

# تطبيقات الأشعة تحت الحمراء في مجال الصناعة

ورشة عمل : الاختبارات اللا إتلافية و دورها في الصناعة السورية

مكان الانعقاد : كلية الهندسة الميكانيكية و الكهربائية بدمشق  
بين

2009/5/5-3

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مكان العمل : شركة مصفاة حمص



# INFRARED THERMOGRAPHIC IMAGING

**Infrared adopted as a standard test method since 1990s for :**

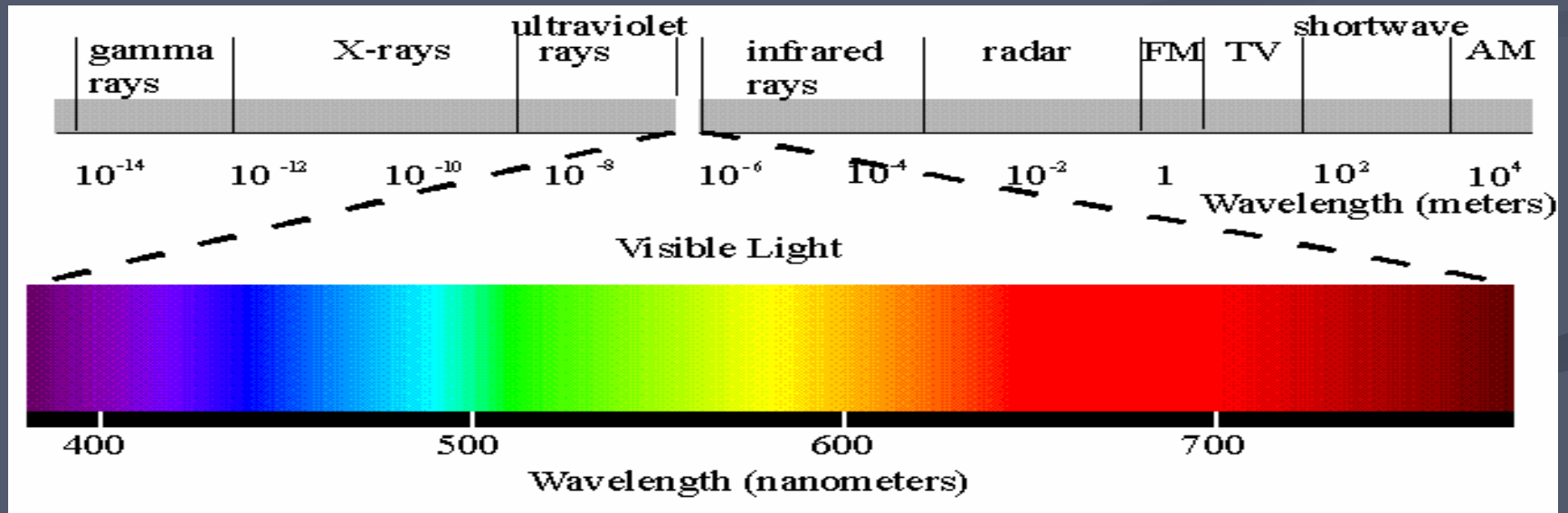
- **ASNT** : American Society for Nondestructive Testing
- **ASHRAE** : The American Society of Heating, Refrigeration, and Air Conditioning Engineers developed a building inspection standard
- **ASTM** : The American Society for Testing and Materials
- **NFPA** : National Fire Protection Association

# INTRODUCTION

1. What is infrared thermography ?
2. Advantages and disadvantage
3. Infrared thermographic imaging applications
4. Conclusion

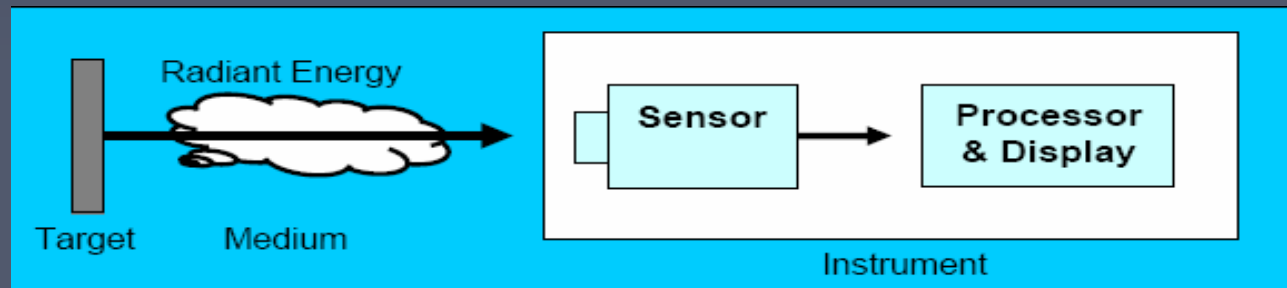
# 1. WHAT IS INFRARED THERMOGRAPHY

- Infrared thermography is the use of an infrared imaging system to detect, display and record thermal patterns and temperature values across a given surface
- Thermal infrared radiation is a form of electromagnetic energy similar to light, radio waves, and x-rays. All forms of electromagnetic radiation travel at the speed of light, ( $3 \times 10^8$  meters/second) they differ only in their wavelength.
- Infrared radiation that is detected with thermal imaging systems has wavelengths between approximately 2 and 15 microns



# 1. WHAT IS INFRARED THERMOGRAPHY

- Infrared radiation is emitted by all objects based on their temperature.



- Heat sensed by an infrared camera can be precisely measured enabling the user to monitor thermal performance and evaluate the severity of heat-related problems. (hotspots” are not visible to the naked eye can be detected by infrared thermographic scanning camera )

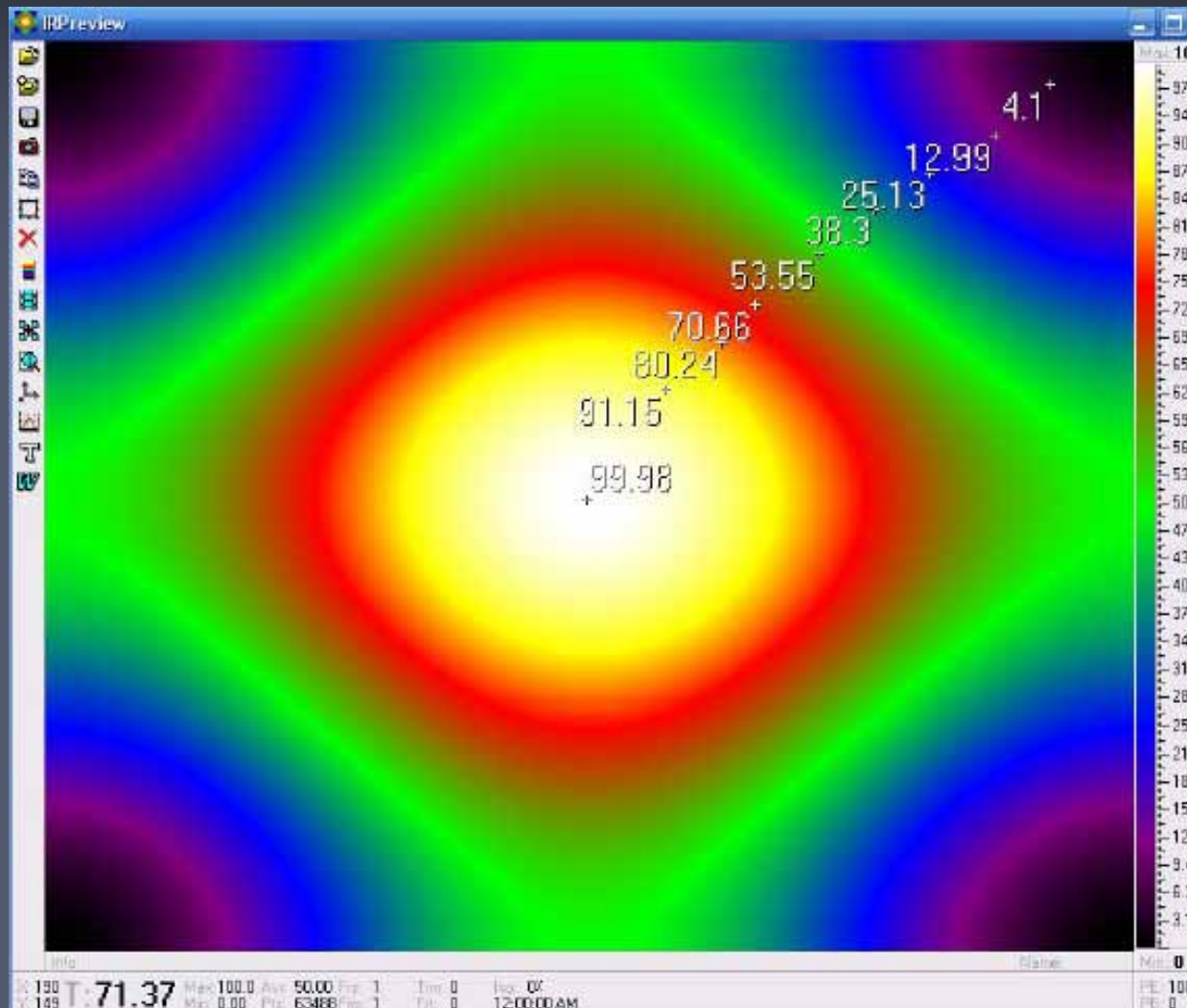
# WHAT IS INFRARED THERMOGRAPHY



- Infrared thermographic cameras



# 1. WHAT IS INFRARED THERMOGRAPHY



Screen

## 2. ADVANTAGES AN DISADVANTAGES

### ■ Advantages :

- It is a non-contact type technique
- Fast, reliable & accurate output
- A large surface area can be scanned in no time
- Presented in visual & digital form
- Software back-up for image processing and analysis
- Requires very little skill for monitoring .

### ■ Disadvantage:

- Unable to detect the inside temperature if the medium is separated by insulation materials



# **3. INFRARED THERMOGRAPHIC AMAGING APPLICATIONS**

## **IN :**

### **1. Refineries ,Chemical , petrochemical and power plants : for the examination and monitoring :**

of refractory- lined process vessels , piping , fired process  
furnaces , flue gas ducting , pumps , electrical motors , machines ,  
steam traps , steam lines , refrigeration systems , manufacturing  
processes , manufacturing facilities , and HVAC systems

,.....

### **2. Civil**

### **3. others**

# **BENIFITS**

1. wall thinning defects
2. Leakages
3. Fluid levels in storage tanks and vessels
4. Heat loss from buildings
5. Identify excessive friction and wear
6. Detect misalignment in coupled systems
7. lubrication situation of bearings
8. Pinpoint areas of refractory damage
9. Locate underground pipe leaks
10. Monitor process heater or boiler tubes

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY



## 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY

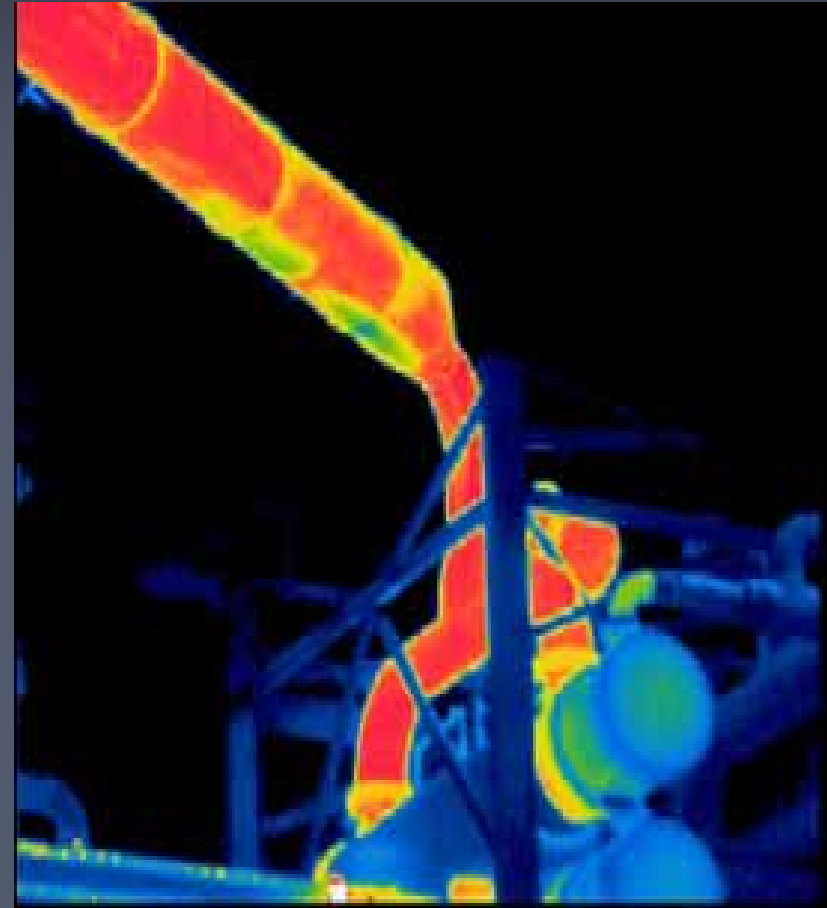


### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY



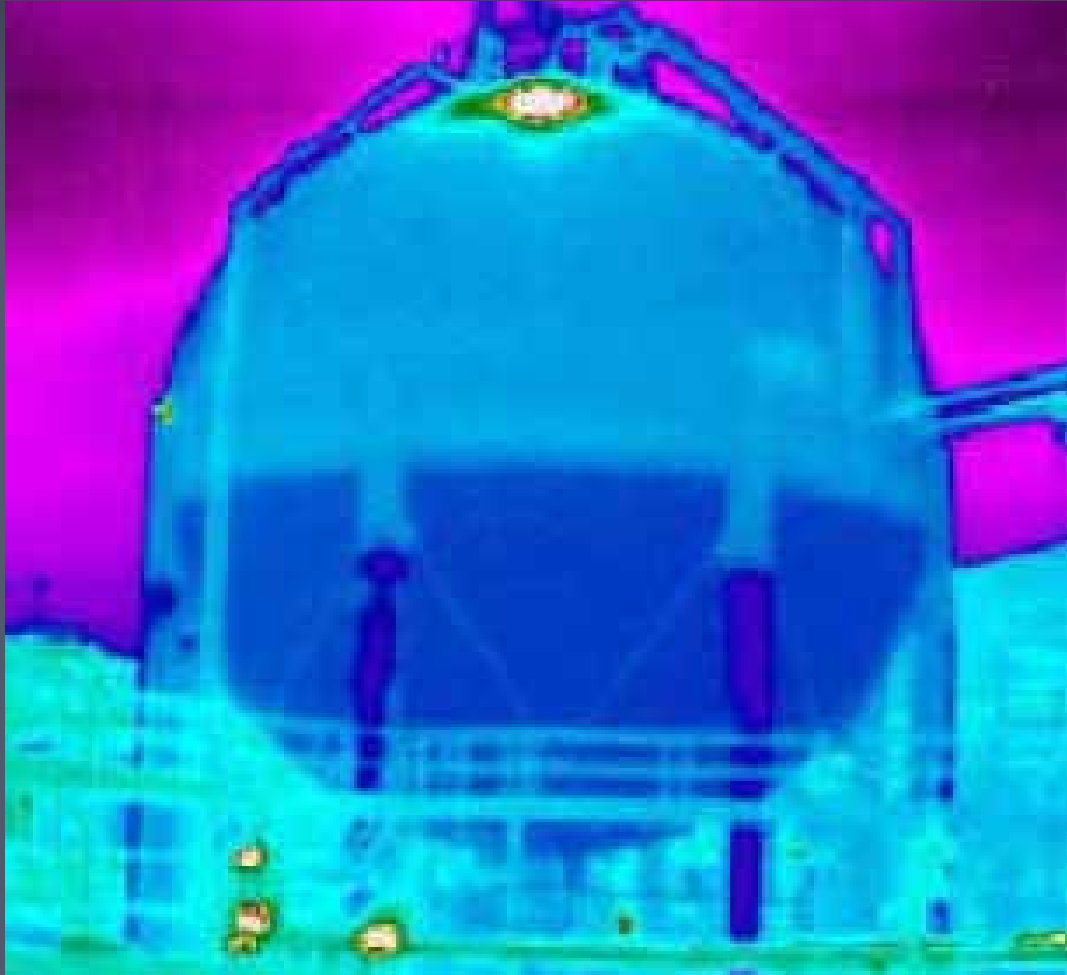


### 3.1 INFRARED THERMOGRAPHIC IMAGING APPLICATIONS IN INDUSTRY (wall thinning defects)



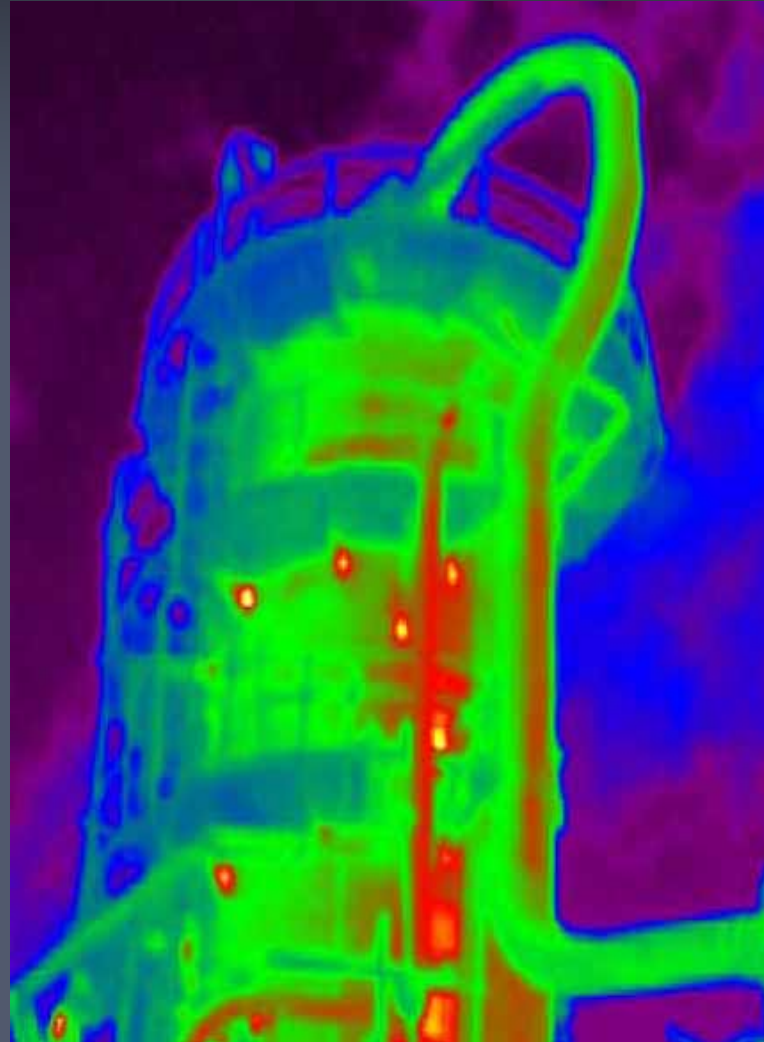
where we need to inspect when UT readings are taken

### 3.1 INFRARED THERMOGRAPHIC IMAGING APPLICATIONS IN (wall thinning defects)



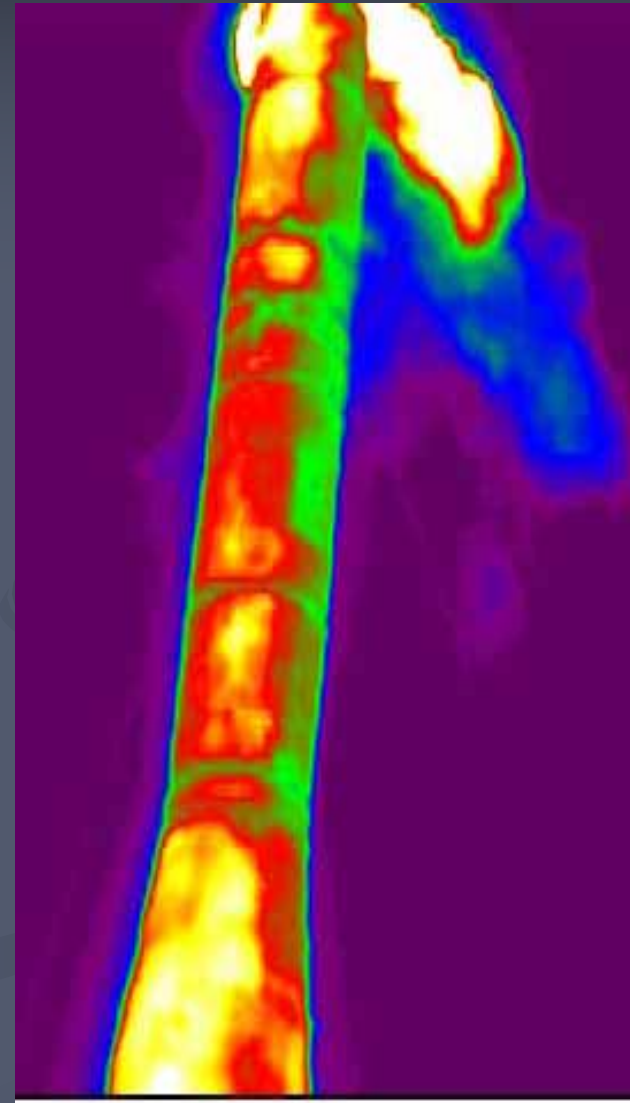


### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (wall thinning defects)



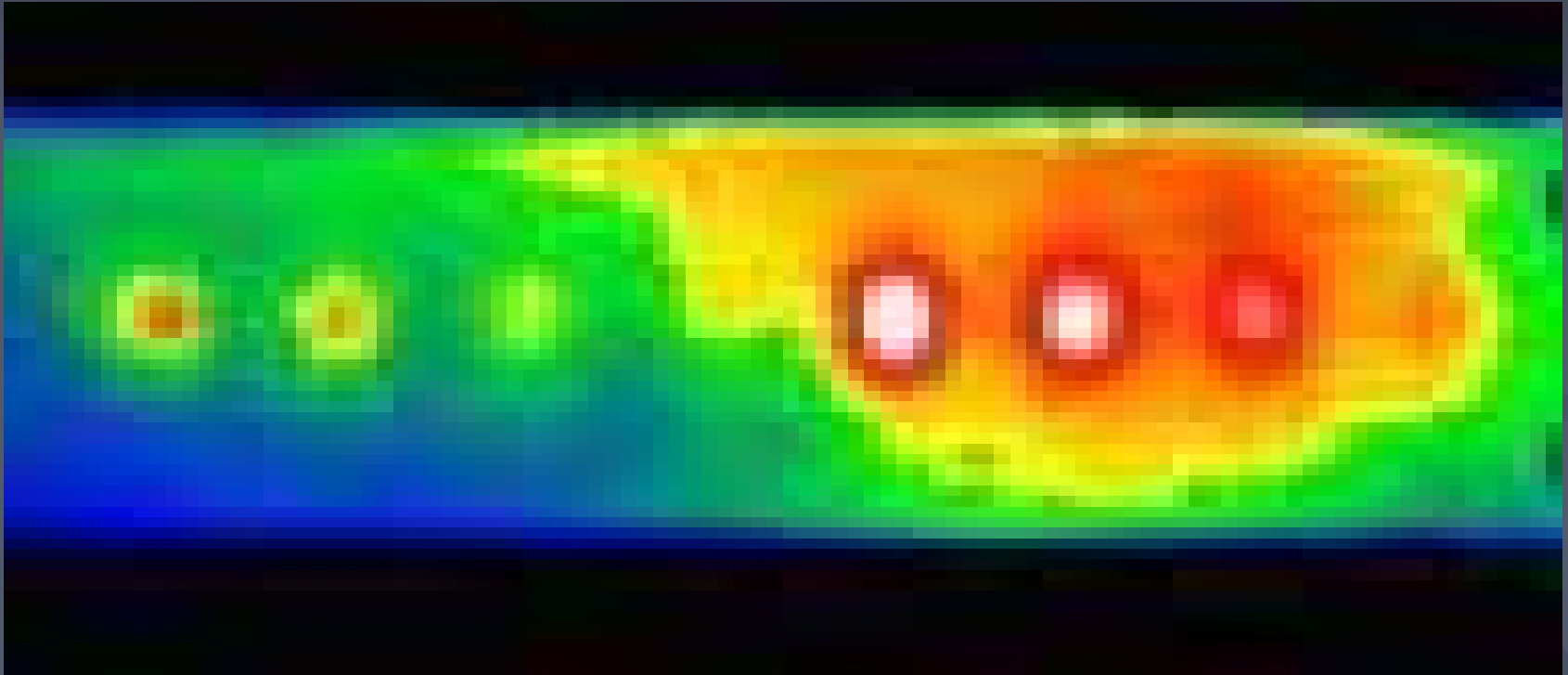
where we need to inspect when UT readings are taken

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Pinpoint areas of refractory damage)



- Lack of refractory

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (wall thinning defects)



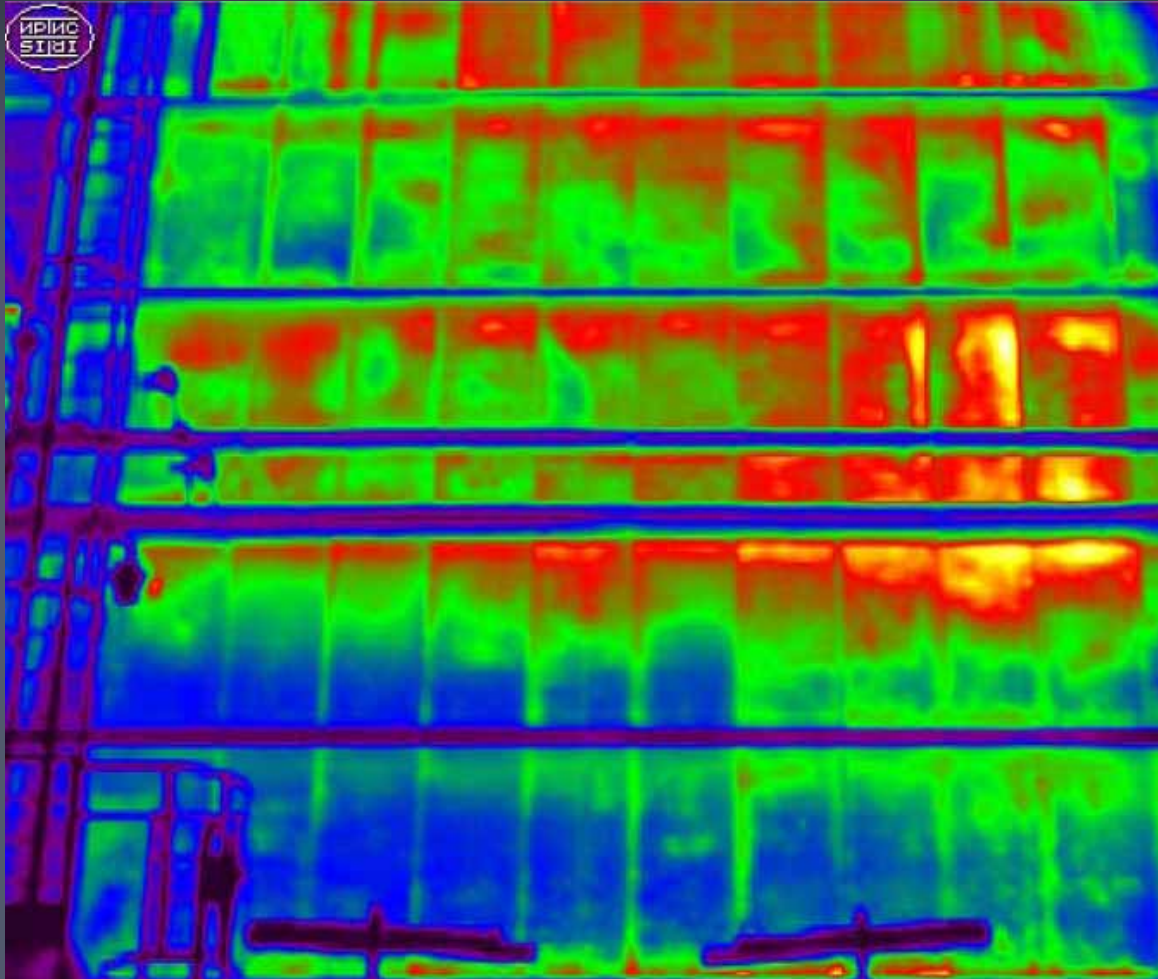
- Piping : wall thinning (pitting or wall loss defects due to media corrosion and cavitation erosion )

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Pinpoint areas of refractory damage)



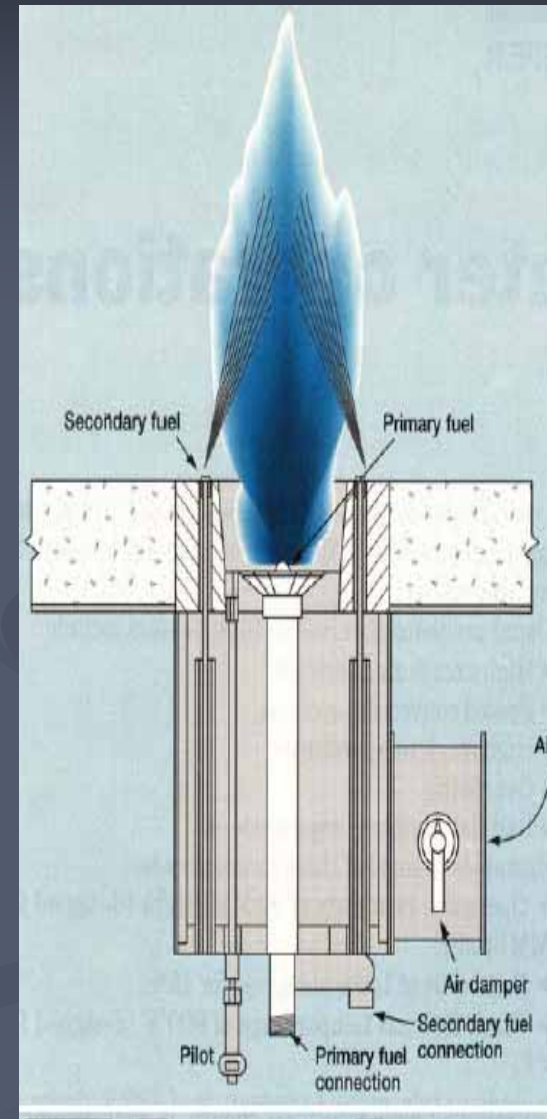
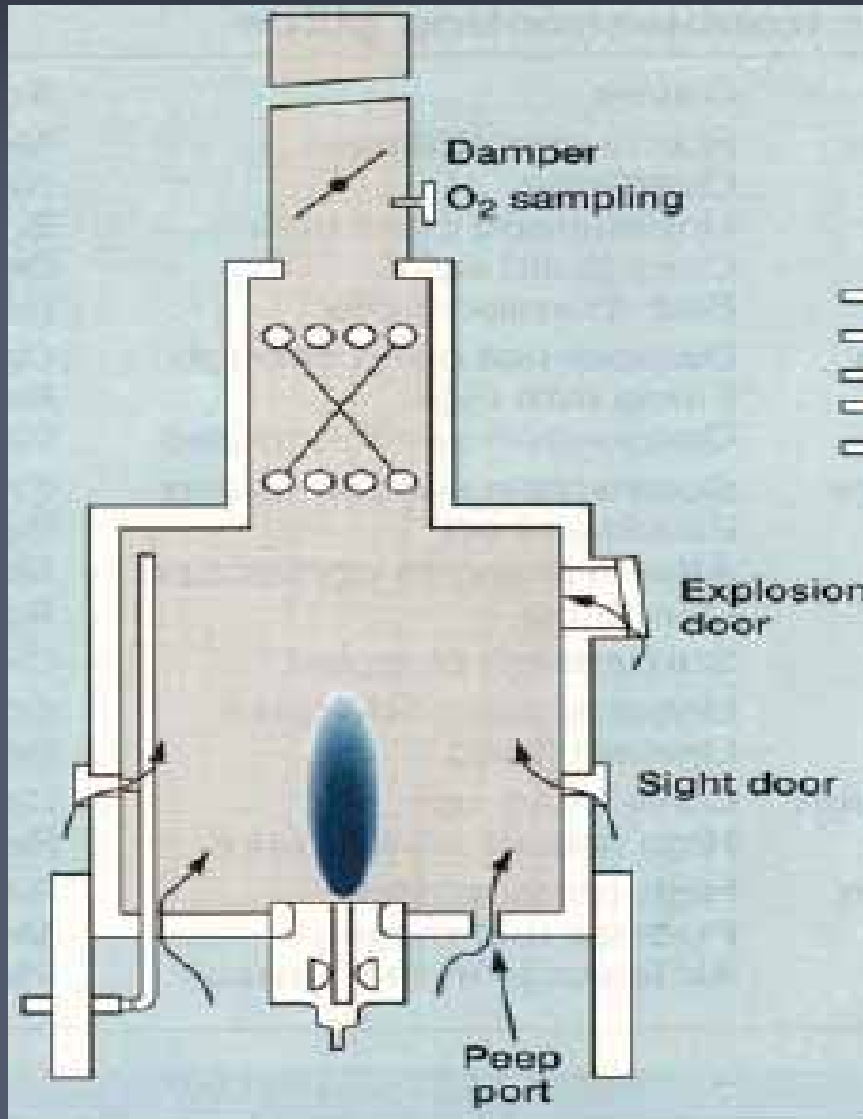
furnaces : refractory breakdown at furnaces because of loss of the insulating layer

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Pinpoint areas of refractory damage)



- Refinery :furnace refractory failure

### 3.1 INFRARED THERMOGRAPHIC IMAGING APPLICATIONS IN INDUSTRY



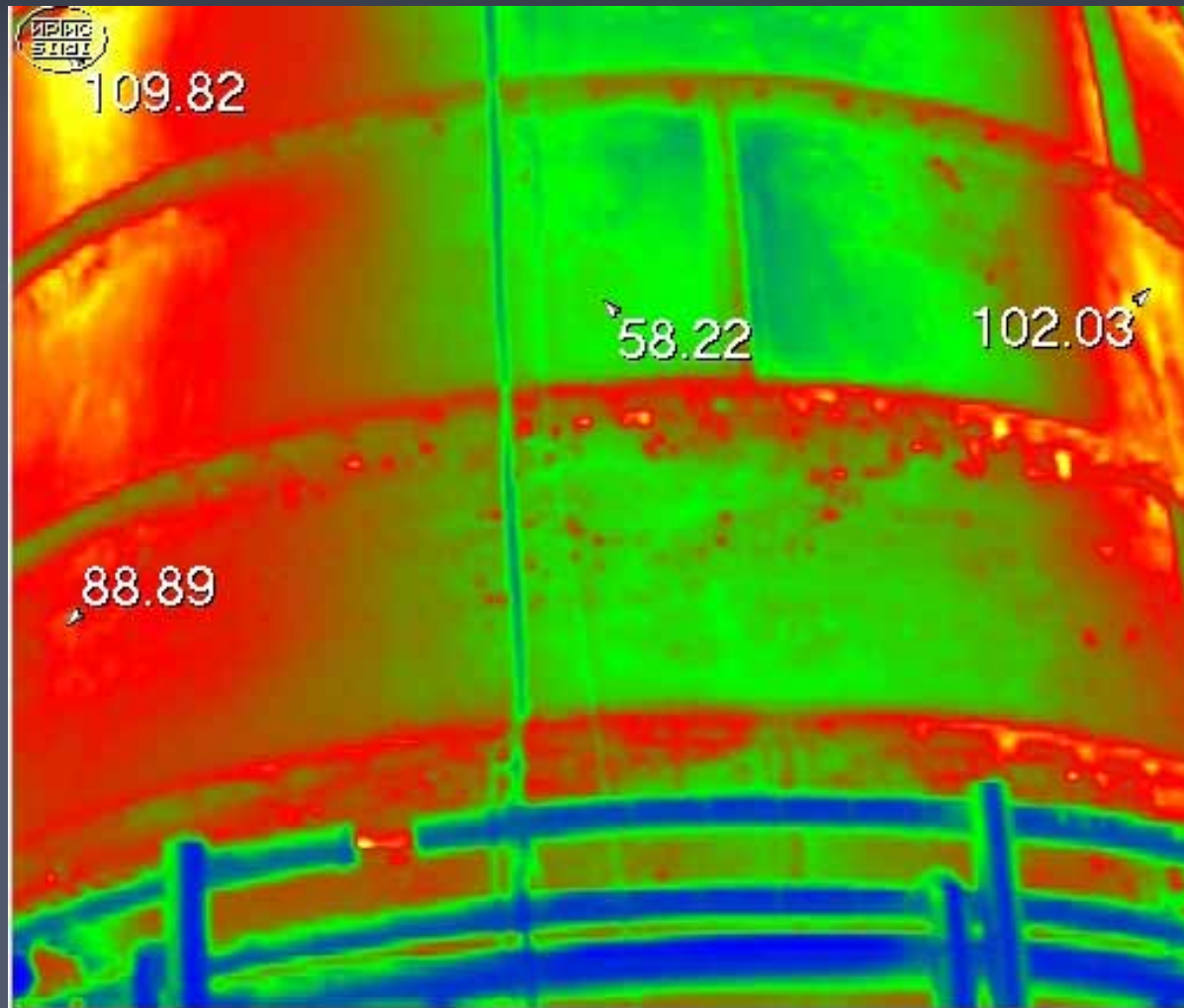
### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Pinpoint areas of refractory damage)



- unbalanced heat loading



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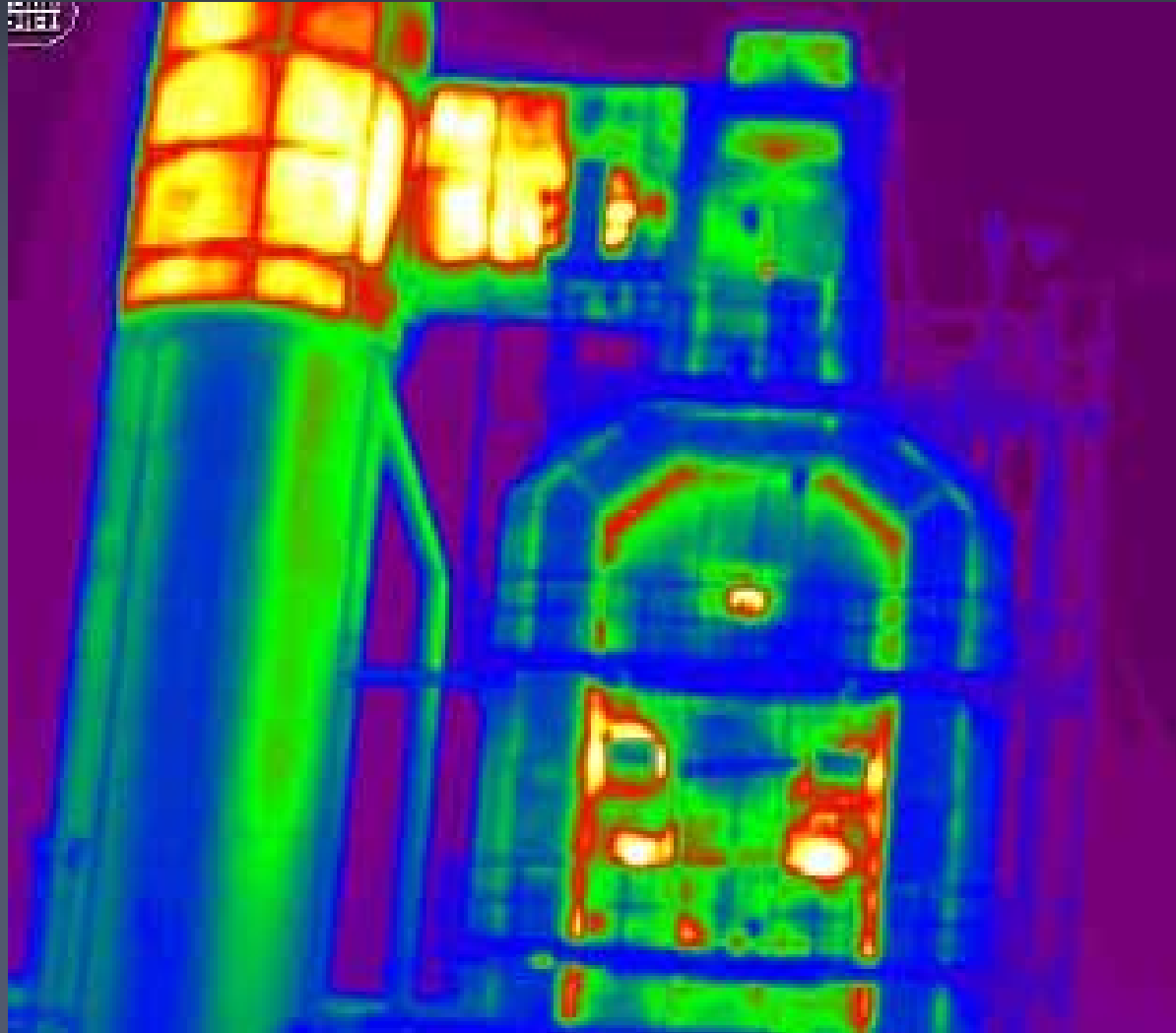
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■ Heater : refractory

## 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY

(Pinpoint areas of refractory damage)



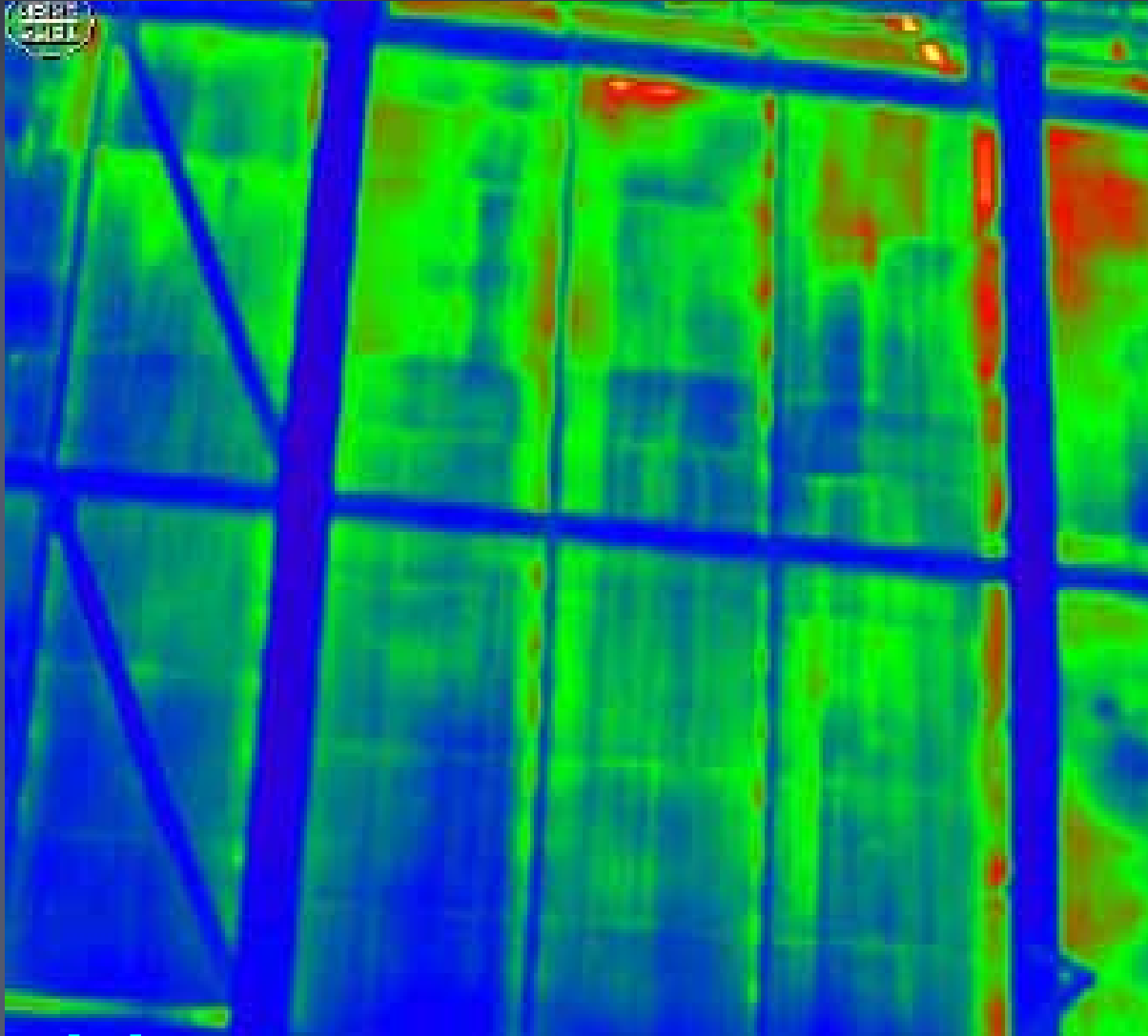
■ Heater refractory damages

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Pinpoint areas of refractory damage)



■ Heater refractory

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Pinpoint areas of refractory damage)



■ Heater : Heat leakage



### 3.1 INFRARED THERMOGRAPHIC IMAGING APPLICATIONS IN INDUSTRY (Monitor process heater or boiler tubes)



- Heater tubes ( flame impingements , coking ,unbalanced heat loading ,deposits,....)

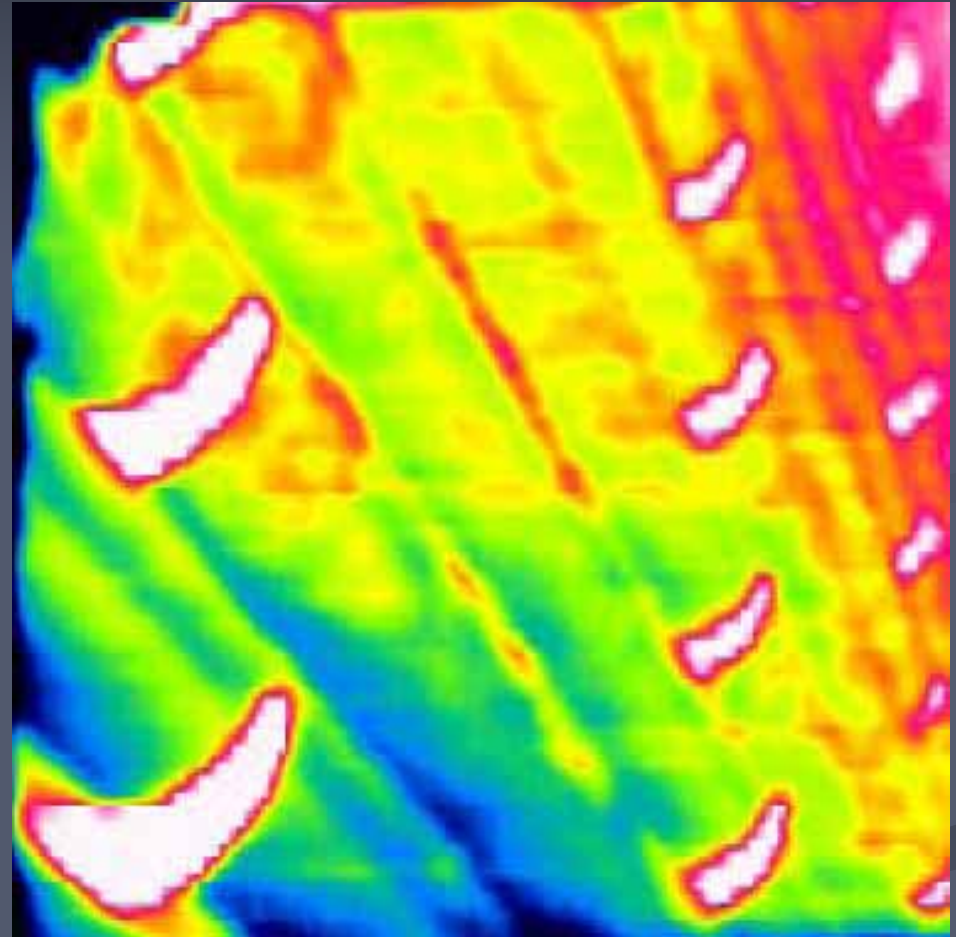
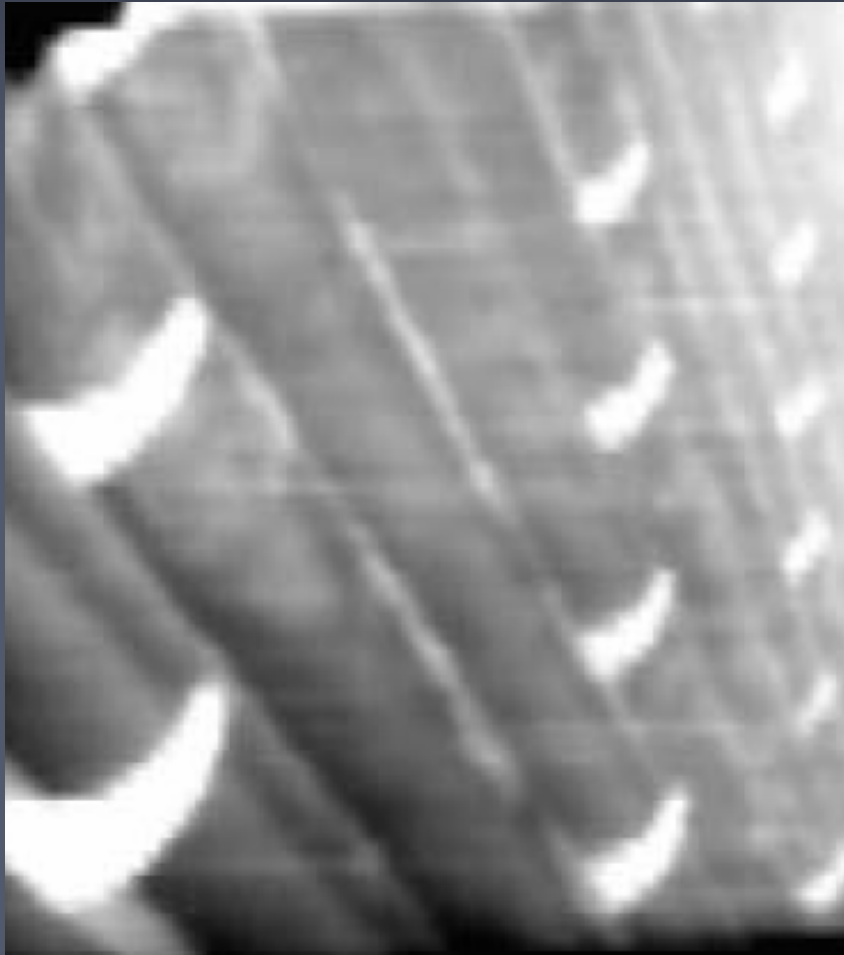
### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Monitor process heater or boiler tubes)



- Heater tubes damaged because of Localized internal fouling

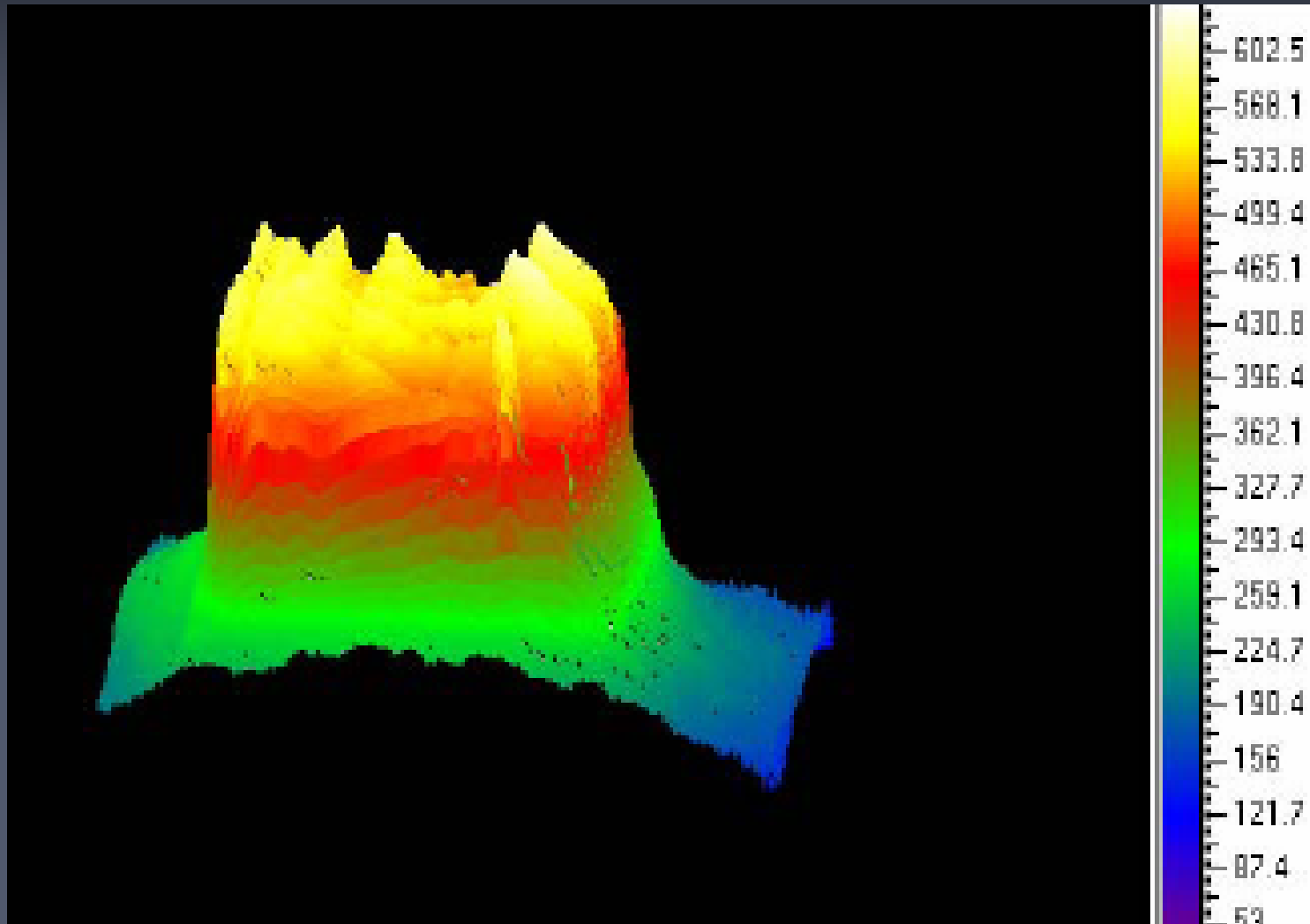


### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Monitor process heater or boiler tubes)



■furnace tube skin temperatures: ( flame impingements , coking ,unbalanced heat loading ,deposits,....)

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (software)



Heater tubes: flame Impingement (maximum temperature points)

### 3.1 INFRARED THERMOGRAPHIC IMAGING APPLICATIONS IN INDUSTRY (Monitor process heater or boiler tubes)



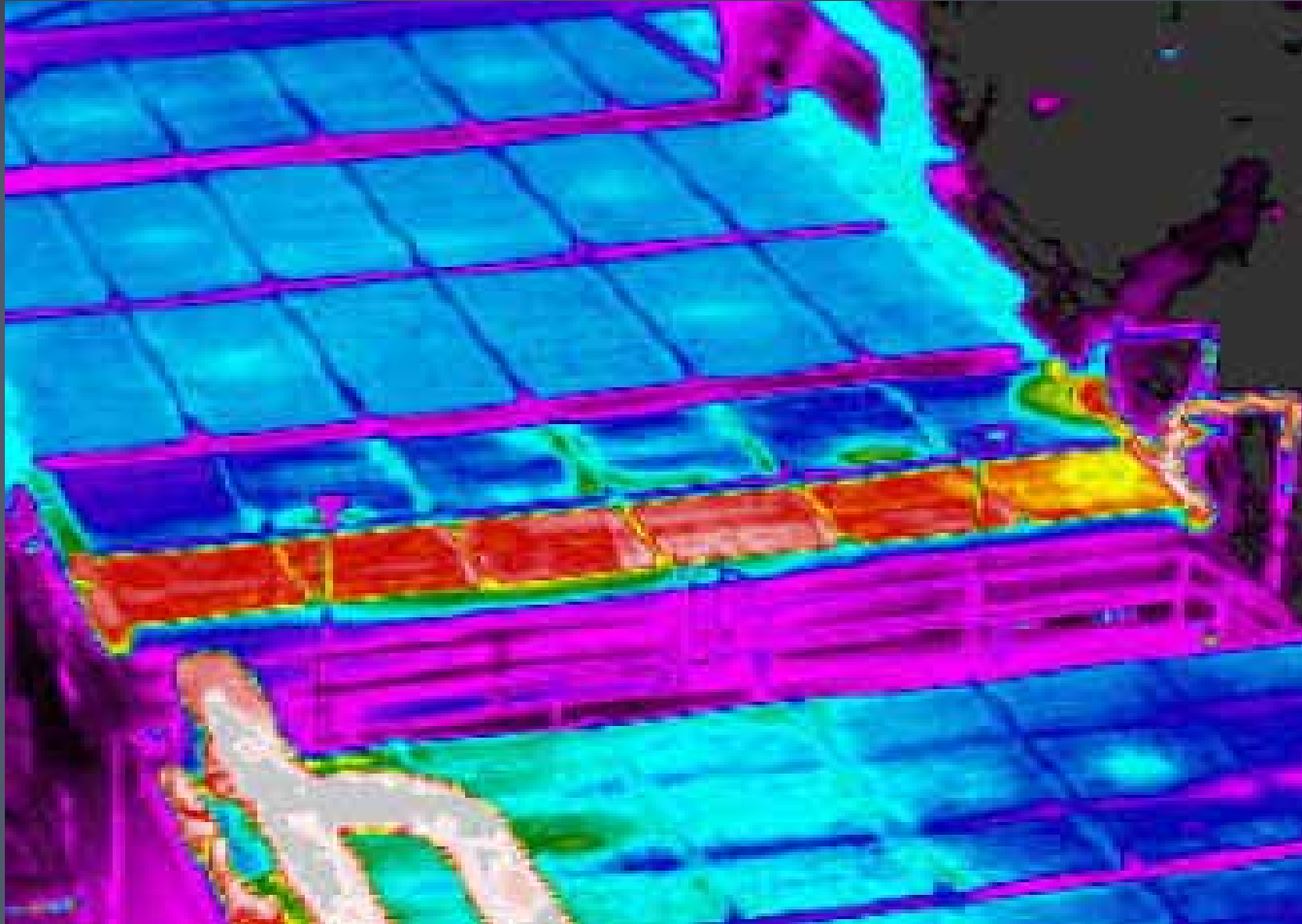
**Localized internal fouling**

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Monitor process heater or boiler tubes)



Heater tubes ■

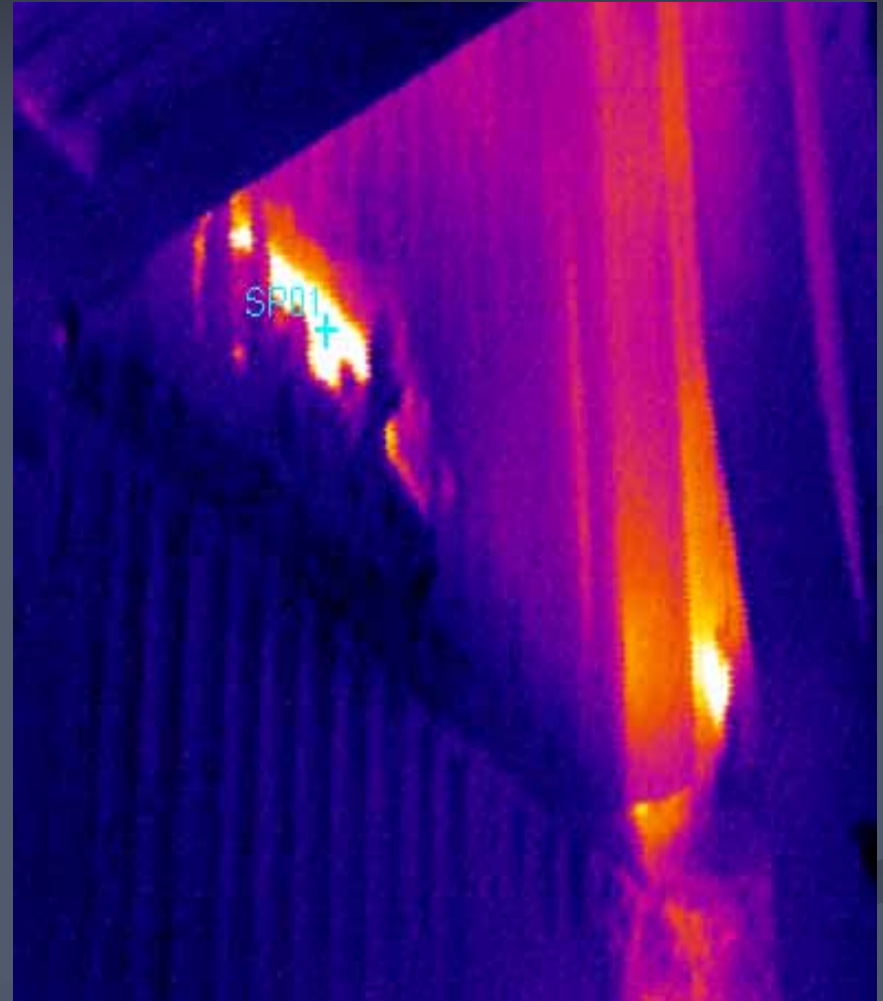
### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Monitor heat exchangers fouling)



Tubes fouling ■

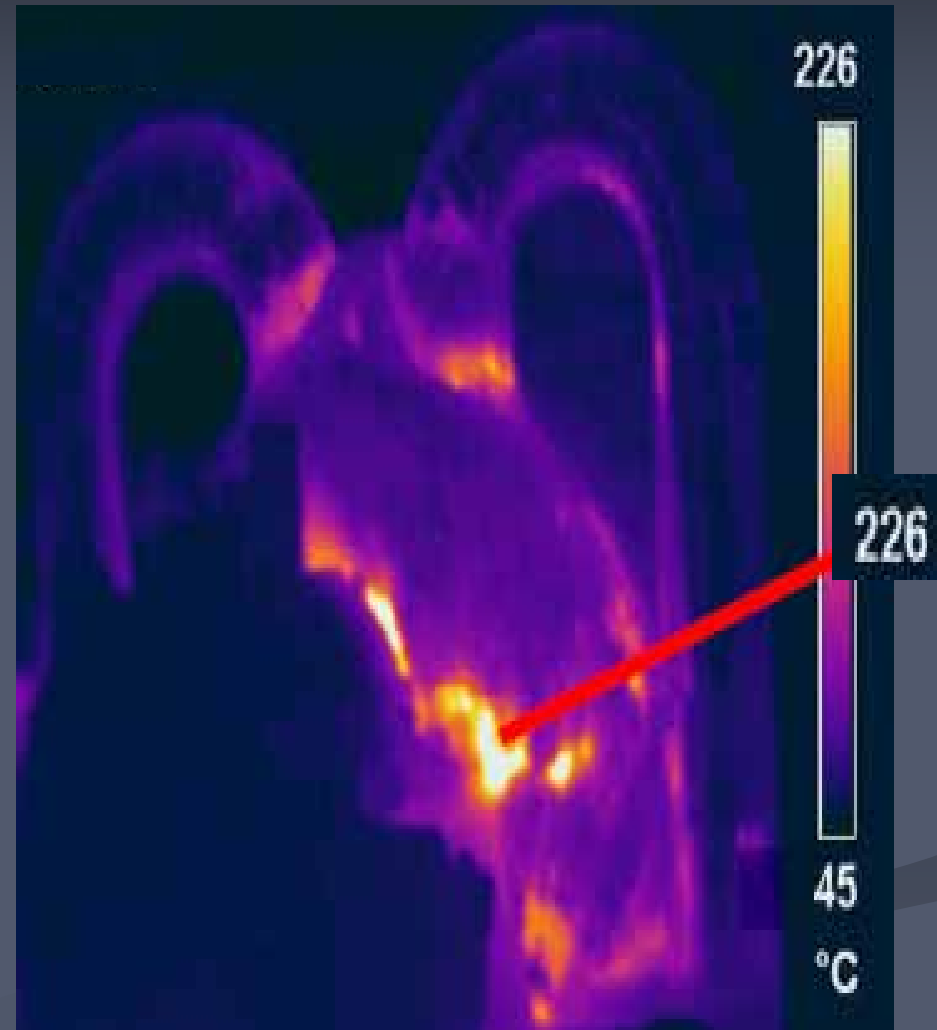


### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Heat leakages)



- Boiler casing leakages

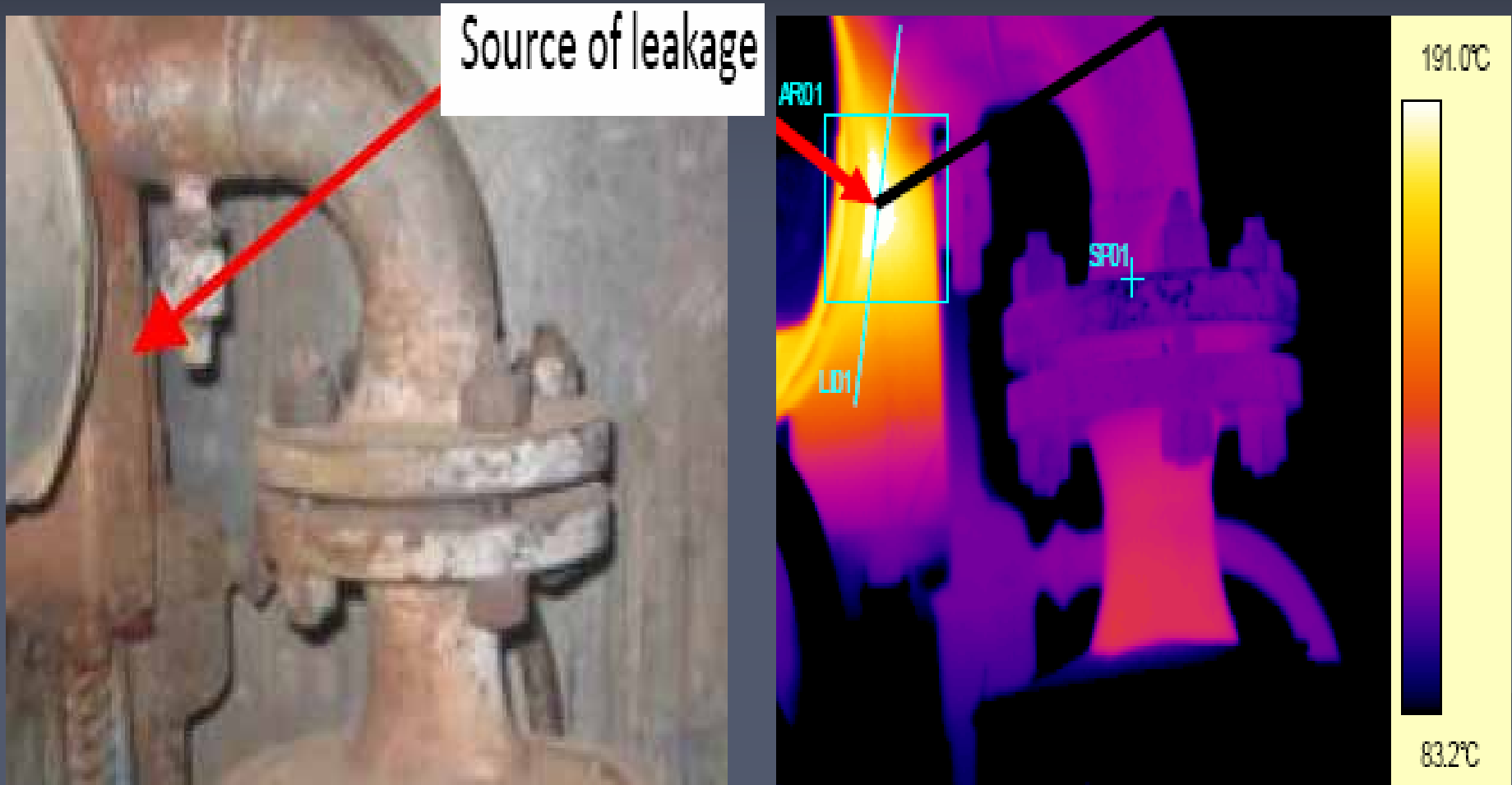
### 3.1 INFRARED THERMOGRAPHIC IMAGING APPLICATIONS IN INDUSTRY (Heat leakages)



- turbine : ( heat leakage form insulation )

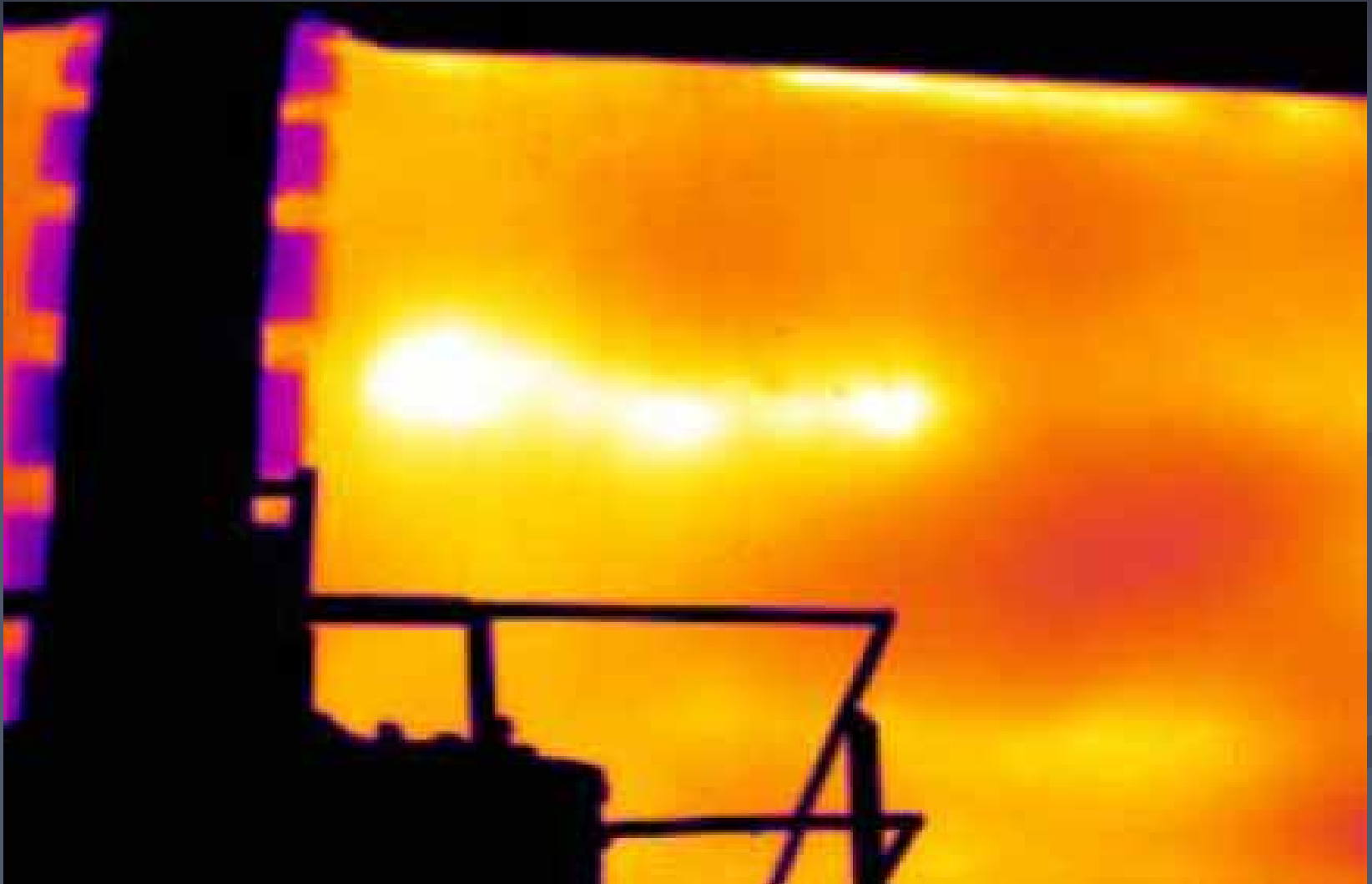


### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Leakages)



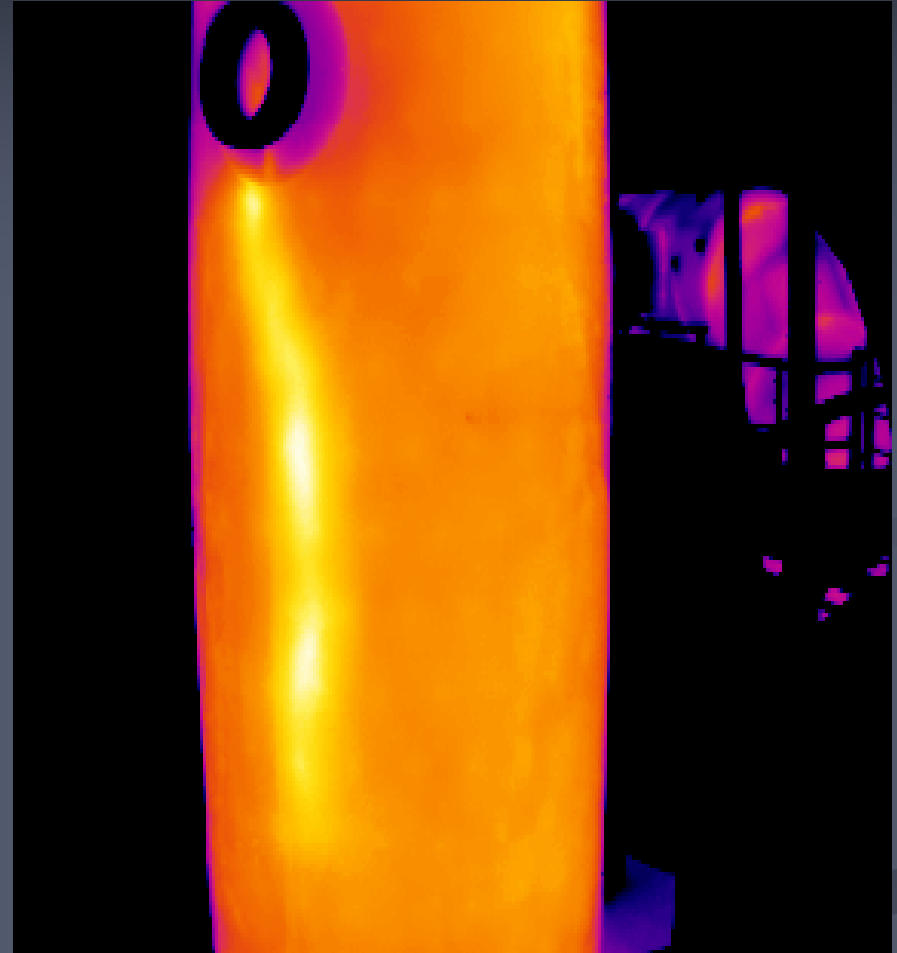
- Power plant steam turbine : turbine inlet (dry superheated steam leakage)

### 3.1 INFRARED THERMOGRAPHIC IMAGING APPLICATIONS IN INDUSTRY (Pinpoint areas of refractory damage)



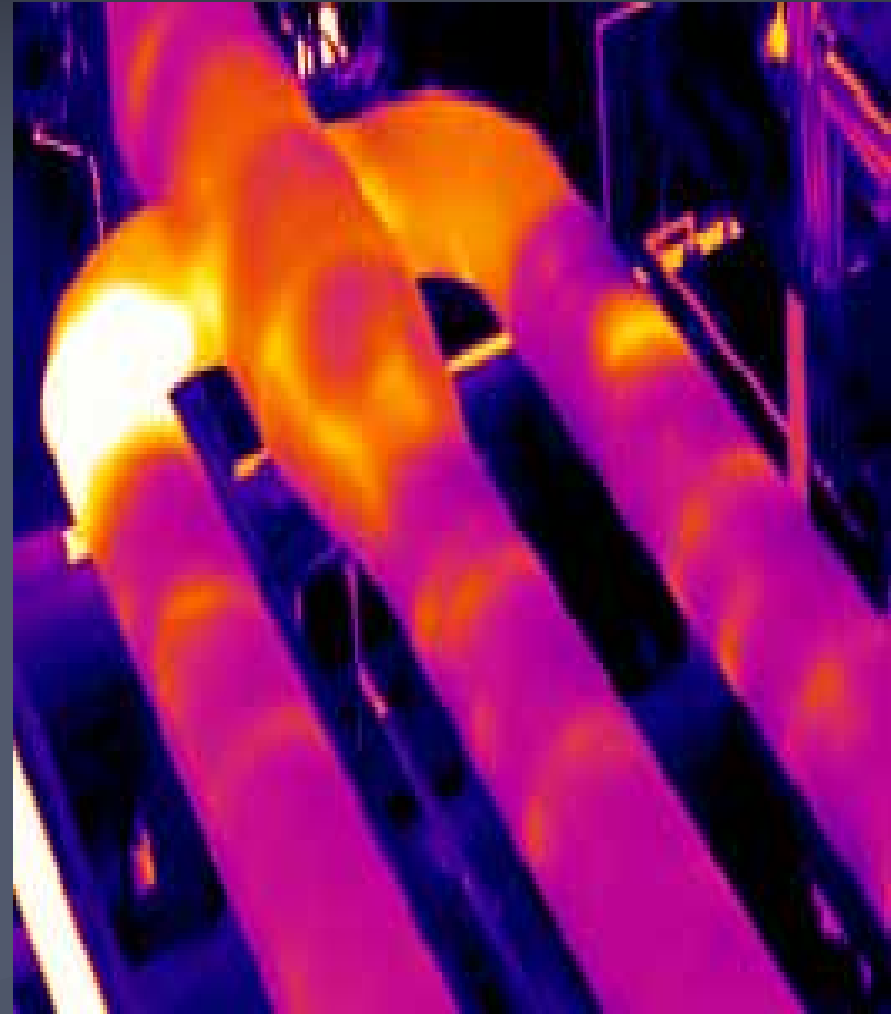
- Hot spots at cement kiln

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Pinpoint areas of refractory damage)



**Refinery : the refractory (lining) have been broken away**

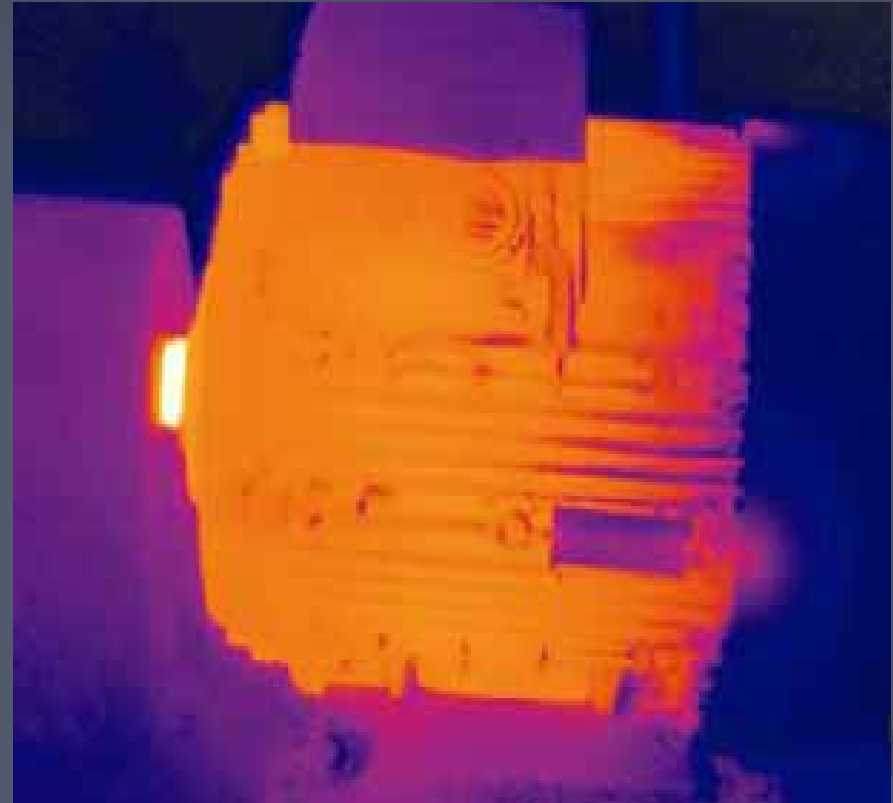
### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Pinpoint areas of refractory damage)



- Refinery : heated compressed air lines (refractory failure)

### 3.1 INFRARED THERMOGRAPHIC IMAGING APPLICATIONS IN INDUSTRY

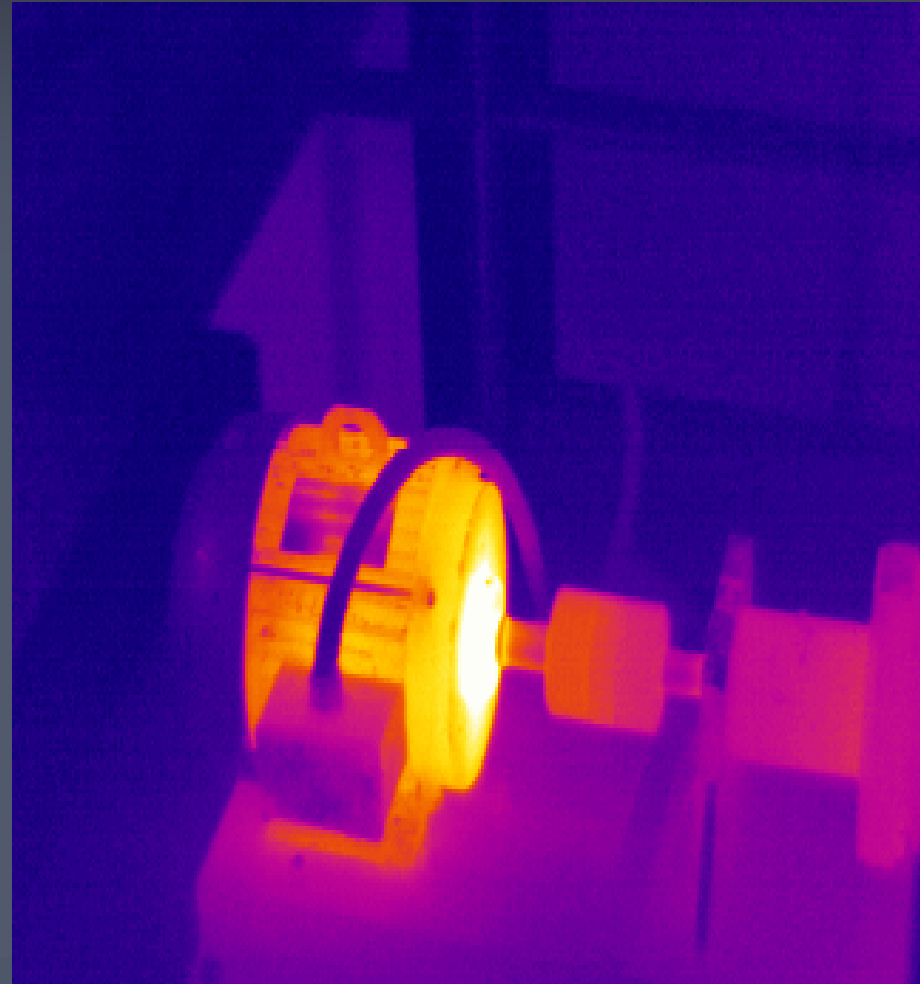
(Identify excessive friction and wear - Detect misalignment in coupled systems  
- lubrication situation of bearings )



- Electrical motors (Lubricant problems , misconnecting ,misalignment ,.....)

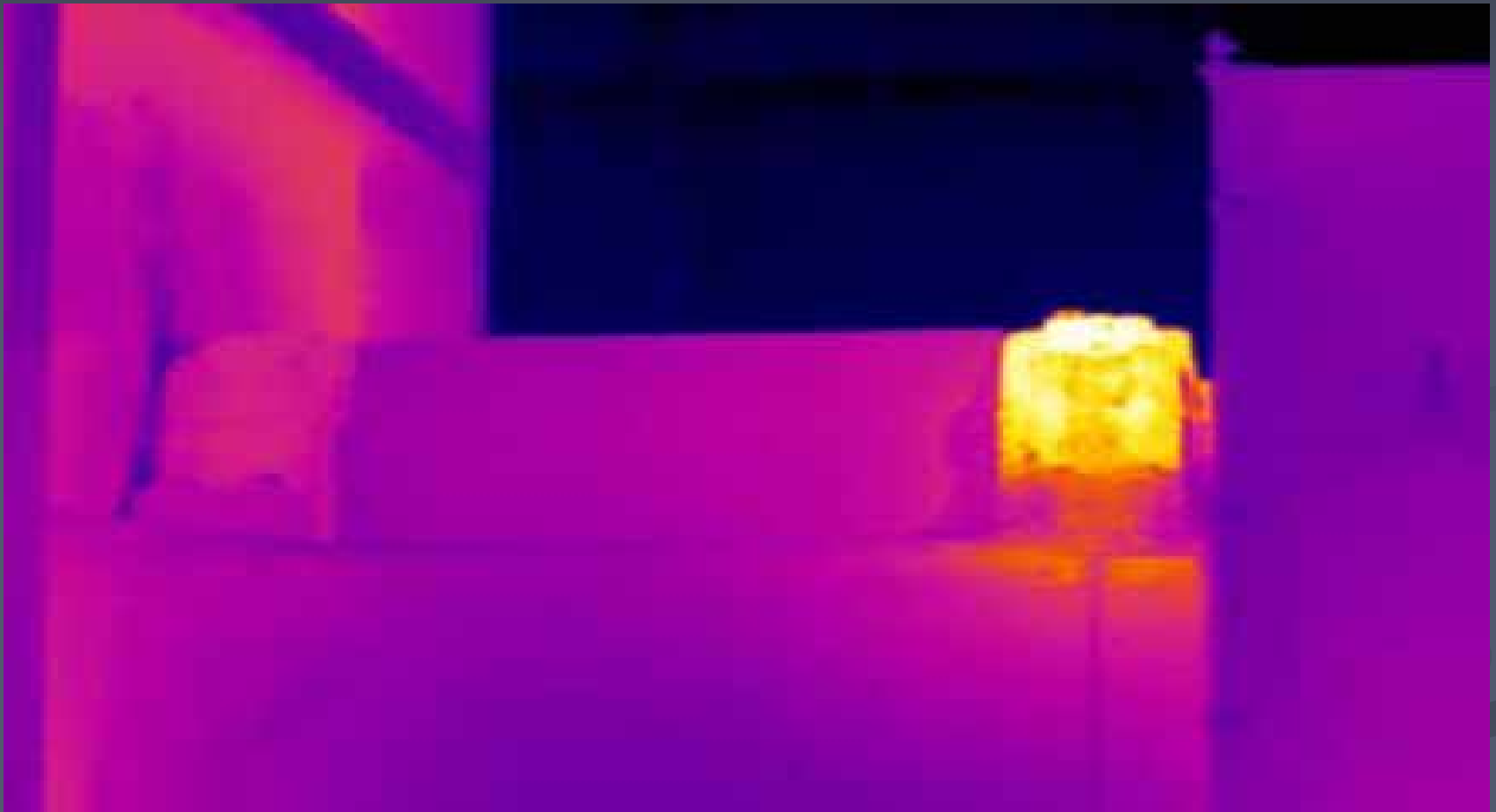


### 3.1 INFRARED THERMOGRAPHIC IMAGING APPLICATIONS IN INDUSTRY (Identify excessive friction and wear - Detect misalignment in coupled systems - lubrication situation of bearings )



- Electrical motors (Lubricant problems , misconnecting ,misalignment ,....42

### 3.1 INFRARED THERMOGRAPHIC IMAGING APPLICATIONS IN INDUSTRY (Identify excessive friction and wear - Detect misalignment in coupled systems - lubrication situation of bearings )



- Rotating machine Bearing : Lack of lubrication

### 3.1 INFRARED THERMOGRAPHIC IMAGING APPLICATIONS IN INDUSTRY

(Identify excessive friction and wear - Detect misalignment in coupled systems - lubrication situation of bearings )



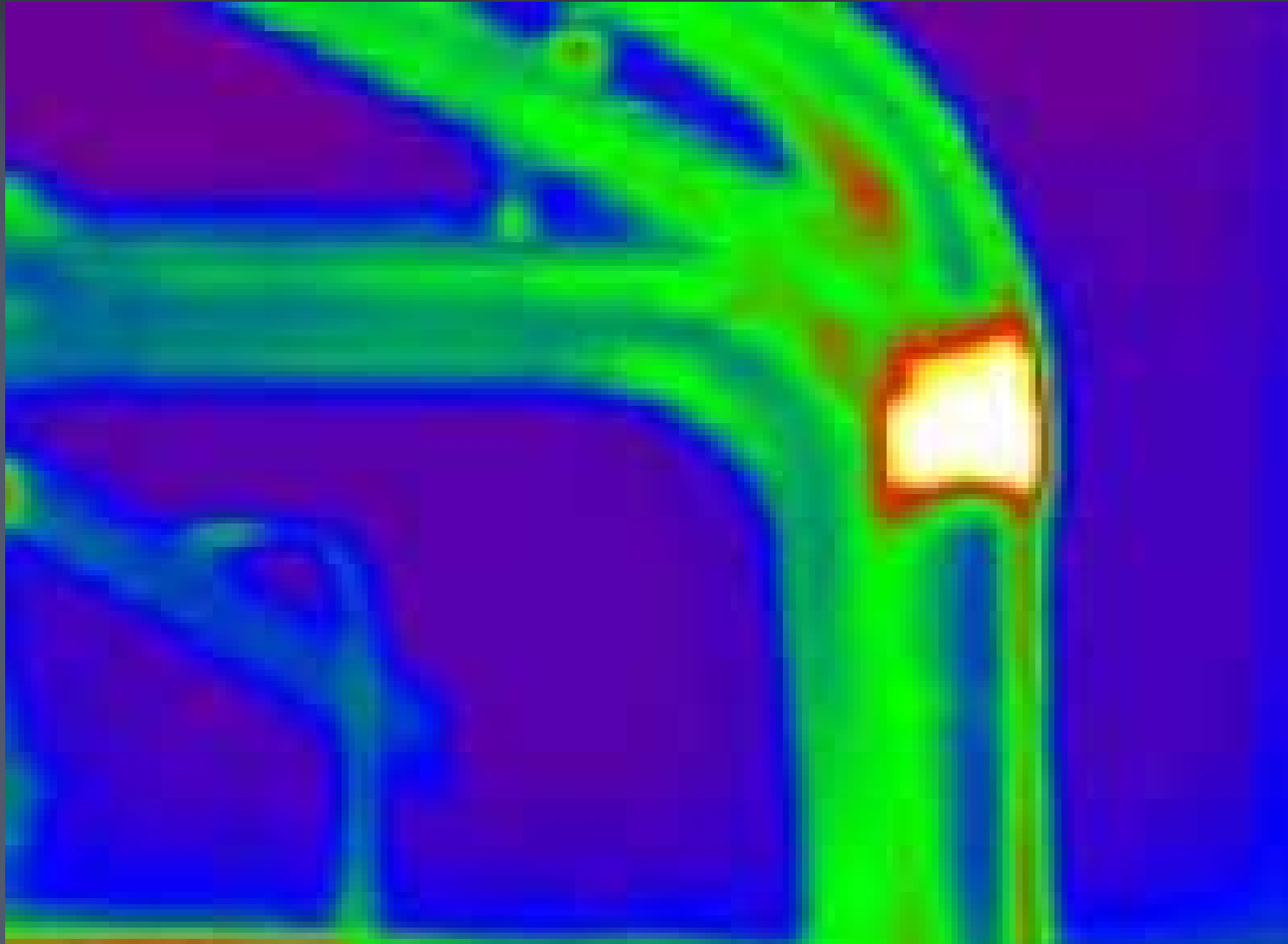
overheated bearing Lubricant problems

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Heat loss )



- Piping (missed insulation)

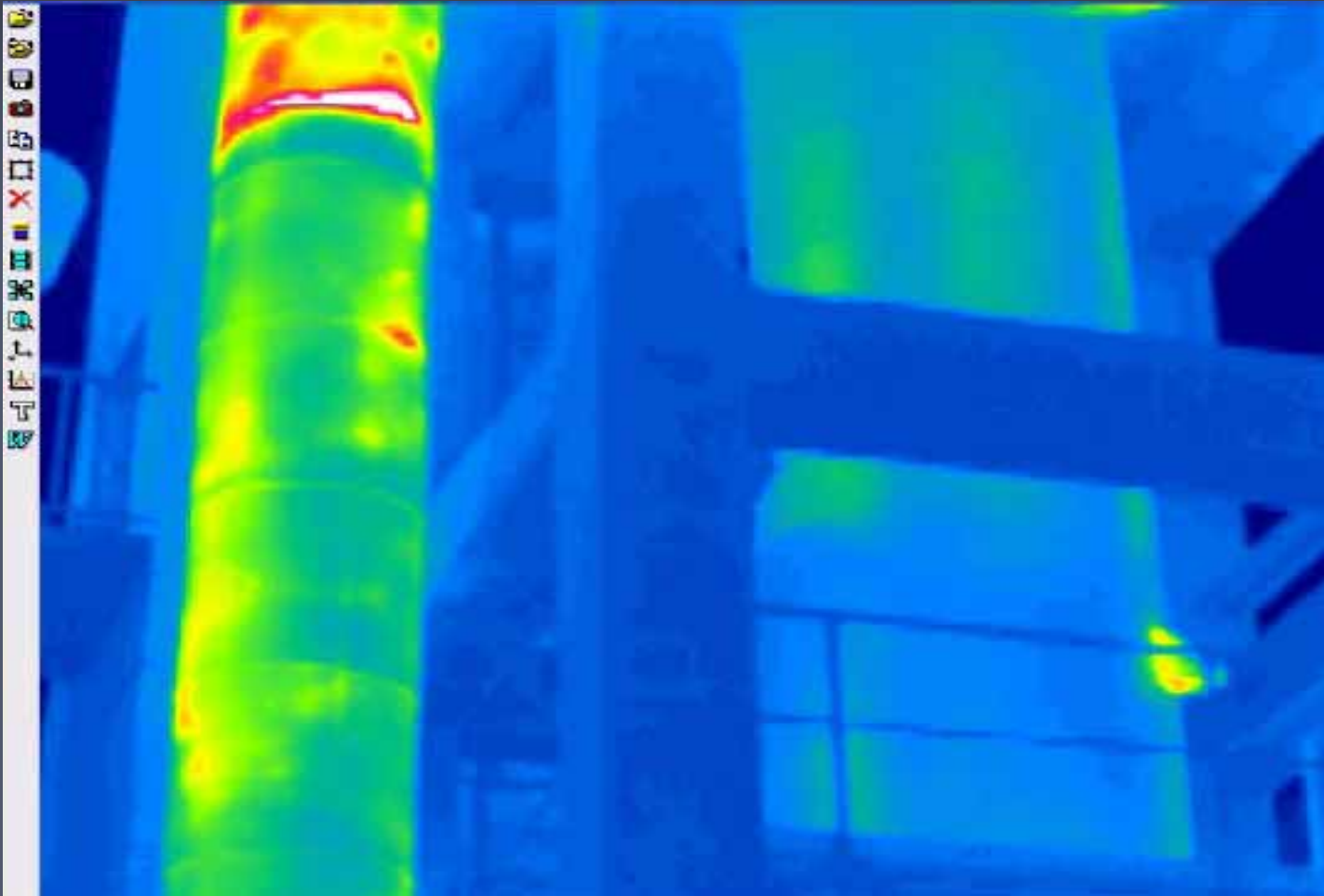
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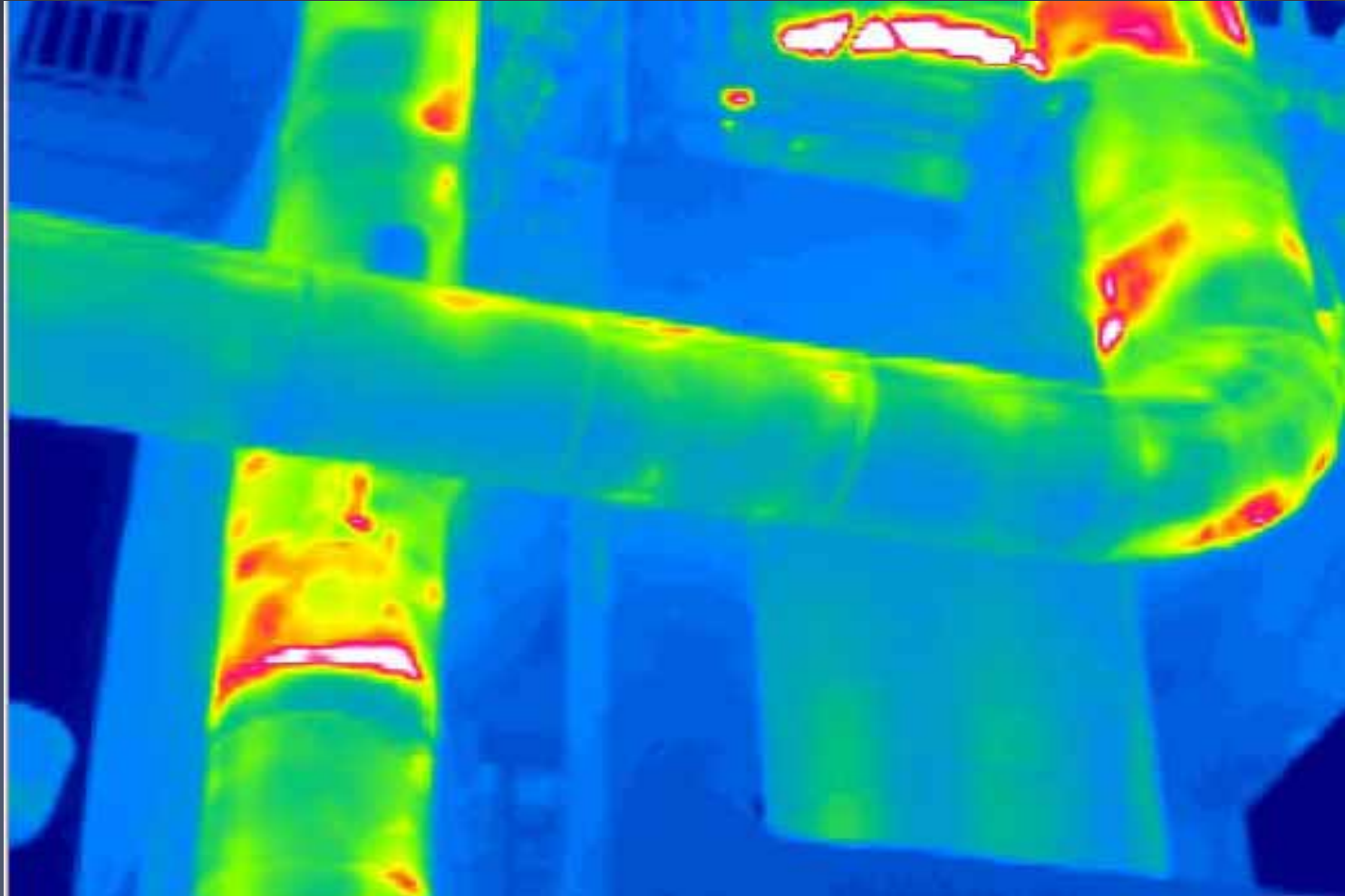


### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Heat loss )



■ Piping (lack of insulation)

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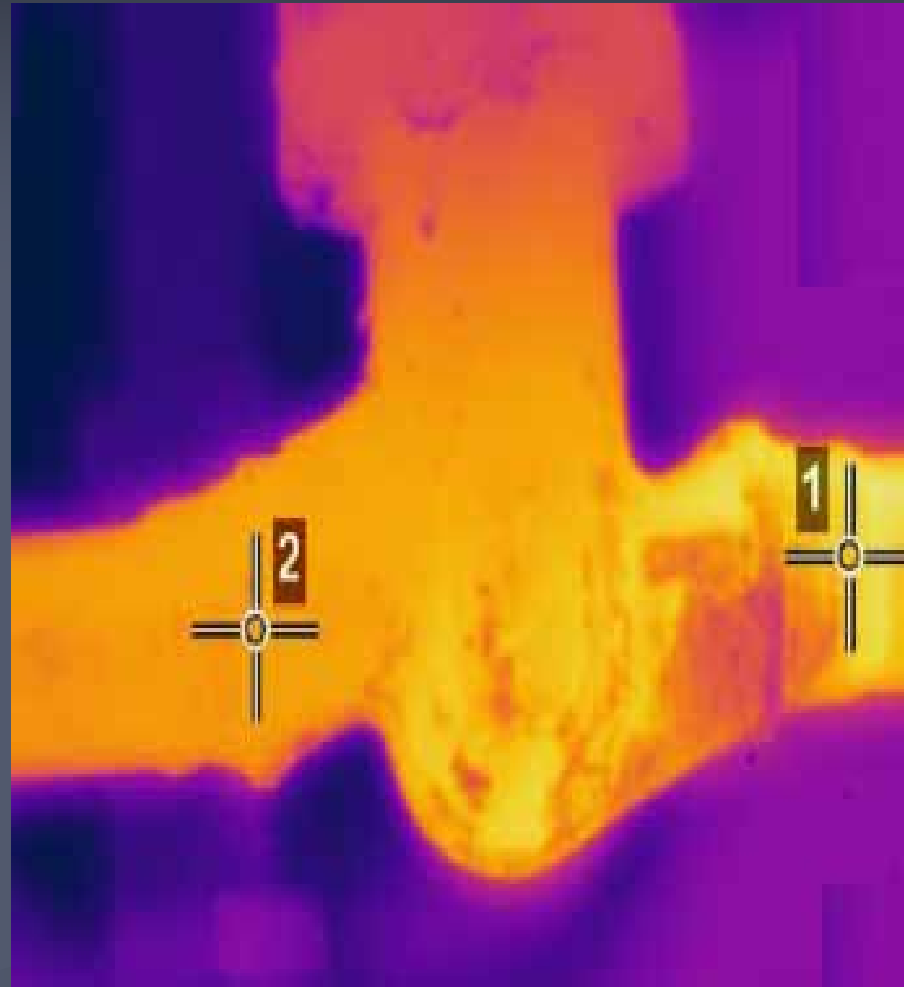
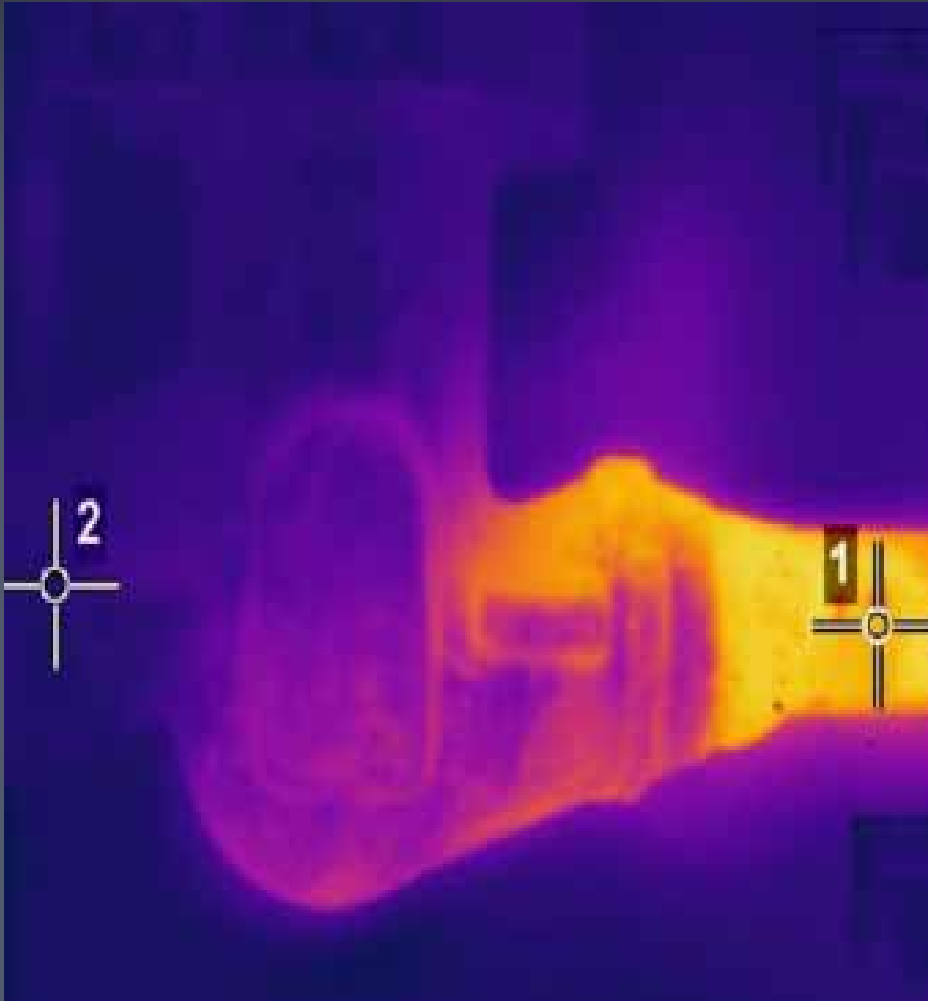
**Piping : lack of insulation**

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Leakages)



- Power plant Valves leakages

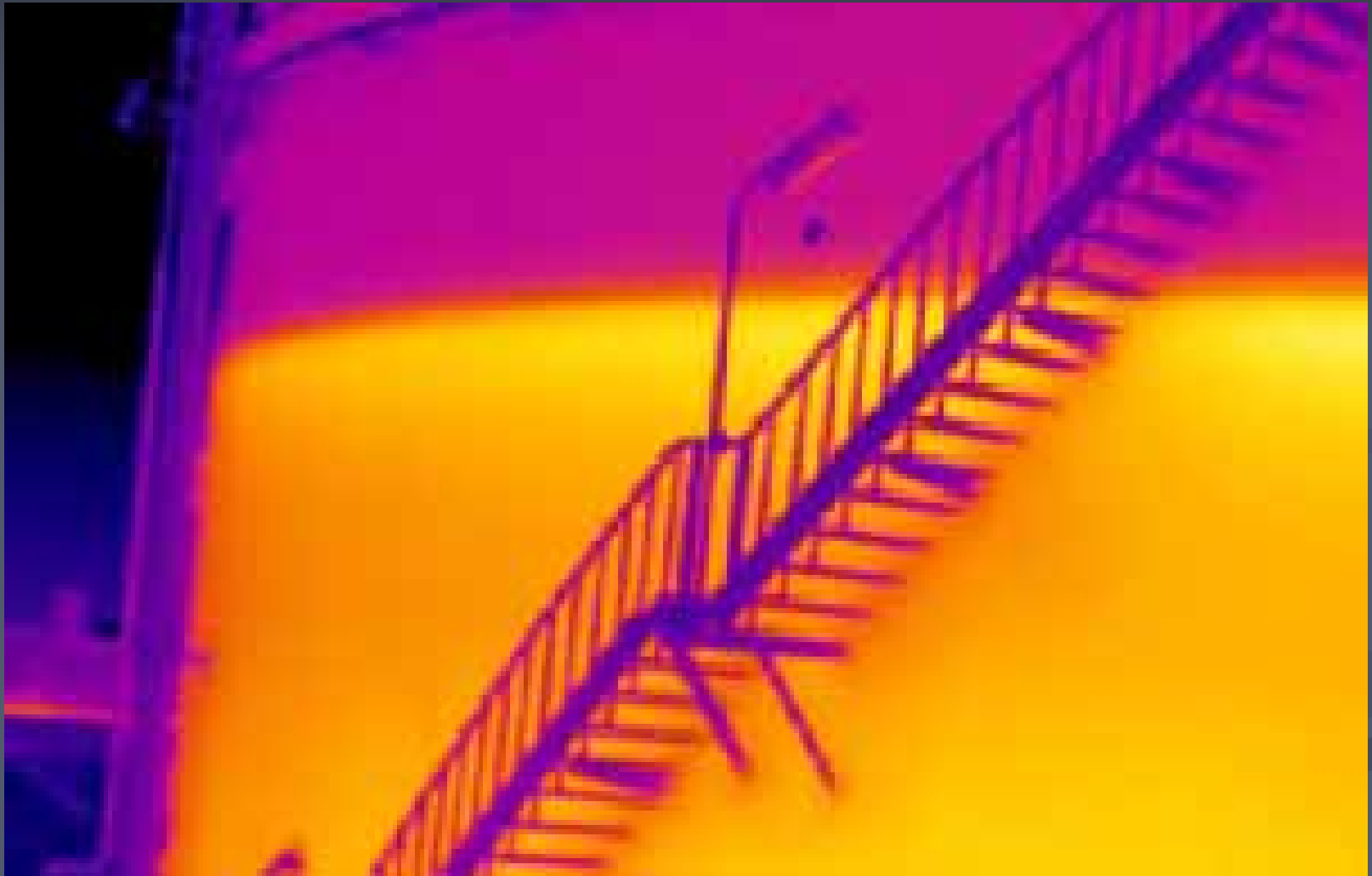
### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY (Leakages)



Power plant : Valves leakages

### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY

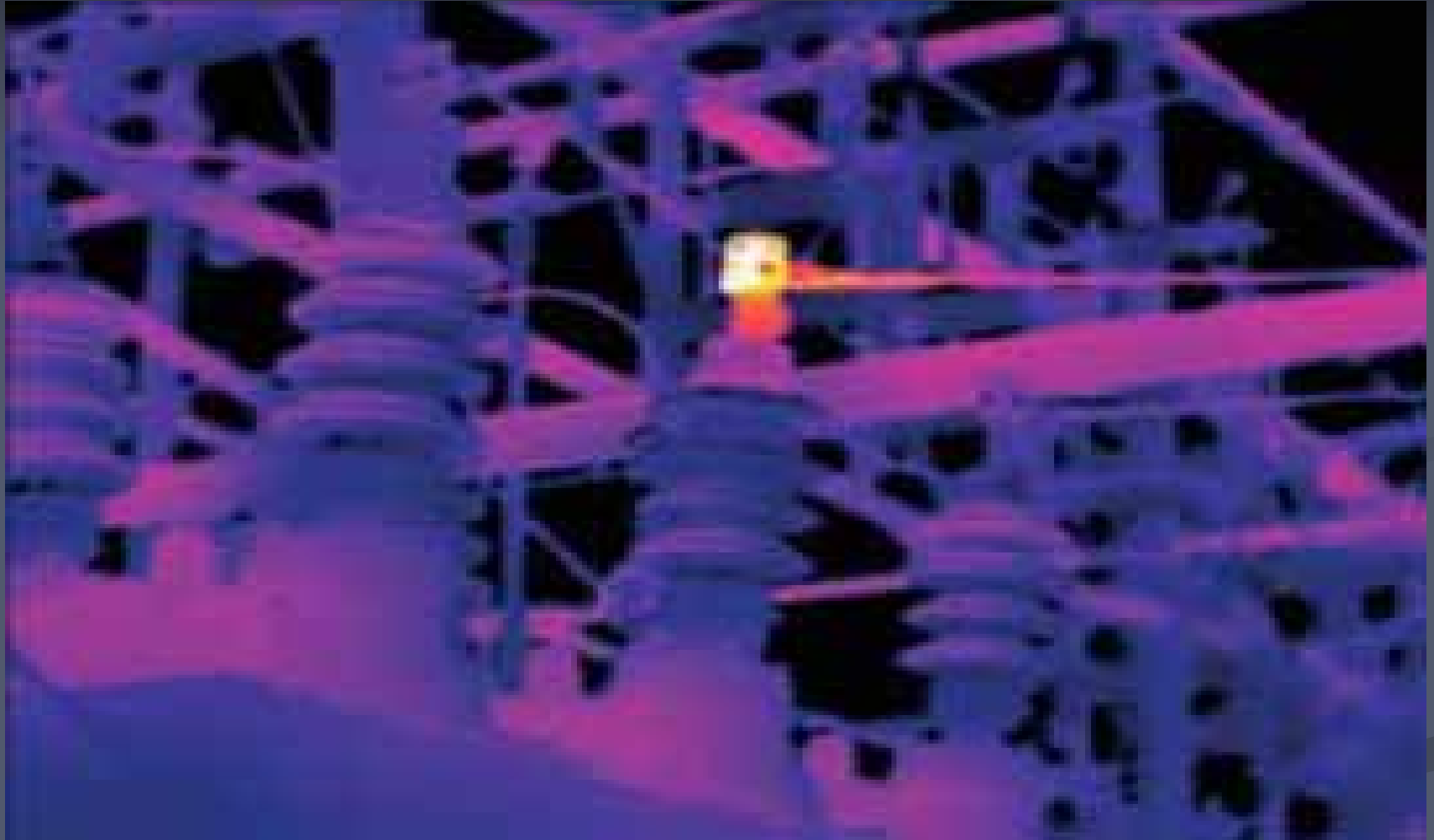
(Fluid levels in storage tanks and vessels)



- Refinery : Storage tank levels



### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY ( Electrical Distribution Systems )

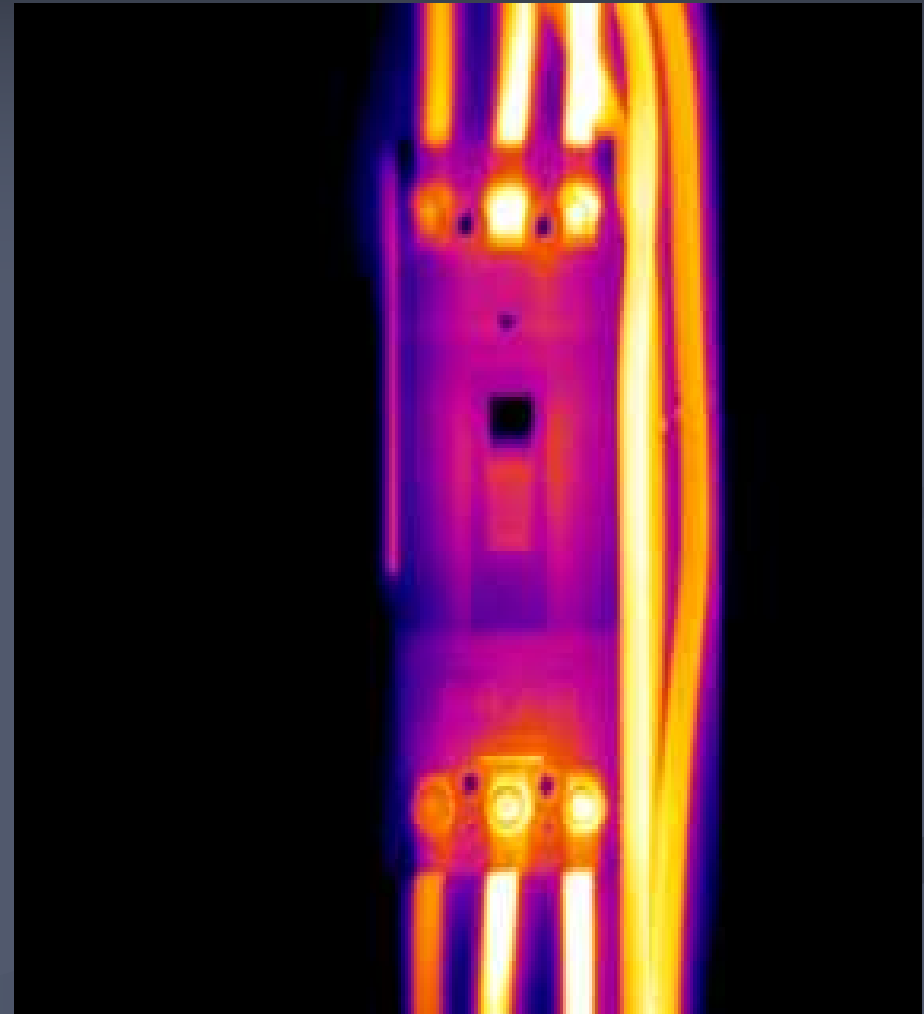


- Ultrahigh voltage power lines : poor connection

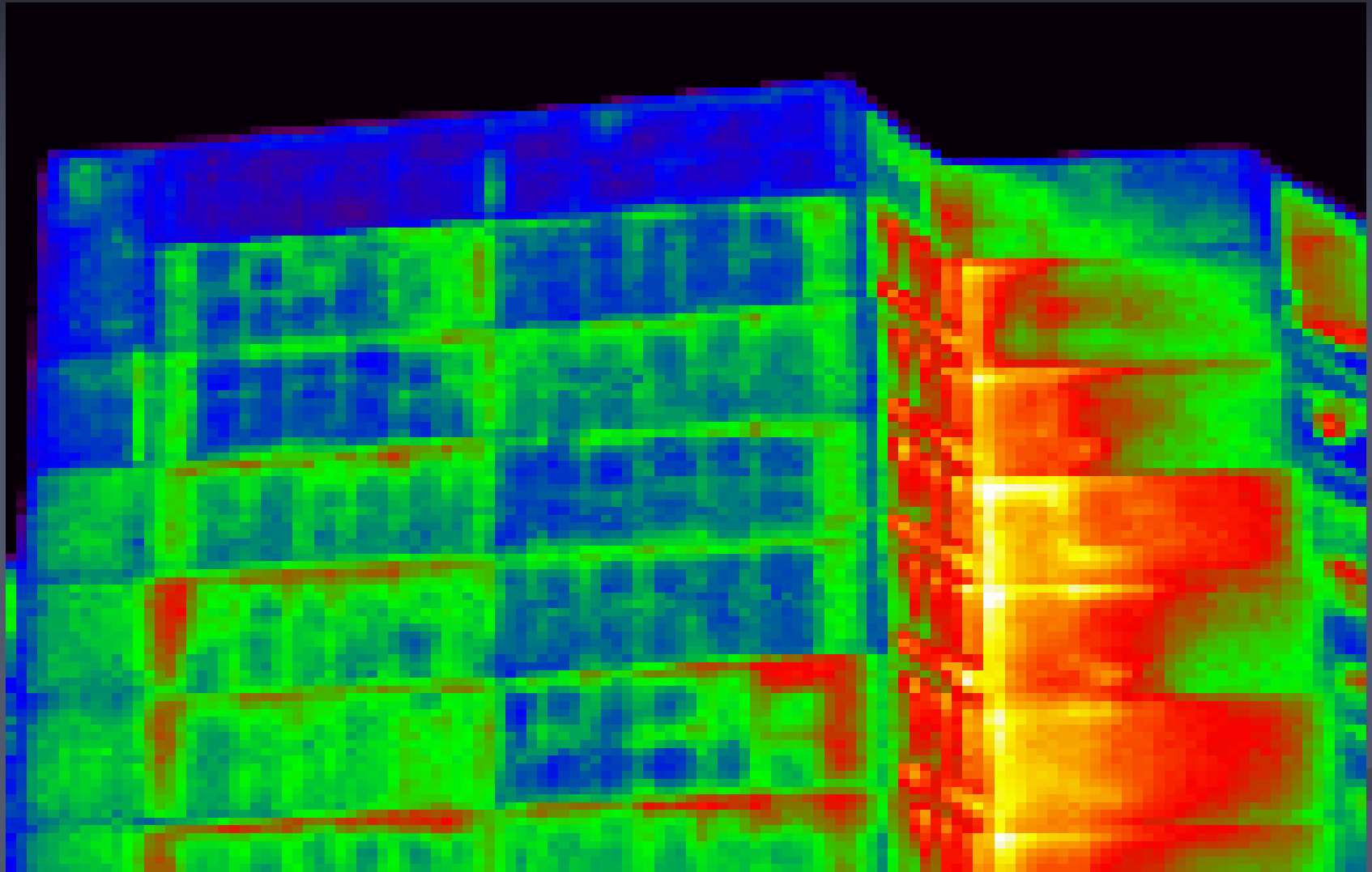
### 3.1 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY ( Electrical Distribution Systems )



Electric equipments (breaker)

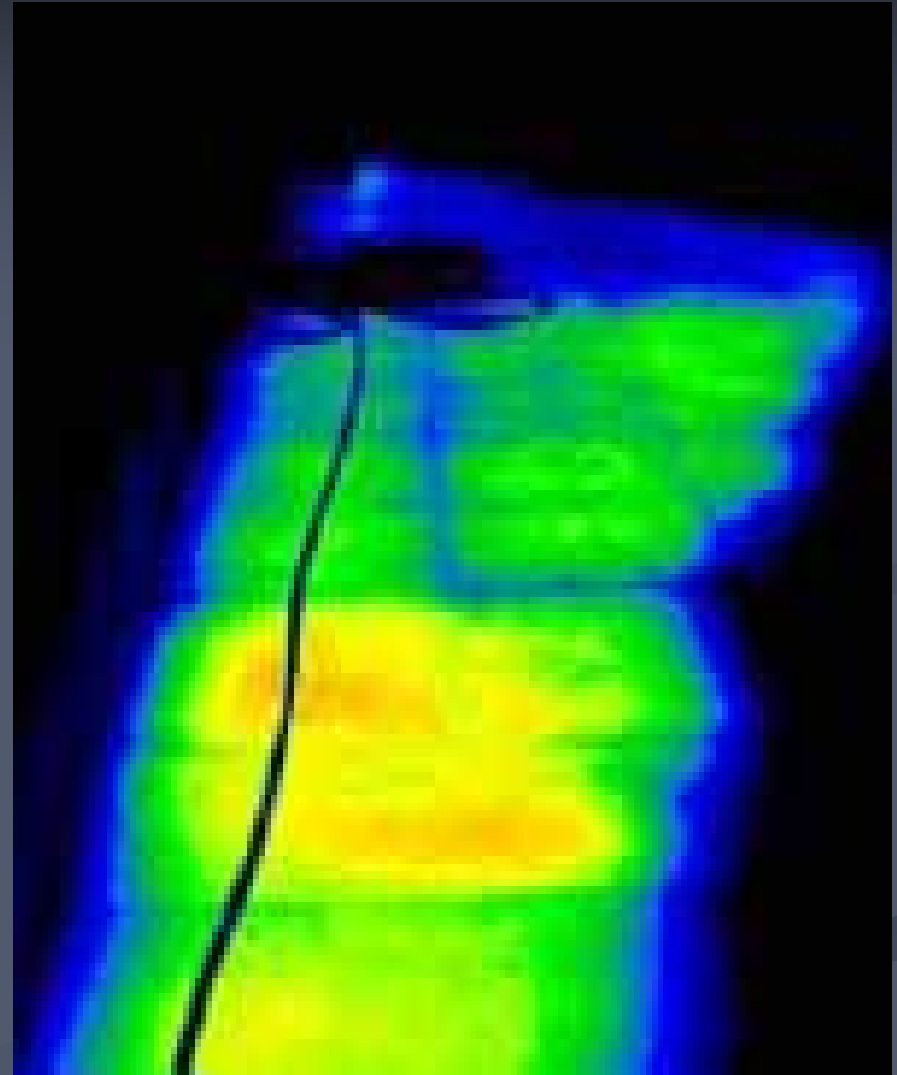


### 3. 2 INFRARED THERMOGRAPHIC AMAGING FOR CIVIL APPLICATIONS



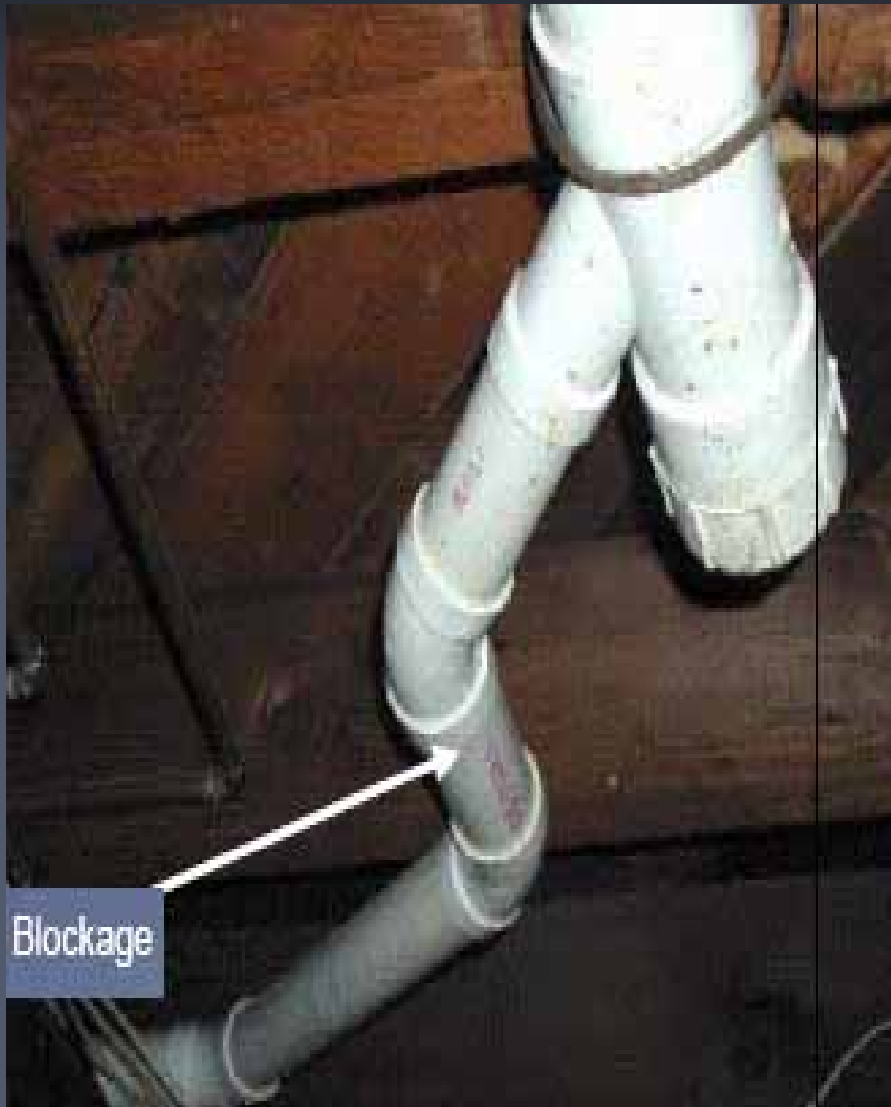
- Heat loss in buildings

### 3. 2 INFRARED THERMOGRAPHIC AMAGING FOR **CIVIL** APPLICATIONS



- Roof (trapped water)

### 3. 2 INFRARED THERMOGRAPHIC AMAGING FOR **CIVIL** APPLICATIONS



**Drain blockage at house**

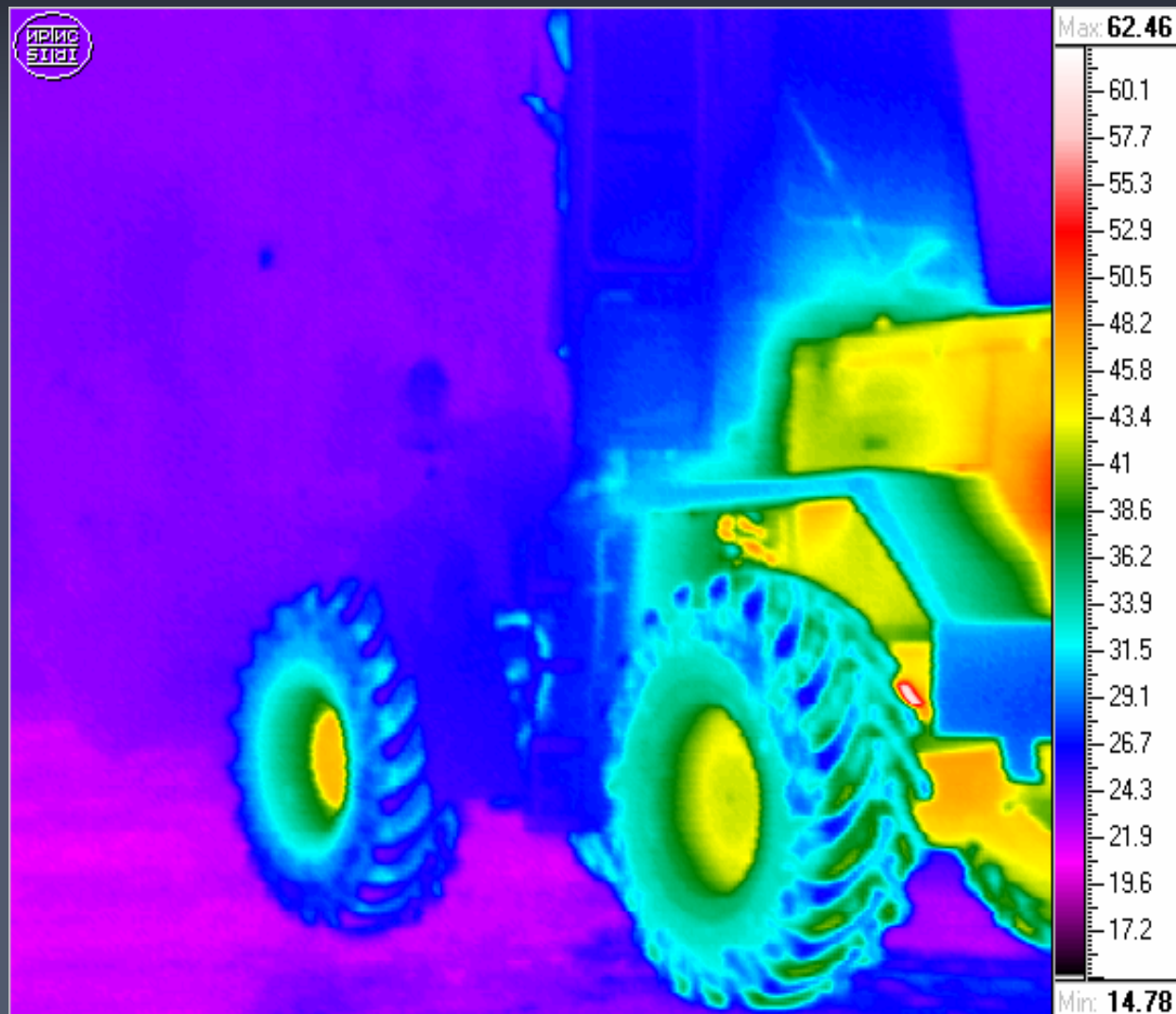


### 3. 3 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY



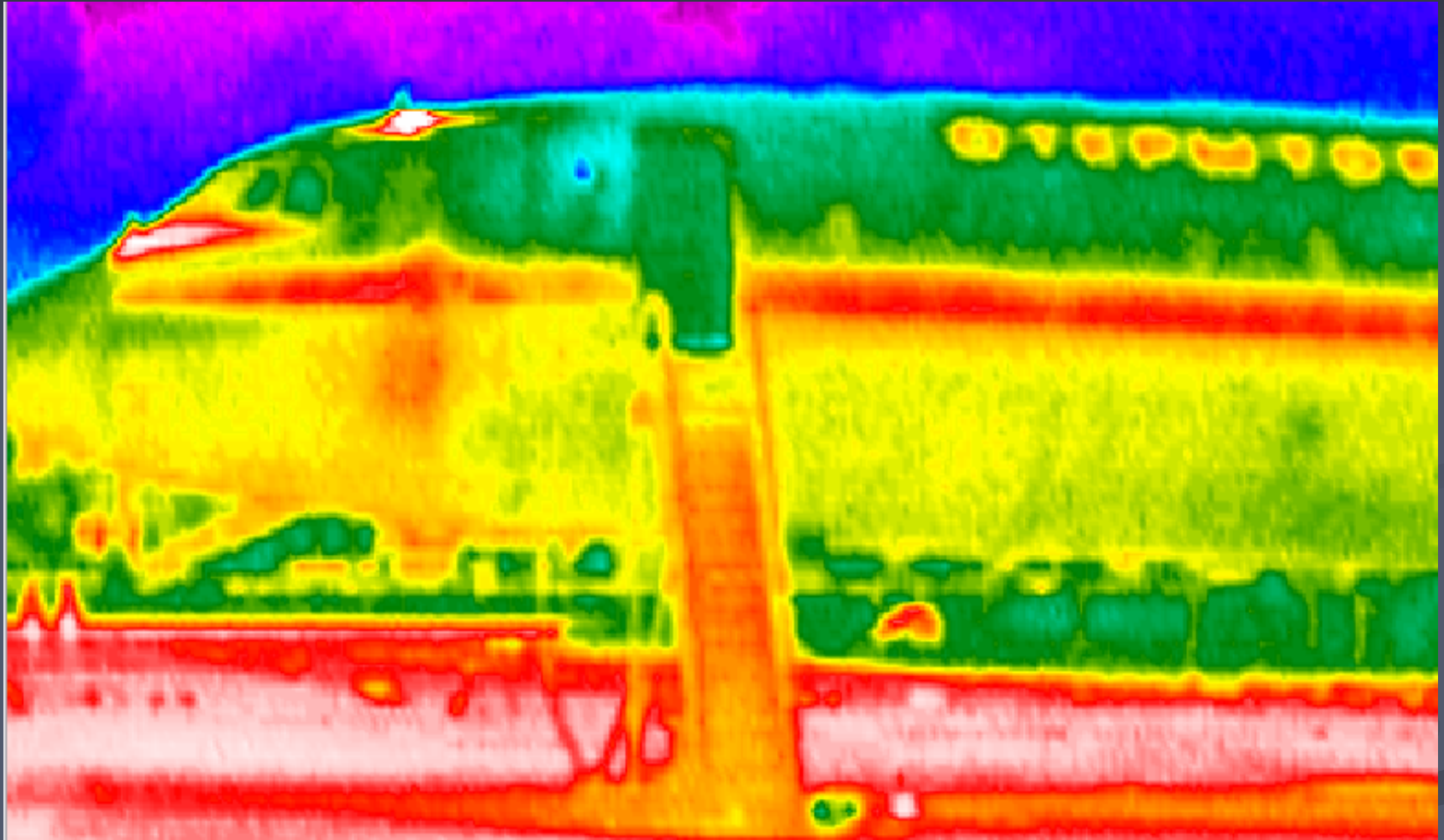
Tire testing

### 3. 3 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY



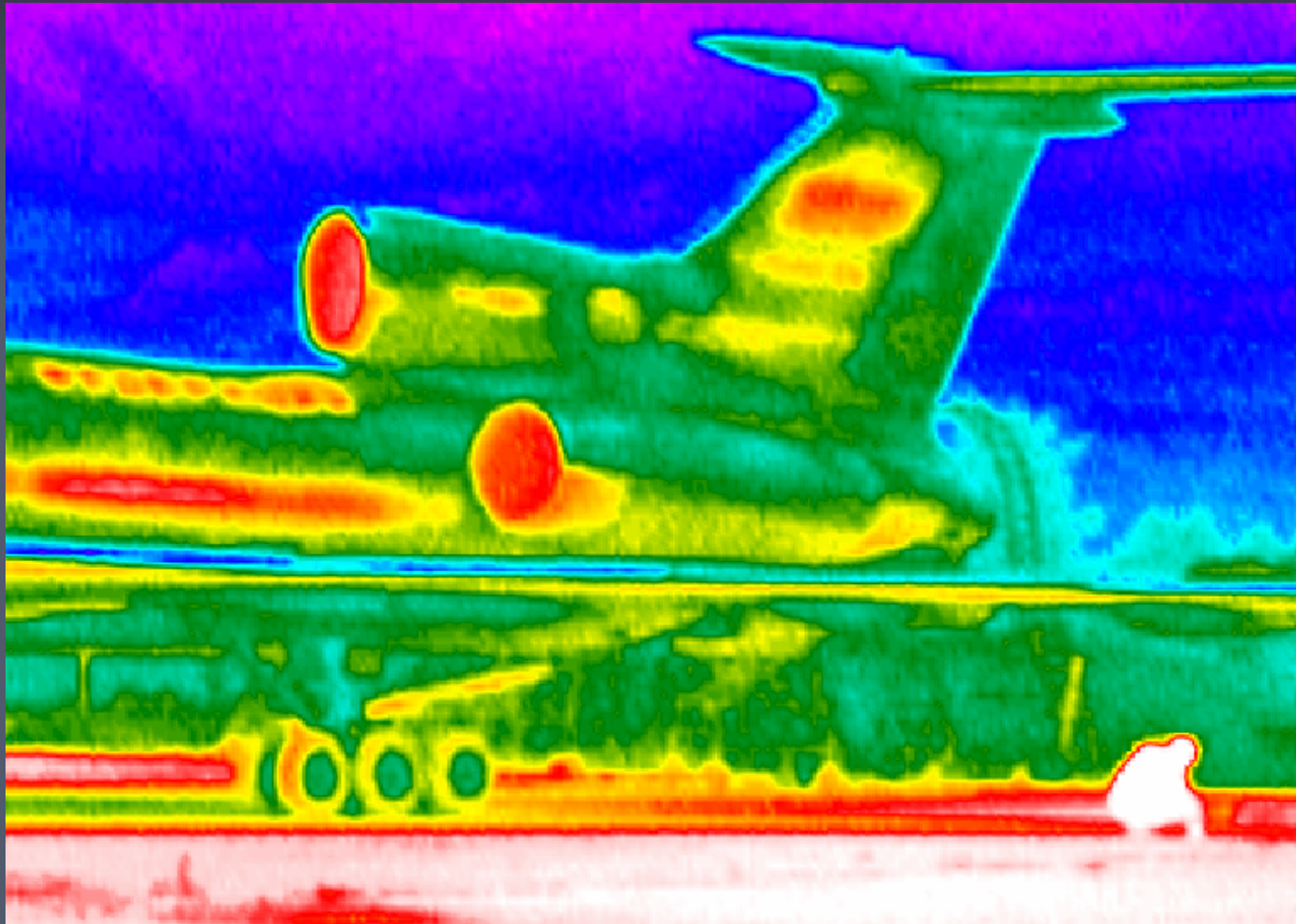
Vehicle inspection

### 3. 3 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY



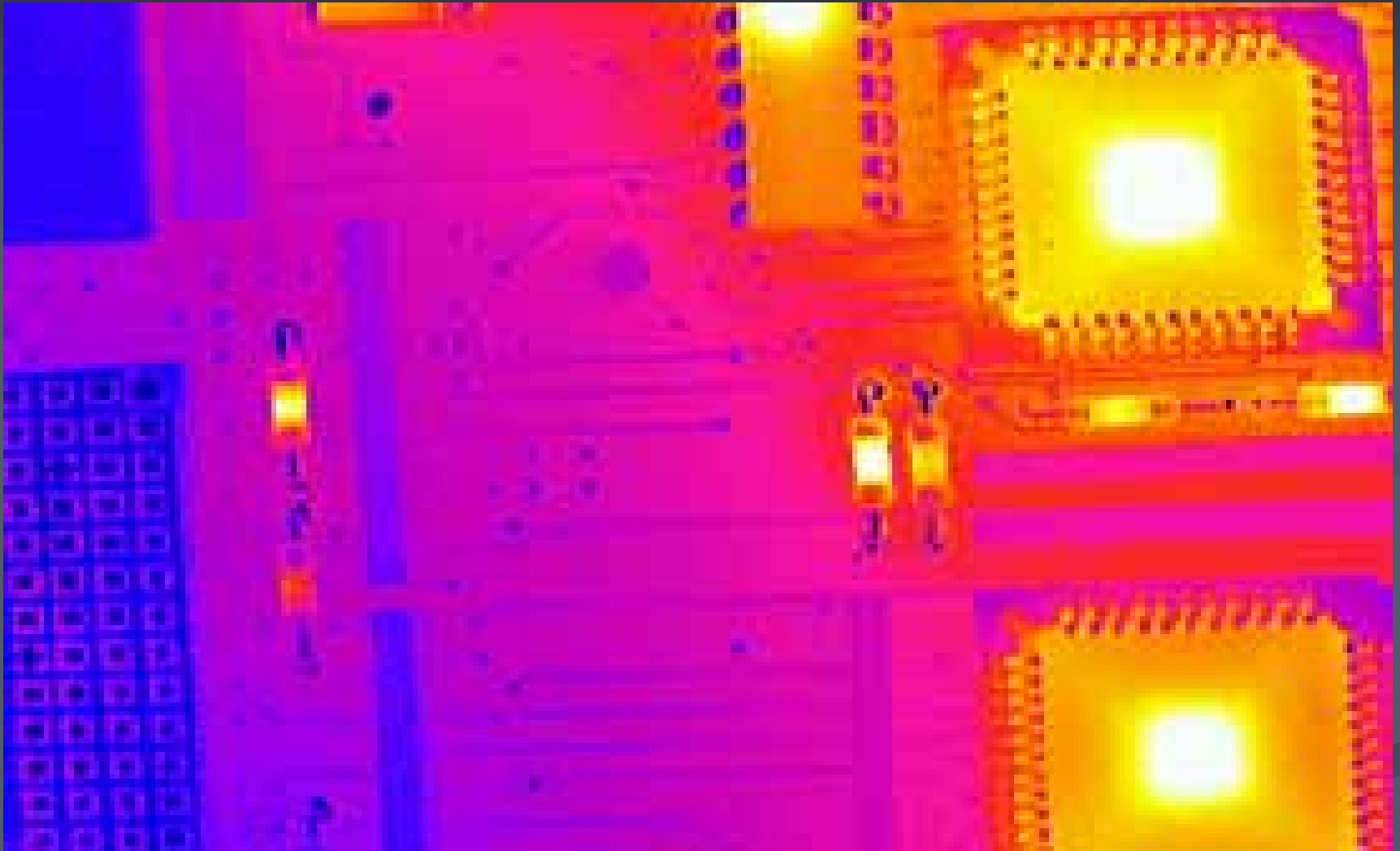
- Airplane inspection

### 3.3 INFRARED THERMOGRAPHIC AMAGING APPLICATIONS IN INDUSTRY



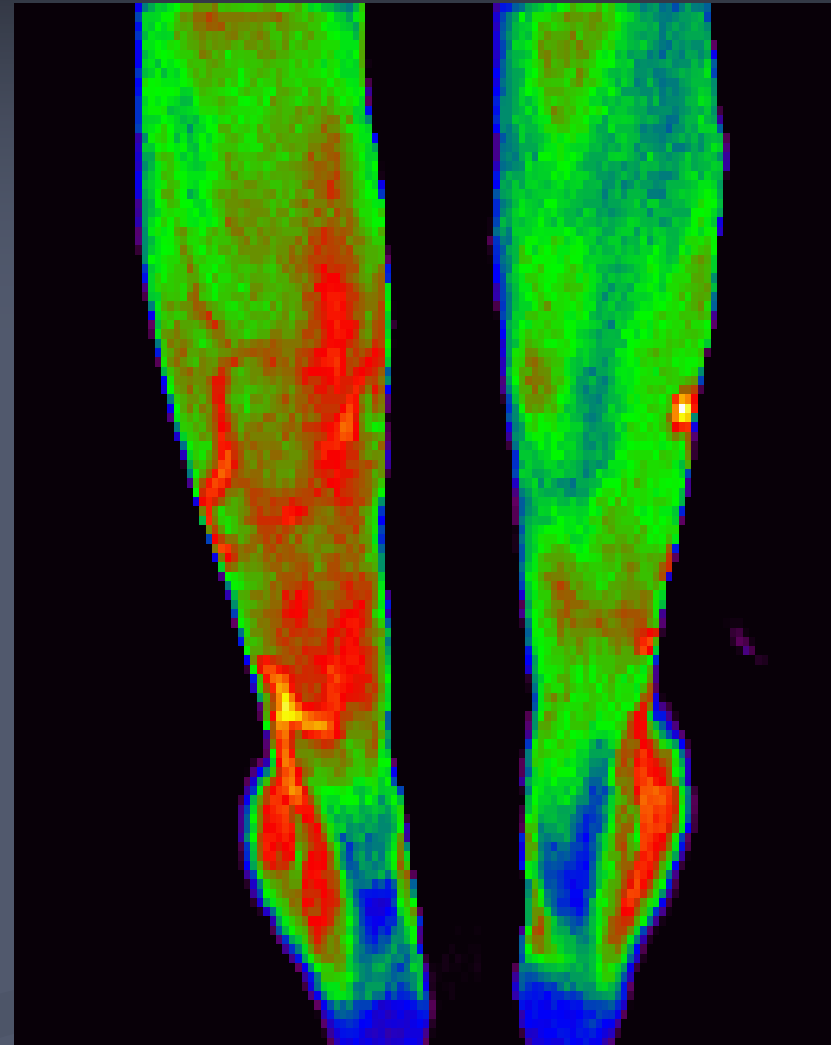
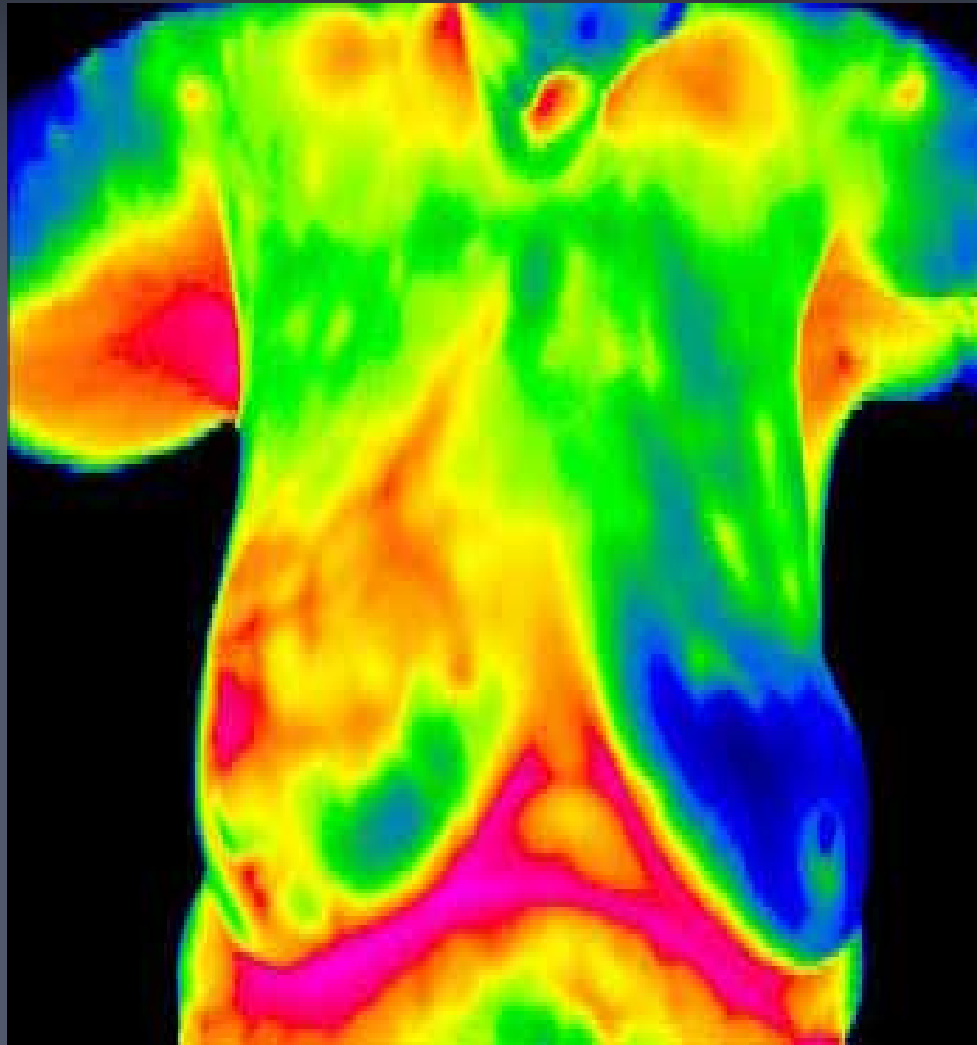
- Airplane inspection

### 3.2 INFRARED THERMOGRAPHIC AMAGING FOR ELECTRONIC COMPONENT APPLICATIONS



Computer components

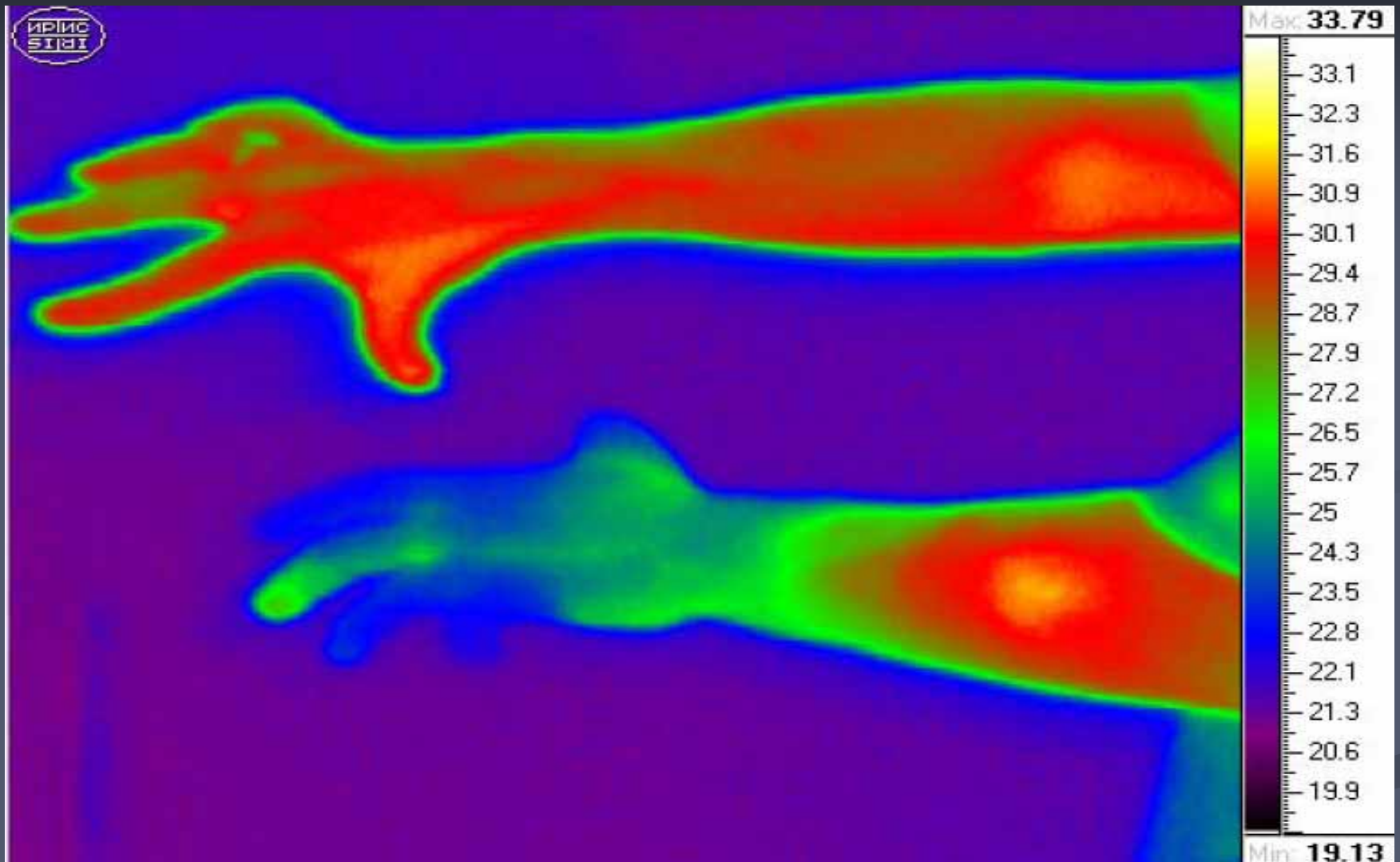
### 3.3 INFRARED THERMOGRAPHIC AMAGING FOR Medical APPLICATIONS



Diseases

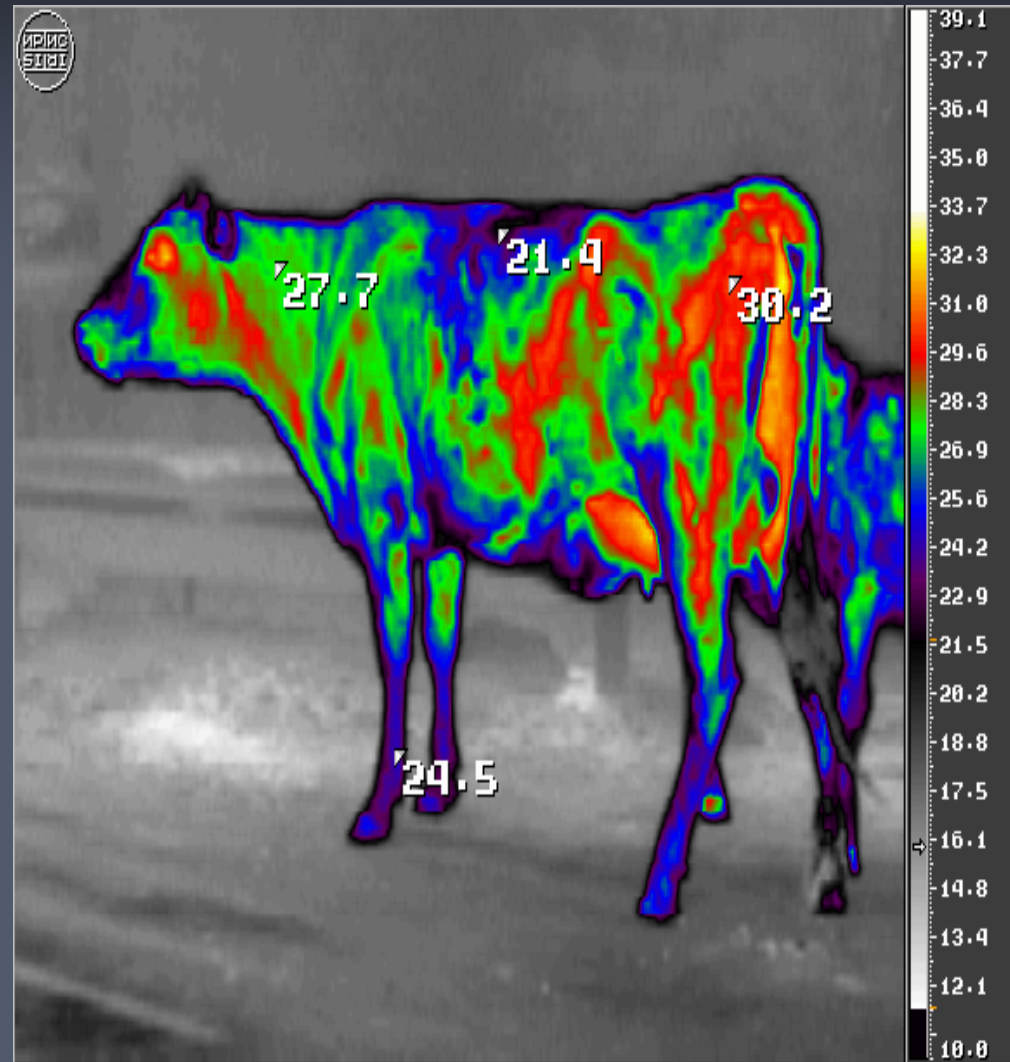
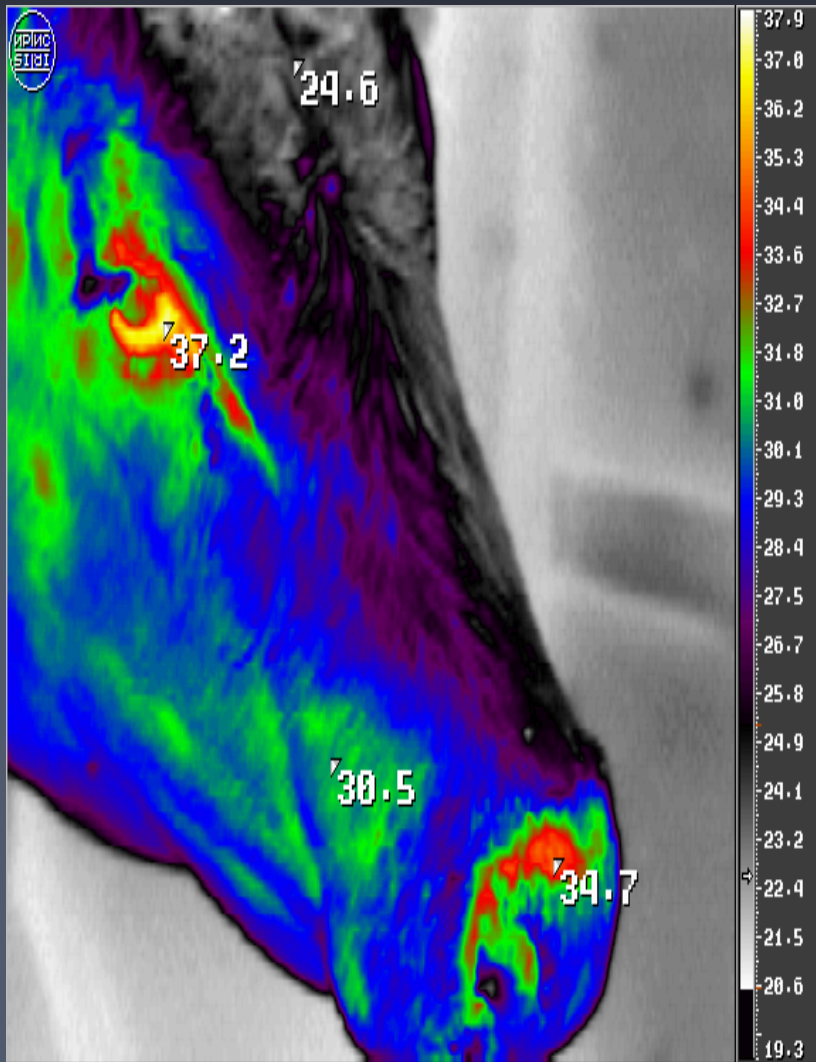


### 3.3 INFRARED THERMOGRAPHIC AMAGING FOR Medical APPLICATIONS



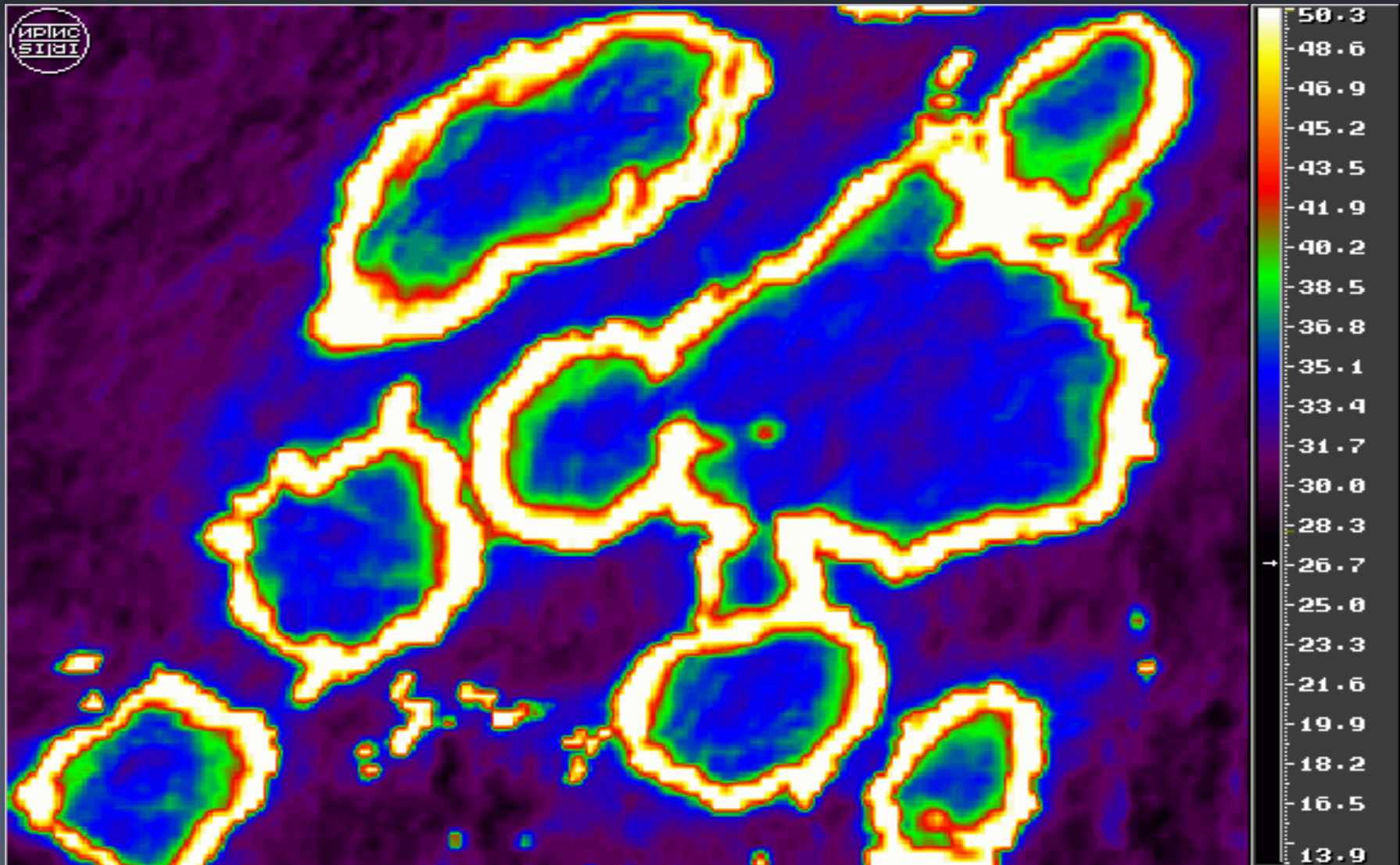
Disease

### 3.3 INFRARED THERMOGRAPHIC AMAGING FOR VETERINARY APPLICATIONS



disease

### 3.3 INFRARED THERMOGRAPHIC AMAGING FOR NFPA APPLICATIONS



■ Fire

# CONCLUSION

- Environmental effects such as wind direction and speed become will affect the results so the survey have to be repeated
- The thermographer have to know internal make – up of inspected equipments
- How and where to start the inspection and what route to take
- Performing infrared surveys is one of the most demanding application required in industry

**BEST REGARDS**