

## **Short Selection Guide for Linearpyrometers LP3, LP4 and LP5**

### **History: Linearpyrometer LP2**

The ancestor of the radiation thermometer types 'Linearpyrometer', which are available today, was the Linearpyrometer LP2. This radiation thermometer was developed at IKE, Stuttgart, in cooperation with Dr. Kunz of PTB Germany. Even the first LP2 with silicon photodiode (August 1981) already had the three decisive design principles which were recently published by others: the 'Lyot' stop, the collimation system for the filter and the partially illuminated photodiode. These design principles led to an excellent Size-Of-Source Effect, ideal application of the filters, and optimum linearity.

### **Properties common to all types**

Due to the outstanding success of the optical design of the LP2, it is continuously applied to this today. The optical principle of the LP3, LP4 and LP5 instruments is the same, but the interference filter system and the electronics is different. An important advance with the LP3 was the development of a compact AD-conversion system for the photocurrent with a resolution in the ppm-range.

An almost **perfect** solution for the front lens is the Apochromate f143, which shows an extremely low dependency of the focal length on the wavelength. Since this apochromate has only 2 glass-air surfaces, the Size-Of-Source Effect is drastically improved compared to a double-achromate lens system.

### **Linearpyrometer LP3 - no longer available**

The LP3 is equipped with two manually operated filter wheels. Each wheel has six places for different interference, glass, or neutral density filters. The LP3 can be optionally equipped with a distance sensor which enables the compensation of the distance effect of the radiation thermometer.

With the LP3, the exchange of the measurement field stop and aperture is relatively simple. This enables its flexible adaptation to a wide range of experimental situations, such as very small targets, extremely narrow pyrometric light path for measurements inside deep holes, extreme distances, polarised measurement etc. Up to 10 different wavelength filters can be applied with two filter wheels. Therefore, the LP3 is even today the best solution for temperature and emissivity measurements in laboratory and industry if remote operation is not required.

## **Linearpyrometer LP4**

The LP4 has one filter wheel with 6 places for filters, which is operated with a stepping motor. Excellent reproducibility of the filter position is obtained with a special snap-on mechanism for the filter wheel. The filter wheel box as well as the complete detection system is temperature stabilised, so that the main sources of thermal drift are eliminated. The improved accuracy of the LP4 will in particular important for its application as (transfer) calibration standard.

The main advantage of the LP4 is that it can be fully remote-operated for automated calibration systems. The LP4 has a built-in distance sensor which enables the compensation of the distance effect of the radiation thermometer.

## **Linearpyrometer LP5**

For international intercomparisons of metrological institutes there is an increasing demand on transfer standards which can be transported within the hand luggage in the aeroplane. For this purpose the LP5 was developed, which is more compact than the LP3 and LP4 (size of LP5 : 138 • 480 • 120 mm). To obtain optimum stability with transport, the LP5 system contains no moveable parts.

The working distance, i.e. the position of the focal plane, is fixed, but it can be adjusted by the user between 0.6 m and infinity if the case of the instrument is opened. Since the distance effect (<1.5%) is not compensated, a recalibration can be necessary after the working distance was changed. The front lens is inside the outer case, so that the front lens is protected better against contamination with dust.

The LP5 has no filter wheel(s). Two filters can be mounted sequentially in the optical path, so that double interference filters or combinations of protection or neutral density filters with wavelength filters can be applied.

Both filters are replaceable to enable the spectral calibration outside the LP5. The aligned aperture stop is mounted on the filter holder, so that the used aperture during spectral calibration and the measurement inside the LP5 is exactly the same. The filter mounting has a good reproducibility.

The complete system, i.e. optics, filters, detector, and the signal electronics, is temperature-stabilised. The LP5 has therefore the best long-term stability of the Linearpyrometer types.

## **Conclusion**

The LP4 is the best solution for an automated measurement system in a calibration laboratory for customer instruments. Due to its superior stability and accuracy, the LP5 is a radiation thermometer especially for metrological applications.