase the ionization current to its maximum and then increasing the quantity of air until the flame signal slightly decreases.
The electrode must be detached from the metallic case of the burner. The flame must always touch the electrode during the whole operation.
Usually the surface of the metallic case touched by the flame is 4 to 5 times the surface of the electrode immersed in the flame. Flame detection with two electrodes is impossible. Should the area of the burner touched by the flame be insufficient, additional surfaces may be added, such as blades or small plates welded to the frame.
When one electrode is used both for ignition and detection, make sure it is adequately insulated and there are no discharges on the surface, or between the flanges, because they may result in a non perfect flame detection system.
The flame signal should always be stable; wide fluctuations are symptomatic either of a malfunctioning electrode or burner, or of unbalances caused by an inadequate positioning of the flame sensor line or of insulation defects.
Make sure the system works correctly over the all range of operating temperatures, as the characteristics of some material change when the temperature increases.

## DETECTION THROUGH UV-TUBE

The signals originated by the UV-tube are higher than the ones originated by the electrode. As the UV-tube of the detector reacts only when illuminated with UV-light from 190 to 270 nm band of the spectrum, neither infra-red radiation (glowing fire brick) nor daylight or artificial light can simulate a flame (except for some discharge lamps).
The service life of the tube is approximately 10,000 hours with and ambient temperature of max. 50° C. If necessary cooling of the tube may be obtained through high pressure air or comburent air (not through heat recycling).

When mounting the detector it should be observed that it is directed at the flame and that its "field of vision" is not obstructed or restricted. A protection quartz glass may be used.
The photocell produces quite stable signals. By checking the ionization current, the conditions of the tube may be assessed and replacement of the latter may be programmed in advance.
Too fluctuating signals indicate there are problems in the combustion.