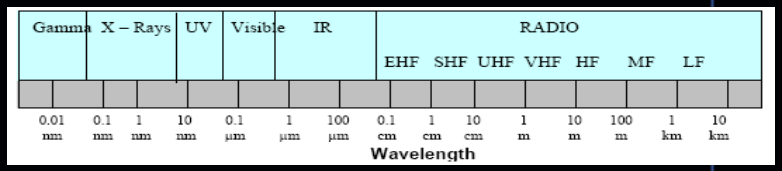
Osnove infracrvenih termovizijskih kamera

Termografija = profilisanje polja temperature na objektu snimanja

Princip: svako telo na temperaturi iznad apsolutne nule zrači IR energiju. IR zračenje je deo elektromagnetnog spektra i zahvata frekventni opseg između vidljivog svetla i radio talasa.

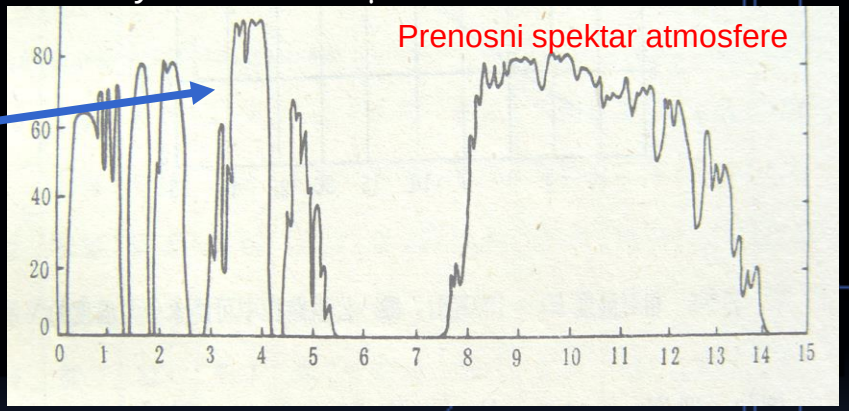


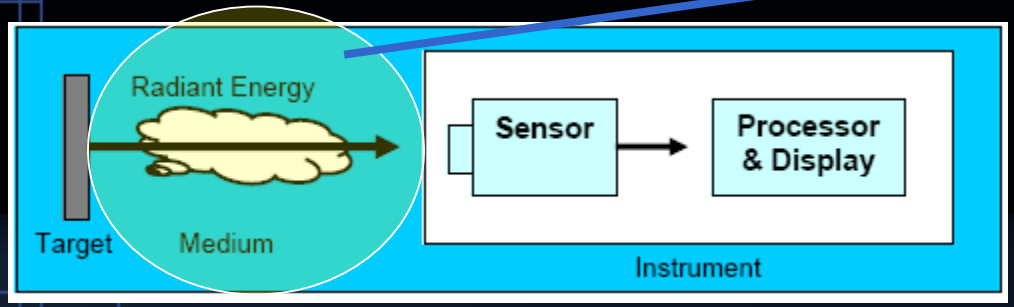
Stefan – Boltzmann z.

$$w = K\sigma(T^4 - T_R^4)$$

w = watts/meter²
σ = Stefan-Boltzmann constant, 5.6697 x 10^{-8} watts/m² – T
T = Absolute temperature, kelvins

Visible light: 0.38~0.78μm
Infrared ray: 0.78~1000μm



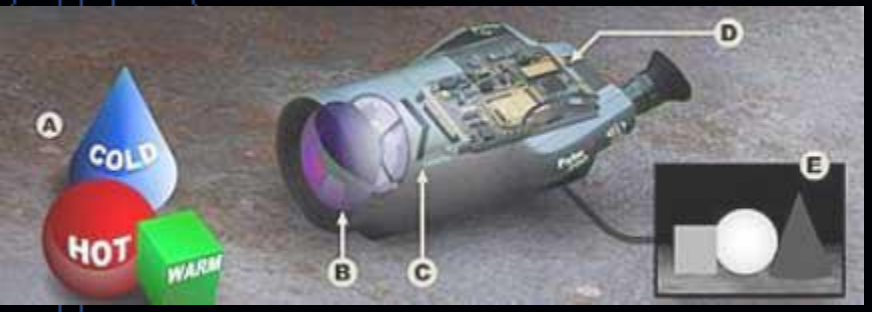


Definisana tri propusna opsega: 1 – 3 μm, 3 – 5 μm, 8 – 14 μm

Sočiva od Silicijuma

Sočiva od Germanijuma

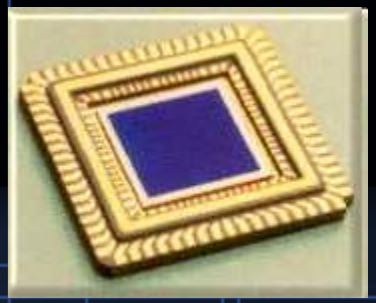
Osnove infracrvenih termovizijskih kamera

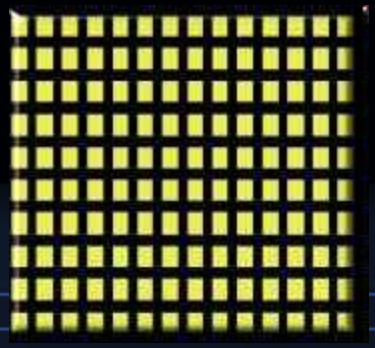


Infracrvena energija sa objekata snimanja A se fokusira korišćenjem sočiva B fokusira na infracrveni detektor C, sa koga se signal dalje vodi na elektroniku za procesiranje slike koja pravi sliku koja se prikazuje na displeju E.

Infracrveni detektor C: najčešće korišćeni prinicip je princip MIKROBOLOMETRA (meri promenu infracrvene energije). MATERIJAL: Vanadium Oxide, Amorfni Silicijum.

IR TERMOMETAR: Snima temperaturu u tačci (Point sighting)
IR KAMERA: profilisanje temperature na 2D površini. Poseduje FPA (FOCAL PLANE ARRAY)

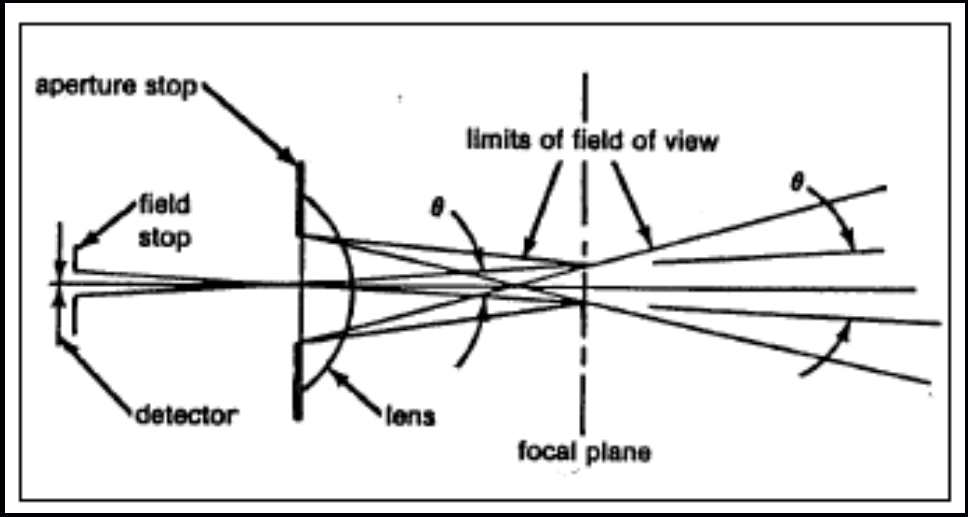




FPA: mreža IR detektora. Najšešće:
WxD = 160 x 120 pixela
WxD = 320 x 240 pixela
FILL FACTOR: kod najboljih modela do 90%

Osnove infracrvenih termovizijskih kamera

FIELD OF VIEW (FOV): polje koje kamera zahvata



U čemu se ogled kvalitet IR kamere?:

1. Kvalitet sočiva (fokus, materijal...)
2. Broj piksela na FPA. Sa identičnim ostalim karakteristikama kamera sa većim brojem piksela je kvalitetnija
3. Elektronika za poboljšavanje slike (u originalu je slika BW a softverski se od nje pravi kolor konturna mapa, mogućnost EKSTRAPOLACIJE itd.)

Osnove infracrvenih termovizijskih kamera

PREDNOST IR termovizije:

1. Beskontaktna tehnika merenja
2. Brza, pouzdana sa veoma tačnim rezultatima merenja
3. Velika površina se može snimiti za veoma kratko vreme
4. Rezultati prezentovani u vizuelnoj i digitalnoj formi
5. Ne zahteva dugotrajnu i komplikovanu obuku operatera

MANE IR termovizije:

1. Cena kamere može biti visoka
2. Nemogućnost detekcije temperature u sredinama koje su razdvojene staklom, polythene materijalom itd.

Osnove infracrvenih termovizijskih kamera

IR Thermal Imaging Miracle MobIR® M4

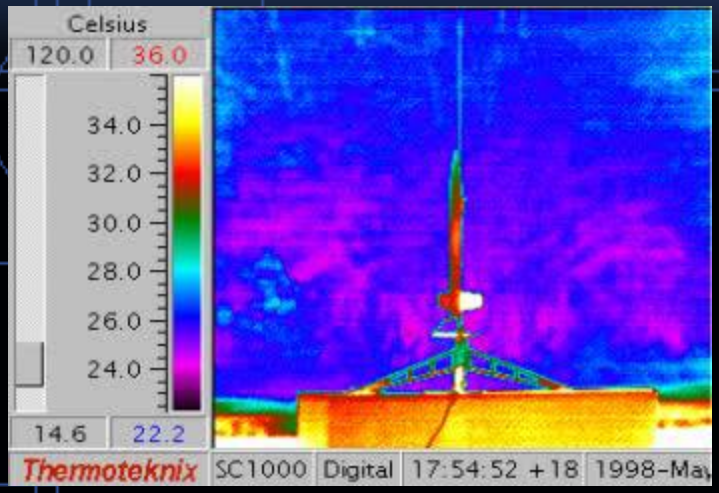
Imaging Performance	
THERMAL	
Detector Type:	Uncooled FPA microbolometer (160× 120 pixels, 35μm)
Spectral Range:	8-14μm
Field of View:	25°×19°
Thermal Sensitivity:	≤120mk at 30°C
Image Frequency:	50Hz PAL
VISUAL	
Built- in Digital Video:	CMOS Sensor, 640 x 480 pixels, 2"colors
Image Presentation	
External Display:	2.2" TFT & 1.2" CSTN high resolution color LCD
Display Color:	256 level, 8 palettes (Rainbow, iron, B&W, etc)
Measurement	
Temperature Range:	-20°C - +250°C
Accuracy:	±2°C or ± 2% of reading
Measurement Modes:	Spot / manual (up to 4 moveable), spot / automatic placement at max, area (up to 4 moveable) displaying either max, min, or average, isotherm, line profile, auto alarm
Emissivity Correction:	Variable from 0.01 to 0.99 (in 0.01 increment)
Measurement Features:	Automatic correction based on user input for reflected ambient temperature, distance, relative humidity, atmospheric transmission and external optics
Image Storage	
Type:	Built-in Flash memory (8G bit capacity)
File Format:	IRI (An individual file consists of infrared image, visual image and voice annotation if any)
Voice Annotation:	Variant for different files, up to 180 seconds per file

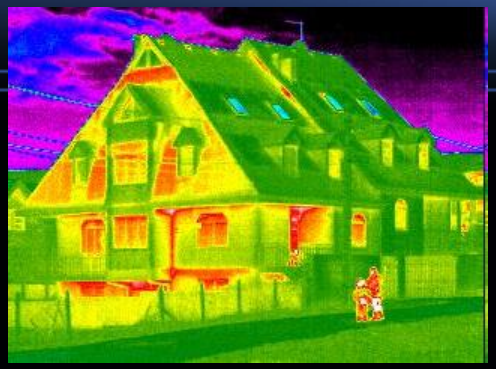
Osnove infracrvenih termovizijskih kamera

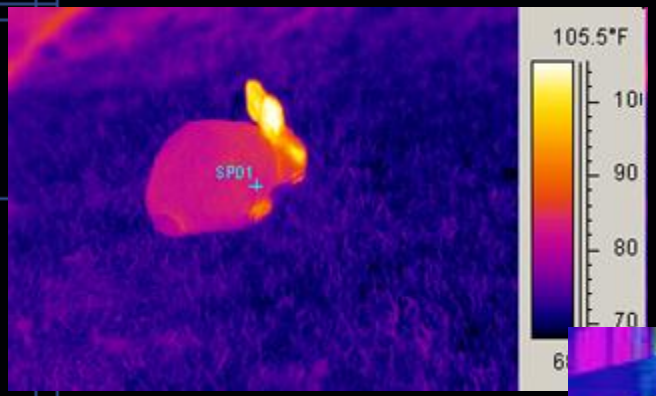
Fully Featured IR Thermal Camera GUIDIR® IR928

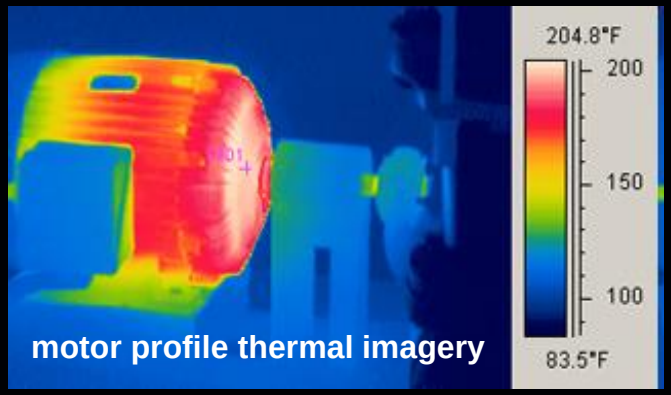
Imaging Performance	
THERMAL	
Detector Type:	Uncooled FPA Microbolometer (320× 240 pixels,45 μ m)
Spectral Range:	8-14 μ m
Field of View:	21°×15°
Image Frequency:	50Hz PAL/ 60Hz NTSC, non-interlaced
Thermal Sensitivity:	0.08°C at 30°C
Electronic Zoom:	×2, ×4 interpolating
VISUAL	
Built- in Digital Video:	CMOS Sensor, 640 x 480 pixels, 2^{24}colors
Image Presentation	
External Display:	4″ high resolution color LCD (TFT)
Viewfinder	0.25″ built-in high resolution color LCD (TFT)
Video Output:	PAL/ NTSC, composite video
Measurement	
Temperature Range:	-20°C - +500°C (up to +1500°C optional)
Accuracy:	±1°C or ±1% of reading
Measurement Modes:	Spot / manual (up to 4 moveable), spot / automatic placement at max, area (up to 4 moveable) displaying either max, min, or average, isotherm, line profile, auto alarm
Measurement Features:	Automatic correction based on user input for emissivity, reflected ambient temperature, distance, relative humidity, atmospheric transmission and external opticsImage Storage
Image Storage	
Type:	Removable 256MB Compact Flash Memory card
File Format:	IRI (An individual file consists of infrared image, visual image and voice annotation if any)

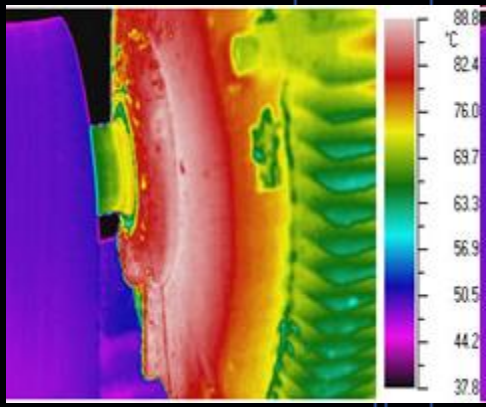
Osnove infracrvenih termovizijskih kamera

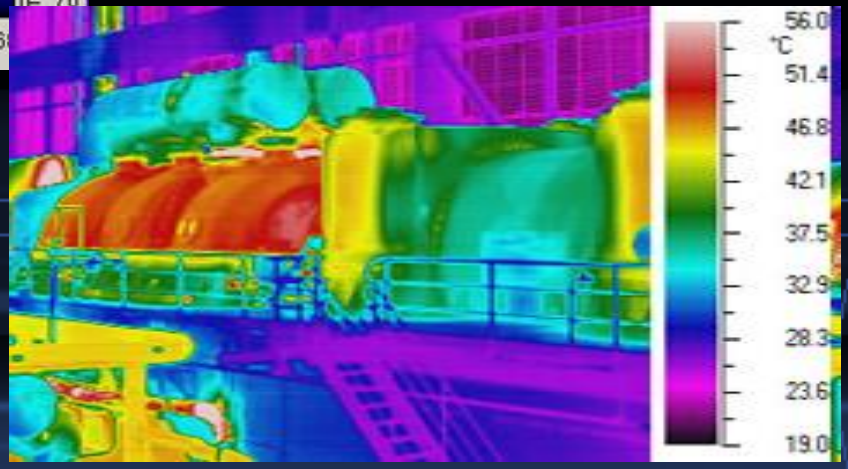




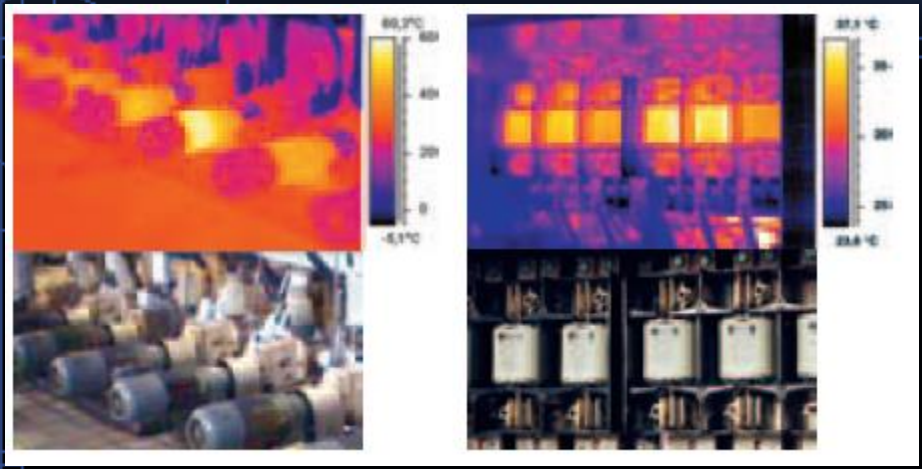


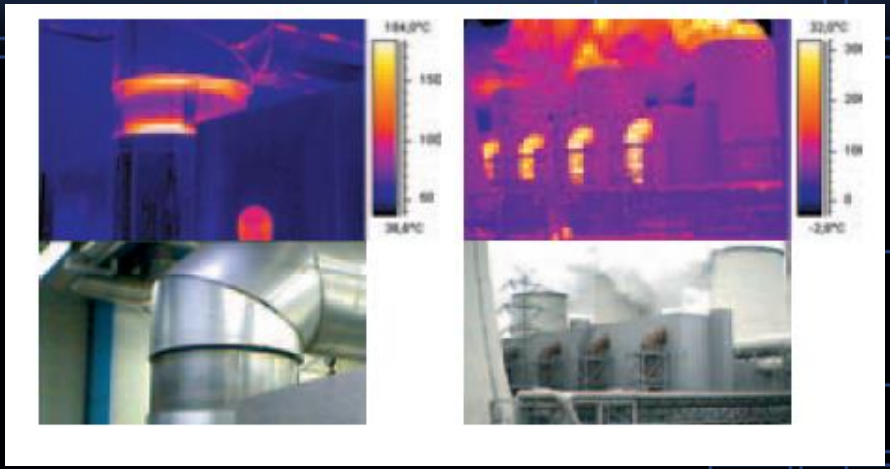


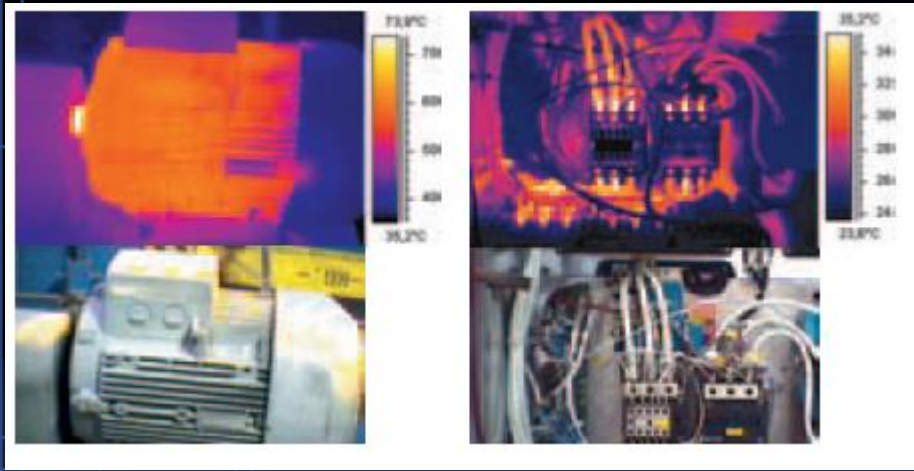


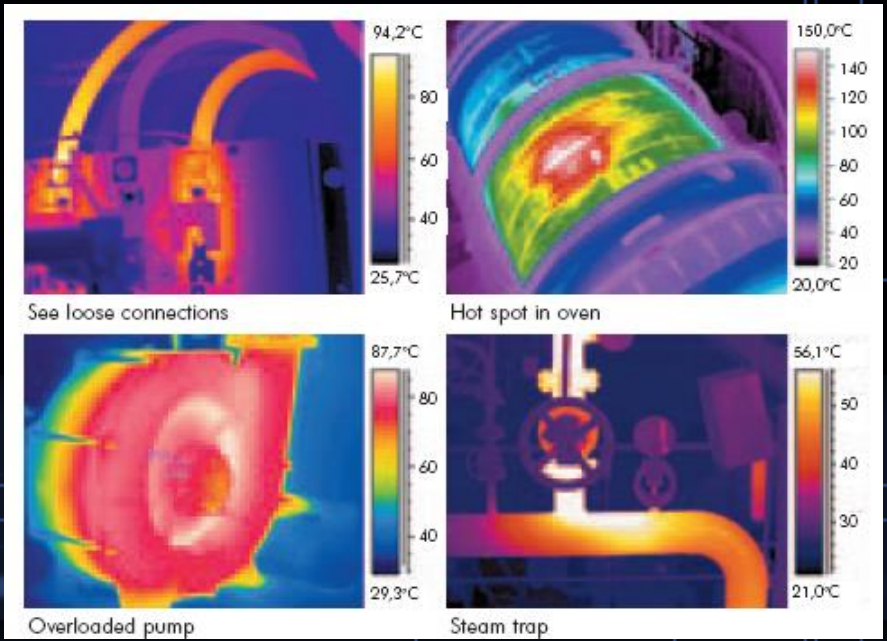


Osnove infracrvenih termovizijskih kamera

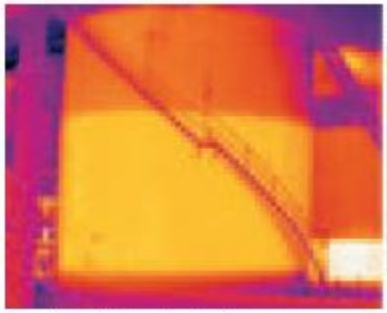




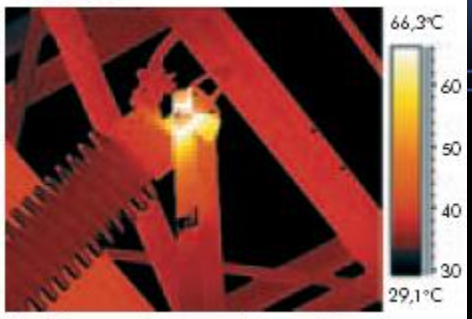




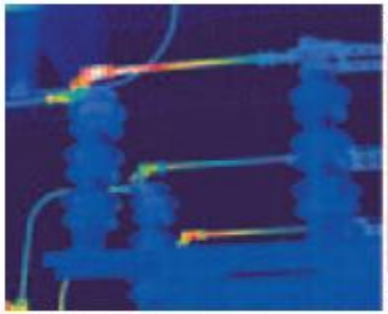
Osnove infracrvenih termovizijskih kamera



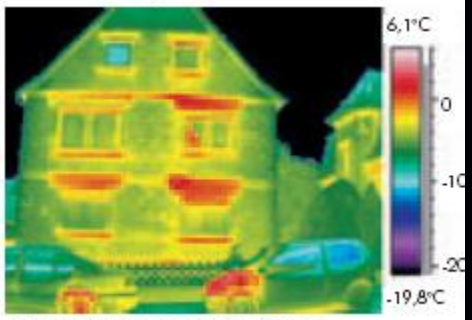
Level detection in tanks



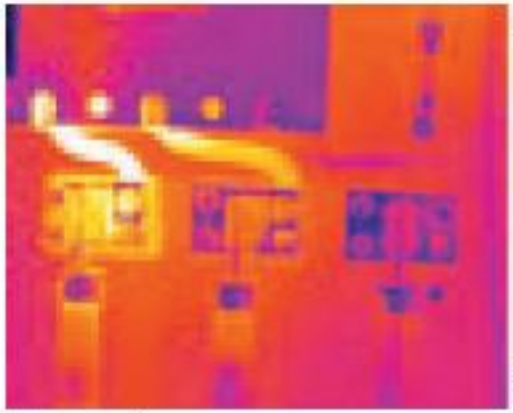
Find incorrectly secured connections



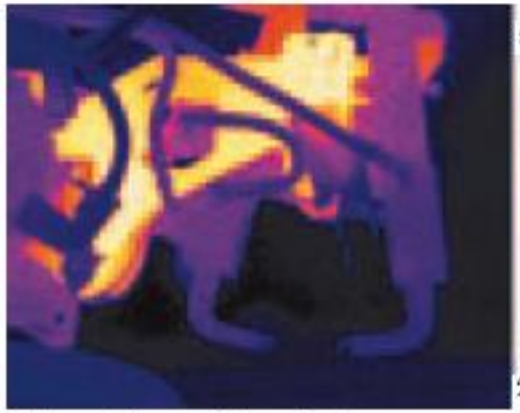
See oxidation of HV switches



Hot spots due to bad insulation



Measure fuses



Hot spot in welding robot