



# CENER

NATIONAL RENEWABLE  
ENERGY CENTRE

ADitech

## ON SITE INSPECTION OF PARABOLIC TROUGH RECEIVERS - ITR INSPECTION SYSTEM -

The purpose of the inspection is the classification of receiver tubes according to their status, based on the **thermographic measurement** of the surface temperature of the glass cover in operating conditions, on **theoretical modelization** and on **statistical analysis**. The tubes will be classified into 3 main groups: **Acceptable**, **Regular** and **Non Acceptable**.

### THERMOGRAPHIC INSPECTION

Main features of **CENER ITR Inspection System**:

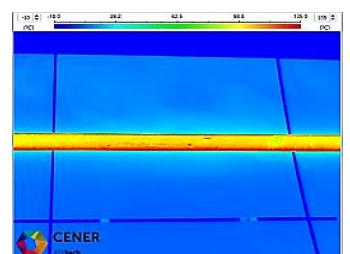
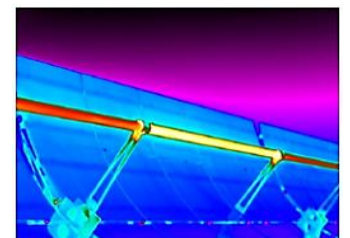
- **Non invasive system**, no interferences with plant normal operating conditions.
- **Terrestrial system**, inter-loops track, vehicle driven by CENER technicians (15-20 km/h).
- **Thermographic camera** system mounted on mast adjustable in elevation and orientation.
- **IR imaging** (videos) to obtain the surface temperature of the receiver tubes glass cover.



### PROCESSING AND ANALYSIS OF INFORMATION

Main functions of **CENER ITR Software**:

- **Automatic detection** of the tubes.
- **Representative temperature measurement** of the glass tube.
- **Comparison** of heat losses estimation and theoretical values from operating conditions.
- **Tubes status classification** based on an statistical analysis.
- **Historical Database Management** that allows the traceability and surveillance of periodic inspections.





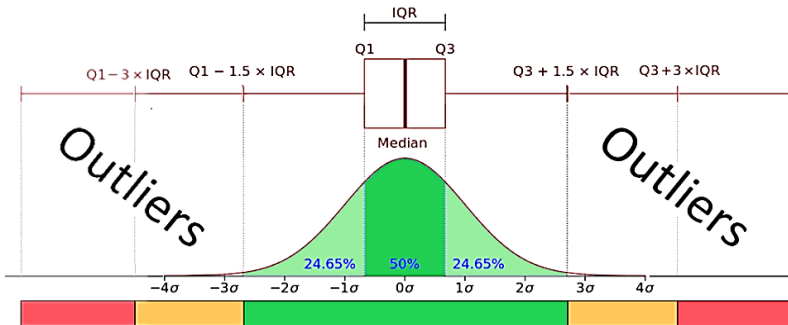
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## ITR SOFTWARE ANALYSIS

Depending on the measurement value, the software classifies tubes in three different states corresponding to three colours: **Acceptable**, **Regular** and **Non Acceptable**.



Example of a box-and-whisker plot statistical analysis for a normal distribution

### CENER ITR Software main features:

- **Comparison** of heat losses estimation and theoretical values from operating conditions and modelling.
- **Classification criteria** of receiver tubes status, including additional box-and-whisker plot for outliers statistical analysis.
- **Traceability and surveillance** of periodic inspections.

#	Tube	Estado	Fecha	# Brackets	Focus	Temp. estimada (°C/m)	Temperatura actual (°C)	Pérdidas (W/m)	Resistencia Térmica (K/m)	Resistencia Radiativa (K/m)	Validación	Comentarios
52	141	2008	2018	22	2015-08-26 10:07:07	63	222	69	174	20,27	Regular	✓ No tiene corrosión
53	140	2008	2018	22	2015-08-26 10:07:14	65	209	69	173	19,86	Regular	✓ No tiene corrosión
54	139	2008	2018	22	2015-08-26 10:07:18	61	209	69	173	21,17	Regular	✓ No tiene corrosión
55	138	2008	2018	23	2015-08-26 10:07:19	56	197	69	172	19,36	Normal	✓ No tiene corrosión
56	137	2008	2018	23	2015-08-26 10:07:20	60	204	69	172	18,51	Normal	✓ No tiene corrosión
57	136	2008	2018	23	2015-08-26 10:07:20	61	210	69	171	22,38	Regular	✓ No tiene corrosión
58	135	2008	2018	24	2015-08-26 10:07:21	72	273	69	171	26,79	Regular	✓ No tiene corrosión
59	134	2008	2018	23	2015-08-26 10:07:22	59	199	69	170	19,78	Normal	✓ No tiene corrosión
60	133	2008	2018	24	2015-08-26 10:07:23	60	207	69	170	21,50	Regular	✓ No tiene corrosión
61	132	2008	2018	23	2015-08-26 10:07:23	61	207	69	170	22,14	Regular	✓ No tiene corrosión
62	131	2008	2018	22	2015-08-26 10:07:24	50	197	69	169	18,26	Normal	✓ No tiene corrosión
63	130	2008	2018	23	2015-08-26 10:07:25	61	209	69	169	21,74	Regular	✓ No tiene corrosión
64	129	2008	2018	22	2015-08-26 10:07:25	57	190	69	168	18,83	Normal	✓ No tiene corrosión
65	128	2008	2018	23	2015-08-26 10:07:26	61	212	69	168	19,57	Regular	✓ No tiene corrosión
66	127	2008	2018	23	2015-08-26 10:07:27	59	192	69	167	19,68	Normal	✓ No tiene corrosión
67	126	2008	2018	23	2015-08-26 10:07:28	55	180	69	167	18,81	Normal	✓ No tiene corrosión
68	125	2008	2018	23	2015-08-26 10:07:28	56	184	69	166	19,26	Normal	✓ No tiene corrosión
69	124	2008	2018	24	2015-08-26 10:07:29	55	184	69	166	19,08	Normal	✓ No tiene corrosión
70	123	2008	2018	22	2015-08-26 10:07:30	43	114	69	165	16,06	Normal	✓ No tiene corrosión
71	122	2008	2018	22	2015-08-26 10:07:30	48	139	69	165	18,92	Normal	✓ No tiene corrosión
72	121	2008	2018	24	2015-08-26 10:07:31	47	136	69	165	17,27	Normal	✓ No tiene corrosión
73	120	2008	2018	23	2015-08-26 10:07:32	49	144	69	164	18,42	Normal	✓ No tiene corrosión
74	119	2008	2018	22	2015-08-26 10:07:33	50	150	69	164	18,46	Normal	✓ No tiene corrosión
75	118	2008	2018	22	2015-08-26 10:07:33	49	149	69	163	17,93	Normal	✓ No tiene corrosión

## MAIN FEATURES OF ITR INSPECTION SYSTEM

- This development has been done in order to facilitate performing **corrective, preventive and predictive O&M strategies** based on the surveillance over time of the receiver tubes state and its degradation mainly due to the vacuum losses inside the tubes.
- **Quick massive on site** inspection system:
  - One half loop (72-96 tubes) is inspected in 90 seconds.
  - One subfield is inspected in 1 day, 4000 tubes per day.
  - One 50 MW plant is inspected in 4 days.
- **Quick overview on site** of the state of tubes in plant:
  - Classification of receiver tubes according to their status.
  - Identification of tubes with non normal behavior (outliers).
- **Impact Production Indicator** for the solar field.

