

Advanced condition monitoring.
Dynamic analysis applied to steam traps.

Introduction

What is a steam trap ? How does it work ? How does it fail ? All these subjects are thoroughly documented on the internet. Because it may affect the performance of a process if it fails, a steam trap is of those equipments that need to be regularly controlled.

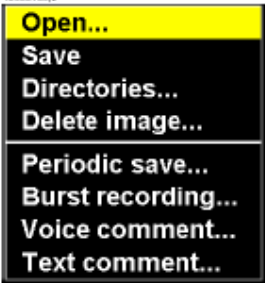
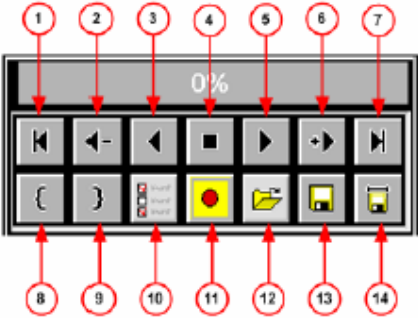
Infrared thermography is an excellent tool

How to use a thermography camera to detect a steam trap fault ?

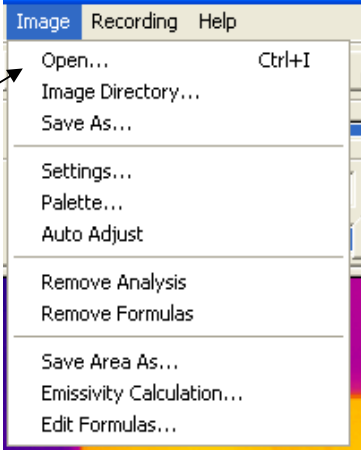
According to A. Bandes and B. Garelick (in *Inspect Steam Traps for Efficient System*. Faulty or inoperative steam traps can cause losses of hundreds of thousands of dollars. Alan Bandes UE Systems, Inc., Elmsford, NY and Bruce Gorelick Enercheck Systems, Charlotte, NC) *Thermal inspection relies on upstream/downstream temperature variations in a trap.*

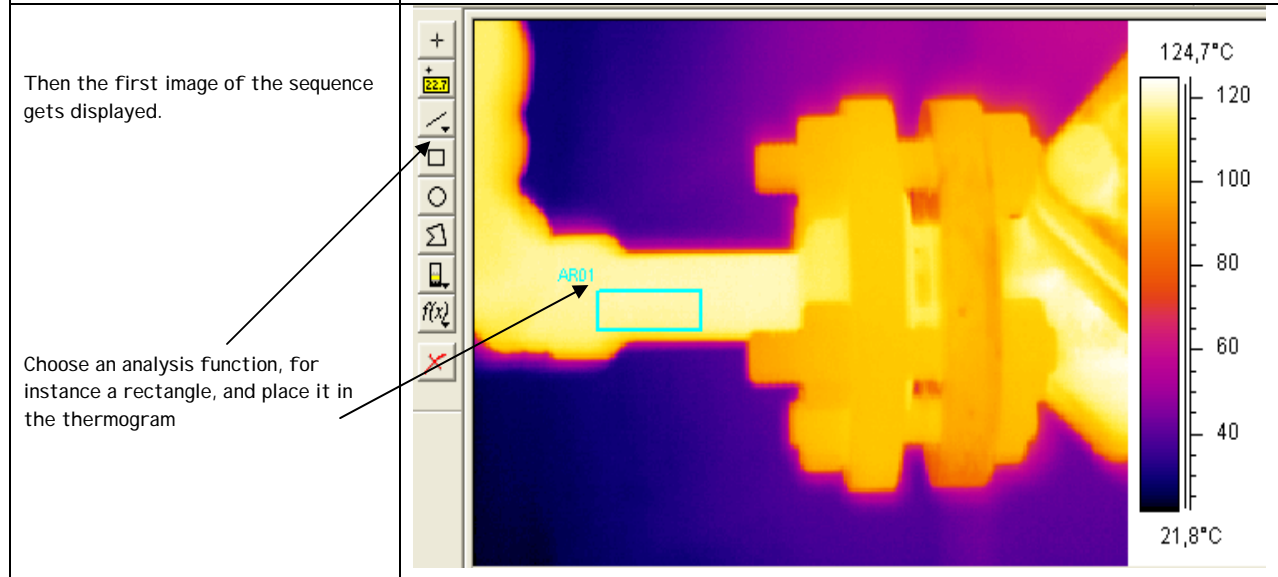
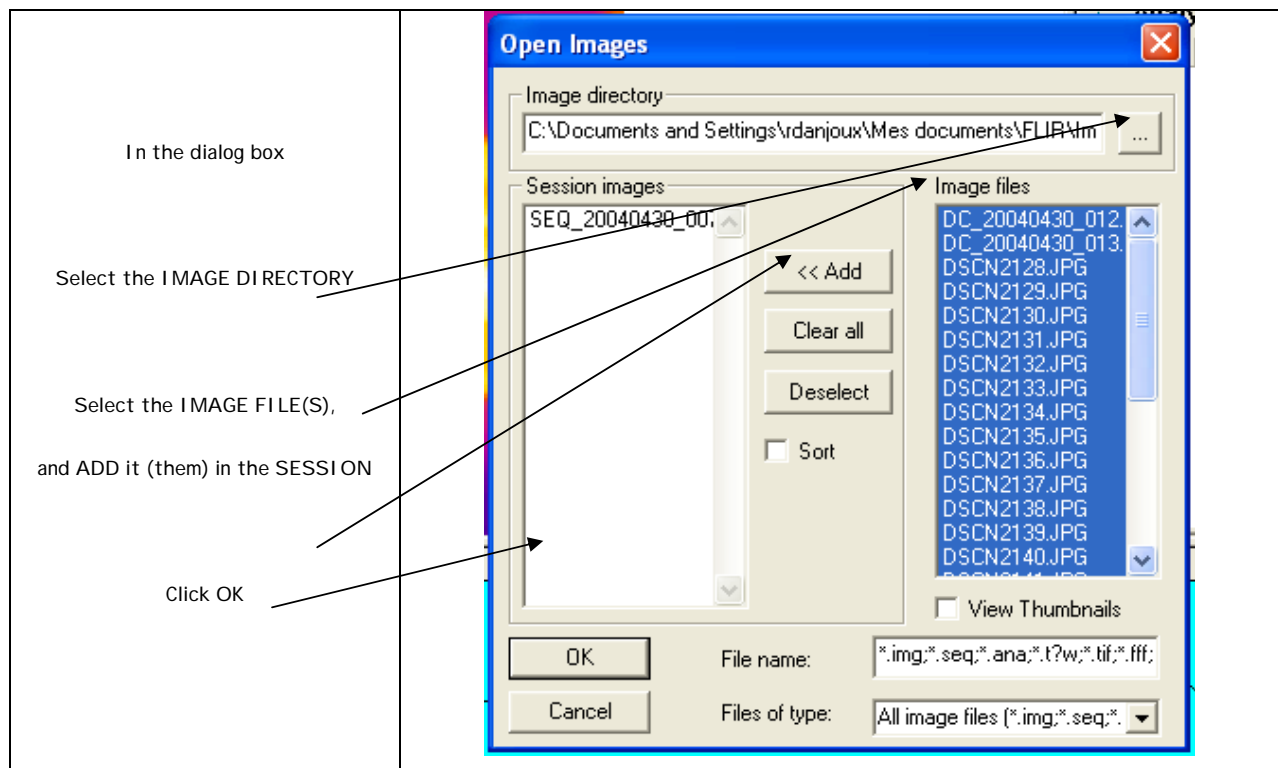
In other words, you need to store, and further analyze a sequence to get full data. Very few customers do that ; at least in France ; and most inspections rely on static analysis of a single thermogram. First of all, few cameras are equipped with such a feature (S60, S65 and others in option). Then, although sequences can be displayed in ThermaCAM Reporter 7.0, the software does not allow for time plotting. Reporter 2000 had a trending function that could do it on a series of single images but not on a sequence. Better take ThermaCAM Researcher !!

Taking a sequence with a ThermaCAM S60/S65 (or a P equipped with the optional burst)

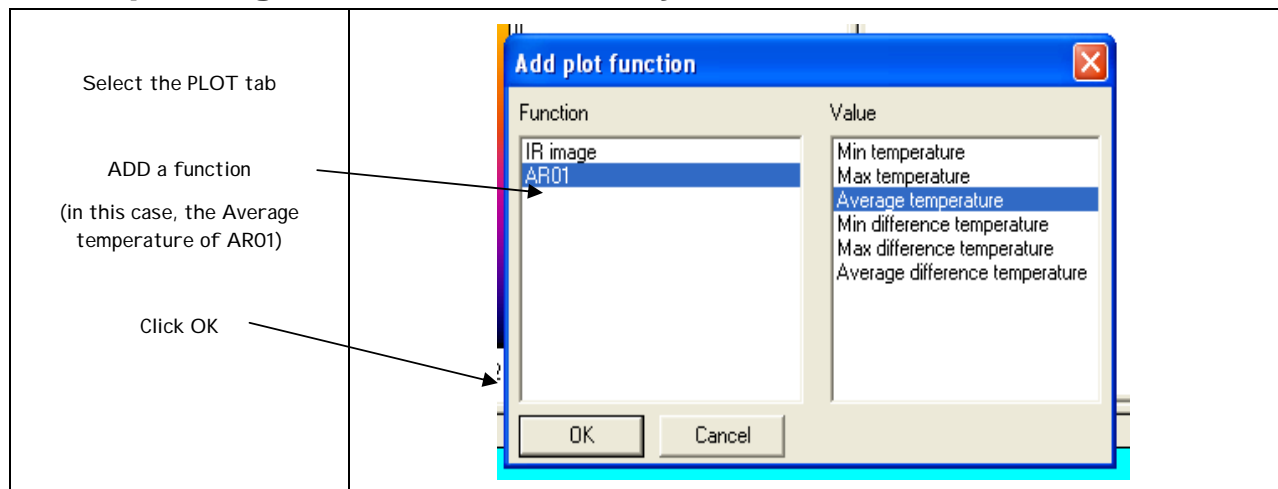
<p>Go to the FILE menu, and select BURST RECORDING.</p>	
<p>Move the cursor to the SETTINGS (10) Set the period to the shortest possible (every 2 images for instance) Set the mode to LINEAR</p> <p>Start RECORDING (11)</p> <p>When done, SAVE the sequence (14)</p>	

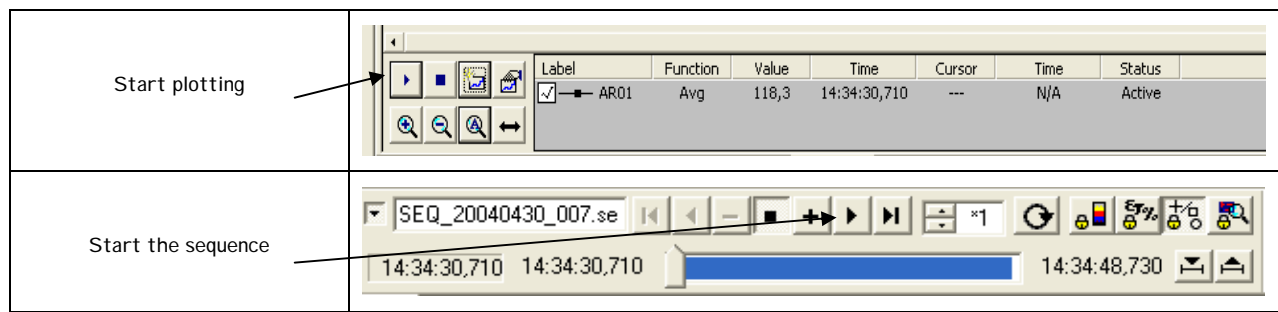
Opening a sequence with Researcher

<p>Select IMAGE > OPEN</p> <p>Or click on the shortcut icon</p>	
--	--



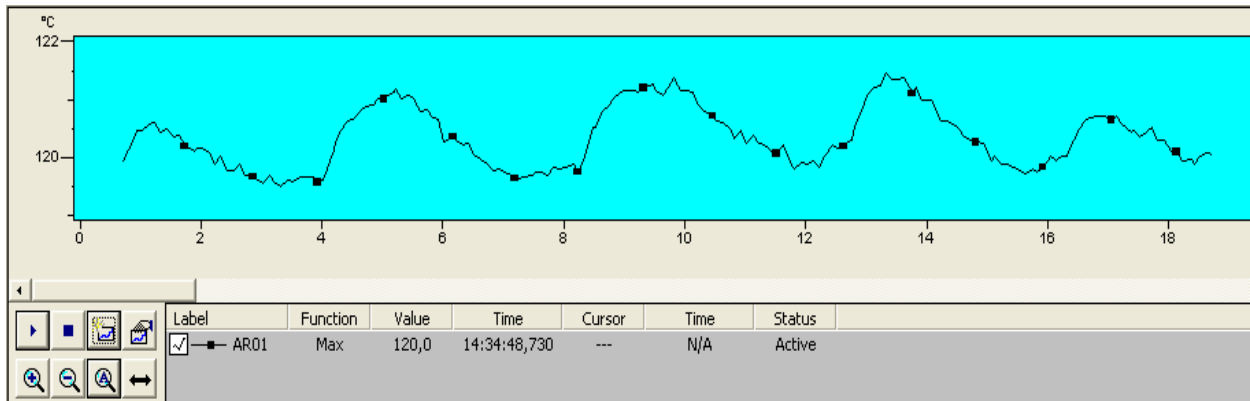
Time plotting the value of an analysis function



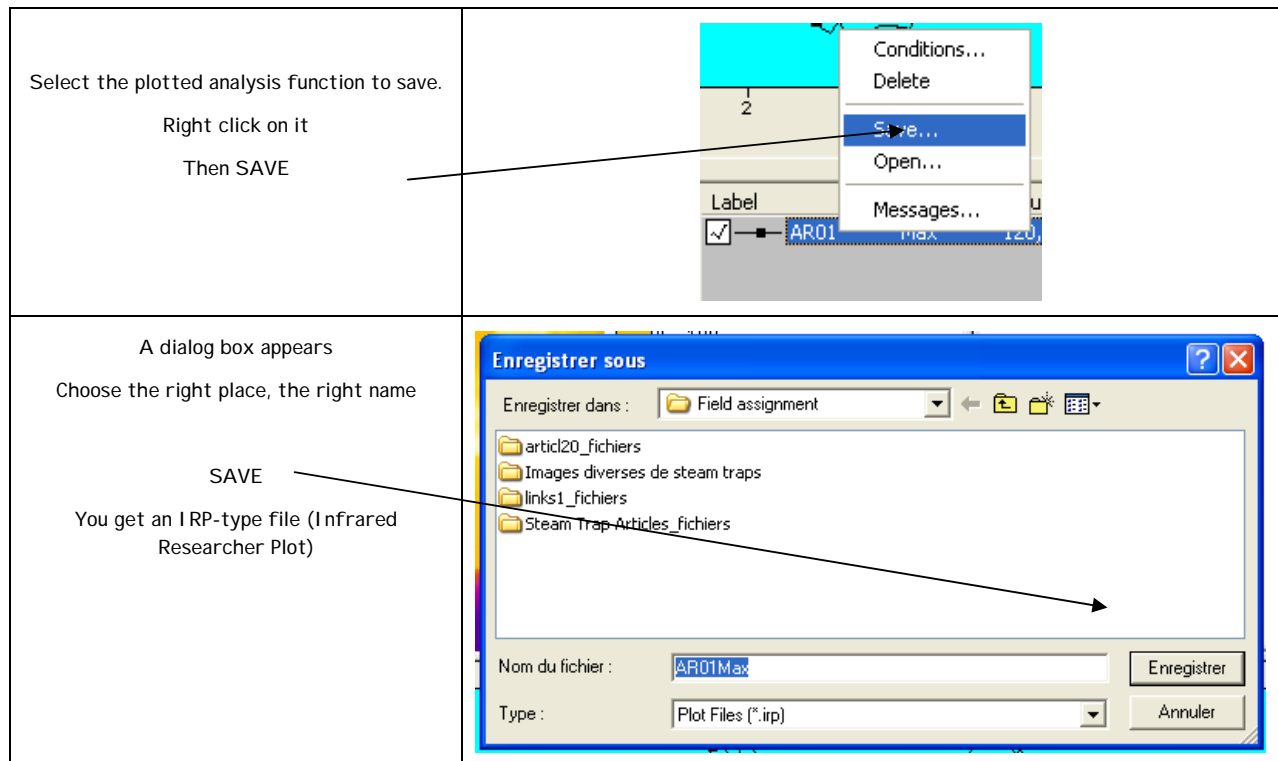


Then you get a time plot.

In the case of a sequence taken on a steam trap, the plot from the max temperature of the output pipe may look like this.



Saving the plot



Working with the plot file

A plot file (*.irp) is a text-style file, so very easy to open with Excel. Let the import assistant guide you (in my case, it is a French version of Excel 2003).

1) Choose fixed width.

Click on Next.

2) If the original unit is a temperature (Celsius, Kelvin or Fahrenheit) the first column presents values in Kelvin.

Place your separators.

Then, depending on the format you choose, you may get the acquisition time, even in milliseconds.

Click on Next.

3) Select the right data type for each distributed column.

Click on Done.

.....
And you get the data in an Excel sheet.

Assistant Importation de texte - Étape 1 sur 3

L'Assistant Texte a déterminé que vos données sont de type Délimité.
 Si ce choix vous convient, choisissez Suivant, sinon choisissez le type de données qui décrit le mieux vos données.

Type de données d'origine

Choisissez le type de fichier qui décrit le mieux vos données :

Délimité - Des caractères tels que des virgules ou des tabulations séparent chaque champ.

Largeur fixe - Les champs sont alignés en colonnes et séparés par des espaces.

Commencer l'importation à la ligne : 1 Origine du fichier : M5-DOS (PC-8)

Aperçu du fichier C:\Documents and Settings\rdanjoux\Mes documents\FLIR\Imag... \AR01Max - SEQ_20040430_007.irp.

1	Type=2	Number=1	Value=3	IROutput=0
2	393,094	1083328470	710000	30/04/2004 14:34:30,71000
3	393,484	1083328470	890000	30/04/2004 14:34:30,89000
4	393,614	1083328470	930000	30/04/2004 14:34:30,93000
5	393,614	1083328471	030000	30/04/2004 14:34:31,02900

Assistant Importation de texte - Étape 2 sur 3

Cette étape vous permet de choisir la largeur des champs (séparateurs de colonnes).

Un séparateur de colonnes est représenté par une ligne fléchée.

Pour CRÉER un séparateur, cliquez à l'emplacement voulu.

Pour SUPPRIMER un séparateur, double-cliquez dessus.

Pour DÉPLACER un séparateur, cliquez dessus et faites-le glisser.

Aperçu de données

Type=2	Number=1	Value=3	IROutput=0
393,094	1083328470	710000	30/04/2004 14:34:30,71000
393,484	1083328470	890000	30/04/2004 14:34:30,89000
393,614	1083328470	930000	30/04/2004 14:34:30,93000
393,614	1083328471	030000	30/04/2004 14:34:31,02900

Assistant Importation de texte - Étape 3 sur 3

Cette étape vous permet de sélectionner chaque colonne et de définir le format des données.

L'option Standard convertit les valeurs numériques en nombres, les dates en dates et les autres valeurs en texte.

Format des données en colonne

Standard

Texte

Date : JMA

Colonne non distribuée

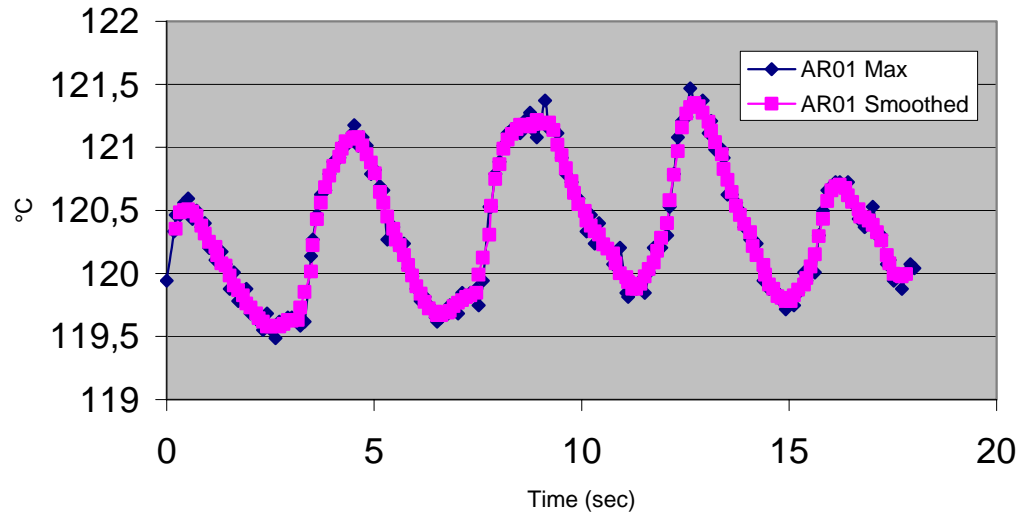
Aperçu de données

Standard	Standard	Standard	Standard	Standard
Type=2	Number=1	Value=3	IROutput=0	
393,094	1083328470	710000	30/04/2004	14:34:30,71000
393,484	1083328470	890000	30/04/2004	14:34:30,89000
393,614	1083328470	930000	30/04/2004	14:34:30,93000
393,614	1083328471	030000	30/04/2004	14:34:31,02900

Any further analysis is possible.

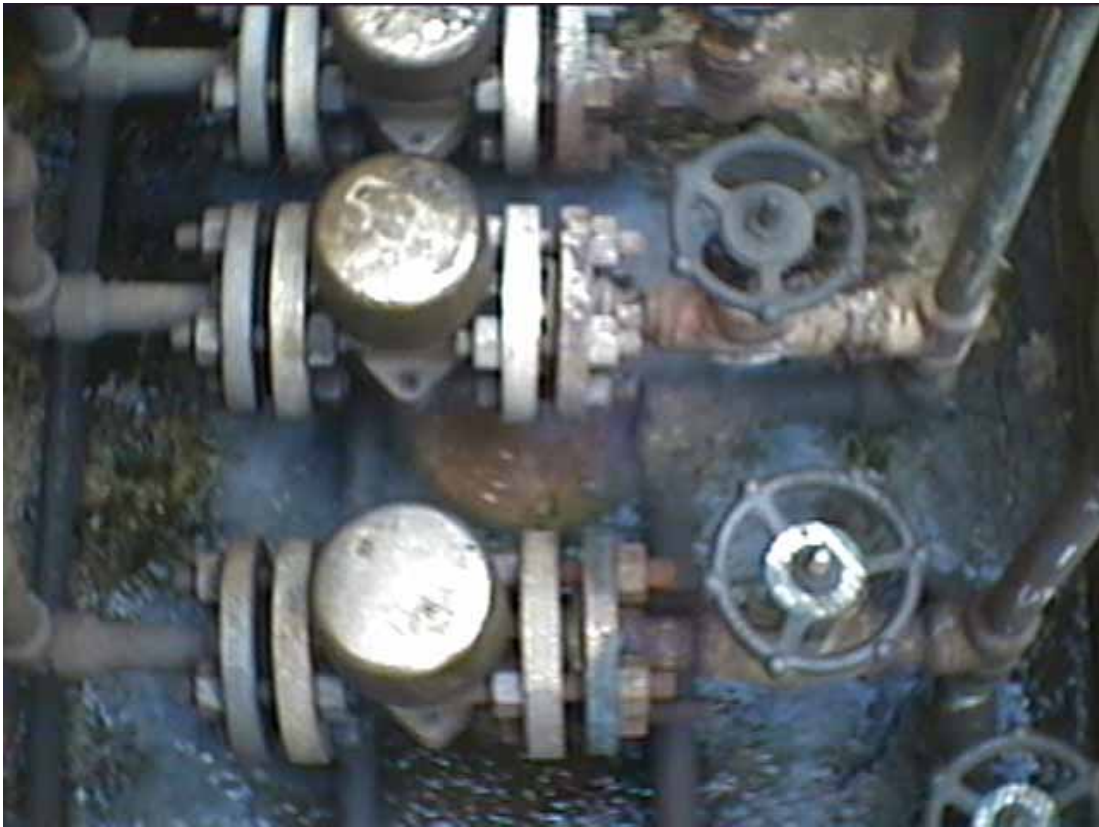
In the case of the steam trap, the initial signal is rather noisy, so a linear smoothing with a (5X1) operator gives a better result (see the details by double-clicking and editing the active inserted Excel object here below).

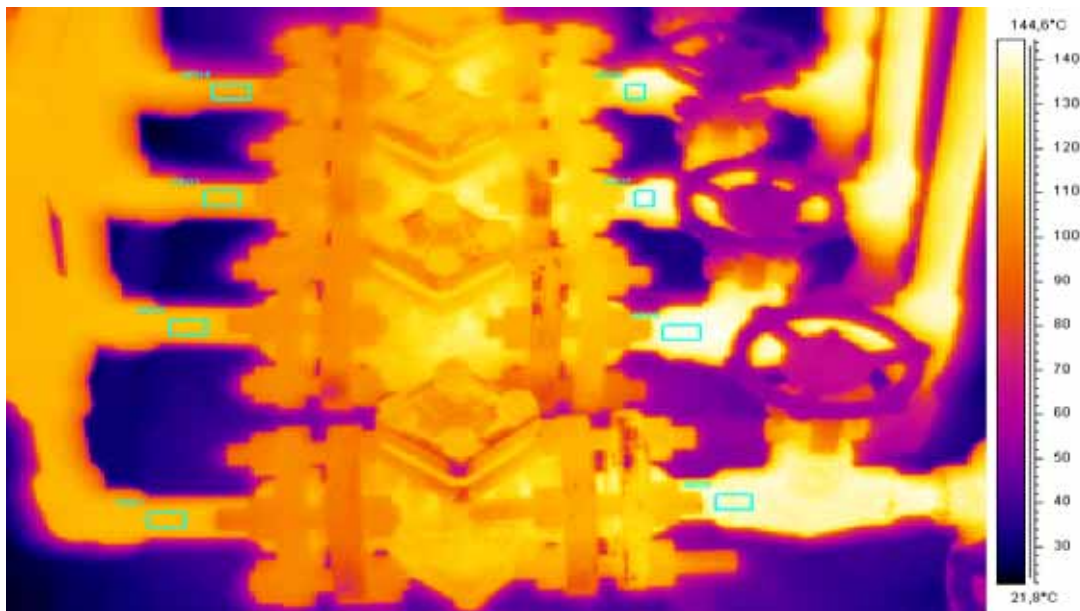
AR01 Max



For the duration of the acquisition the mean value is 120.26°C , the amplitude (peak to peak) is inferior to one degree and non constant. This latter may be due to all external possible parasites, probably the wind in our case. The period, however, looks rather stable : ca. 4.2 seconds.

A second sequence was grabbed with 4 steam traps in the field of view. Since there was no tripod used, a slight move between each thermogram was noticeable. The complete results, however, are equivalent to those presented before, and only one thermogram is shown here.





Conclusion

Considering the steam pressure, the fluid temperature, the type of equipment (discharge volume & duration), the production settings, etc, it should be possible to define for each steam trap a standard set of working factors for a reference baseline. Then, a monitoring would allow for tracing a trending curve. This is the basics for condition based maintenance and predictive maintenance.

APPENDIX 1

a) In English

1. Armstrong Steam Traps
<http://www.armstrong-intl.com/products/traps/st.php3>
2. Nicholson Steam Trap Home Page
<http://www.nicholsonsteamtrap.com/>
3. Philippopoulos S.A.
<http://www.philippopoulos.gr>
4. Power Plus International
<http://www.boilersupplies.com/>
5. Welcome to Hoffman Specialty - Offering a wide range of products for...
<http://www.hoffmanspecialty.com/>
6. Steam Traps - GESTRA GmbH. The global leader in steam trap design, control systems and production of valves for heat and process fluid control. ... Temperature-Control. Steam Traps. Check valves. level control ...
<http://www.blowdown-valves-steam-traps.com/>
7. Steam Traps - Sterling
<http://www.sterlco.com/steam-traps.html>
8. CU Services
Manufactures plug-resistant orifices to replace steam traps in high pressure and high temperature steam service.
<http://www.cuservices.net/>
9. Inspect Steam Traps for Efficient System. Faulty or inoperative steam traps can cause losses of hundreds of thousands of dollars. ... What is a steam trap? ..
<http://www.maintenanceresources.com/ReferenceLibrary/SteamTraps/Inspect.htm>
10. State Supply
<http://www.statesupply.com/>
11. Federal Technology Alert - Steam Trap Performance Assessment

- http://www.pnl.gov/fta/15_steamtrap/15_steamtrap.htm
12. Louisiana Steam Equipment, Inc.
http://www.steamsolutions.com/LSE/lse_main.htm
 13. Steam Trap Articles
Links to many articles on Steam Traps and Steam Systems. ... Maintaining Steam Traps Failed steam traps waste and adversely affect product quality. Therefore, a maintenance program for steam traps is a good investment ...
http://www.plant-maintenance.com/maintenance_articles_steam.shtml
 14. Steam Traps
<http://meds.iti.org/frame.asp?X=Steam+Traps&Y=background>
 15. Sterling Application Engineering
<http://www.sterlco.com/index.cfm?srccd=201>
 16. BDK Steam traps, leader in valves from india
<http://www.bdkindia.com/stream/stream.html>
 17. Inspect and Repair Steam Traps
http://www.plantsupport.com/download/STE_0011.PDF
 18. Spirax Sarco
<http://www.spiraxsarco.com/us>
 19. Steam Traps
<http://www.miyawakiusa.com/steam%20traps.htm>
 20. Yarway Corporation
<http://www.yarway.com/>
 21. Sterling Worldwide Sales
<http://www.sterlco.com>
 22. CU Services Thermal Analysis Systems
<http://www.cuservices.net/?source=looksmart>
 23. Inspect and Repair Steam Traps: Office of Industrial Technologies ...
<http://www.oit.doe.gov/bestpractices/steam/pdfs/traps.pdf>
 24. Enercheck Systems, Inc.
Systems for ultrasonic inspection of steam traps, electrical and compressed air/gas systems and reporting to plant personnel about energy losses and system design problems.
<http://www.enerchecksystems.com/>
 25. http://www.gestra.de/scripts/english/alpha.php?datei=progarm1.php&menue=eng_produkte
 26. maintaining steam traps
<http://www.enerchecksystems.com/articl20.html>
 27. Welcome to Bestobell Steam Traps - manufacturer of Delta Element Steam...
<http://www.bestobellsteamtraps.com/>
 28. Steam-A-ware Sizing & Selection Software
<http://www.armstrong-intl.com/products/stsoftware.php3>
 29. Yonggu Valves
<http://www.yonggu.com.cn/index.htm>
 30. Steam Traps and Vent Valves.
<http://www.steam-traps-vent-valves.com/>
 31. Armstrong International, Inc.
<http://www.armstrong-intl.com/armhome.html>
 32. PIPING VALVES INSULATION Steam Specialties Steam Traps - 5/3/04
<http://www.petropages.com/keywords/k4508.htm>
 33. Warren Bestobell

<http://www.warrenbestobell.co.uk>

34. Choosing Steam Traps
http://www.engineeringtoolbox.com/28_282.html
35. Steam Traps and repair parts
<http://www.tunstall-inc.com/>
36. Steam trap testing
<http://www.steamtraptesting.com>

b) In French, or translated into French

1. ... bien souvent associée à une solution dont la pression de la vapeur obéit à la loi de Raoult ... la composition de la vapeur dans le piège à distillat change graduellement ...
http://www.er.uqam.ca/nobel/dep_chim/CHI_2413/Exp4_020103.doc
2. ARRAS MAXEI , Procédés pour la fabrication de transformateurs et machines tournantes.
... de vapeur des vernis et ainsi éviter les phénomènes de distillation de ceux-ci. Ils sont équipés de piège simple ou ... Piège pour groupe de vide type cartouche. Piège pour ...
<http://www.maxei.fr/lmp-pompe-vide.html>
3. Comment éviter l'accumulation de condensats dans les systèmes sans conditionnement de vapeur
... du système au moyen de pièges. à vapeur Piège à. vapeur Électrovanne. SYSTÈME TYPI QUE DE PURGE AVEC PI ÈGES À VAPEUR. Lorsqu'un piège à vapeur est utilisé pour la ...
<http://www.ccivalve.com/pdf/590.pdf>
4. Bouts De l'Homme De Chaudière - Purgeurs de vapeur De Maintien
... de vapeur peut ... piège échoue ouvert, il y aura un gaspillage d'énergie, la vapeur ne sera pas complètement consommée ou condensé dans l'échangeur et la vapeur soufflera à ...
http://worldlingo.com/wl/Translate?wl_lp=EN-FR&wl_fl=2&wl_url=http%3A%2F%2Fwww.boilerroomsupplies.com%2Ftips%2Findex.html