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# SOLUTIONS FOR REFRIGERATORS

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# WE IMPROVE THE QUALITY OF PROCESS AND PRODUCT

Loccioni Industry works side by side to the top players of industrial sector, by doing automated quality test of their products, processes and buildings. Day by day challenging projects are faced with enthusiasm, inspiration and proficiency, collaborating with customers from the initial phase of prototype development to the realization of turnkey solutions.

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## A bit of Loccioni in every factory, all over the world

# SOLUTION FOR REFRIGERATORS

## LABORATORY

- > Vibration test (on the complete refrigerator or its components) to check the functionality of compressor fan
- > Aesthetic control by profilometry and artificial vision: alignment of doors or other components, surfaces check,
- > command panel check
- > Thermovision
- > Noise test (on the complete refrigerator and its components)
- > Data acquisition systems for any kind of measurements (temperature, energy, power, etc.)

## PRE-FABBRICATION

- > **Heating** element check
- > **Aesthetic** test for the detection of the perceived quality

## TURN-KEY TEST LINE & AUDIT AREA

Loccioni Home develops turn-key test lines for refrigerators composed by many areas, each one dedicated to a specific test.

Each area is connected to the system server monitoring and stores all data concerning products and system performances.

The data, stored in a consultable database, shall be analyzed through an appropriate data analysis software.

## SPECIAL SOLUTIONS

Loccioni Home special solutions for refrigerators are developed through:

### Infrared Analysis

- > Short time testing of 100% of refrigerator production through acquisition of

- > thermal images to
  - > Calculate the maximum values of temperature in pre-defined small areas
  - > placed in correspondence of the inlet and outlet tubes of the condenser and over the compressor. Starting from these values it is possible to build the set
  - > of features that will be used to classify the refrigerator.
  - > Detect over charging of the refrigerant gas
  - > Detect under charging of the refrigerant gas
  - > Detect collapsed tubes
  - > Detect obstructions

### Artificial Vision Technology

- > On-line artificial vision test on refrigerators to support:
  - > Assembly process
  - > Test and quality control system
  - > Functional and aesthetic test
  - > High precision measurement
- > Dimensional check of gap of refrigerators doors to check:
  - > Planarity
  - > Deepness measure
  - > Gap measure
  - > Door alignment
  - > Orthogonality
- > Colorimetry for display quality control to verify:
  - > The color display LCD and LED buttons
  - > Light and chromatic measurement on panels TFT, LED, display LCD, OLED
- > Surface quality control to detect defects on metal surface: scratches, bumps, etc.

### Noise & Vibration Technologies

- > On-line vibration test to detect:
  - > If the fans in the no frost refrigerator are running or not
  - > Possible defects related to the fan (e.g. unbalance, fixation on the shaft, touching parts)
- > On-line vibration test on compressors to analyze:
  - > Knocking head
  - > Springs
  - > Serpentine
- > On-line acoustic test on refrigerators to obtain:
  - > More accurate noise and vibration analysis
  - > Possibility to detect additional mechanical defects

### Process monitoring software

On line Statistical Process Control for process and products monitoring to evaluate:

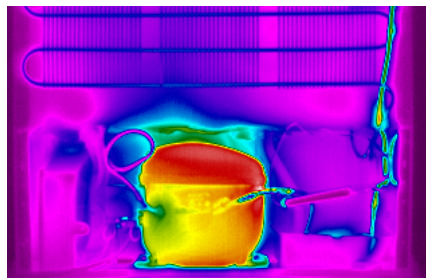
- > Number of faulty pieces
- > Efficiency of the stations/process
- > Status of the stations
- > Trends (production, type of defects, stop/running time, operators logged)

### Sustainability

Loccioni's competences and solutions are also focused on providing sustainable systems. Sustainability could be continuously monitored and checked by measuring the total consumption of energy, water, air of conveyor, testing equipments and instruments on the production line. These data, displayed in a monitor, could be also correlated to the production volume, enhancing the total sustainability measure of the whole system.



1. Refrigerators line



2. Infrared analysis

## Refrigerators Testing Line

### 1. Nitrogen test machine

Test for checking macro-leakages by means of nitrogen injection in the refrigerators circuit

### 2. Helium test machine

Test for checking macro-leakages by means of helium injection in the refrigerators circuit

### 3. Helium recovery station

After recovering the helium loaded on station 2 a check history test will process the results of the two previous stations and will send the refrigerator to the Vacuum Test Area, or to the Reject/Rework station if one of the previous tests is failed

### 4. Vacuum test area

Test to create the pressure vacuum and reduce the humidity level inside the refrigerator circuit

### 5. Reject/rework station

The barcode reading on the refrigerator identifies the problem encountered during the tests driving the operator to solve the problem

### 6. Gas load machine

Station for refrigerator coolant injection. The loading plans are directly sent to system server according to the type of refrigerator

### 7. Electrical safety tes & sniffing station

Test on the refrigerator electric safeties and sniffing test to individuate coolant leakages

### 8. Pass/fail station

Totally automatic processing station of the tests results carried out along the line sends the refrigerator either to the repairing area (Repair & RejectArea) or to the loading area for the functional test line

### 9. Repair/reject area

The barcode reading on the refrigerator identifies the problem encountered during the tests driving the operator to solve the problem

### 10. Electrical safety test

Electrical safety test on the repair refrigerators before sending them to the functional test line

### 11. Functional test area

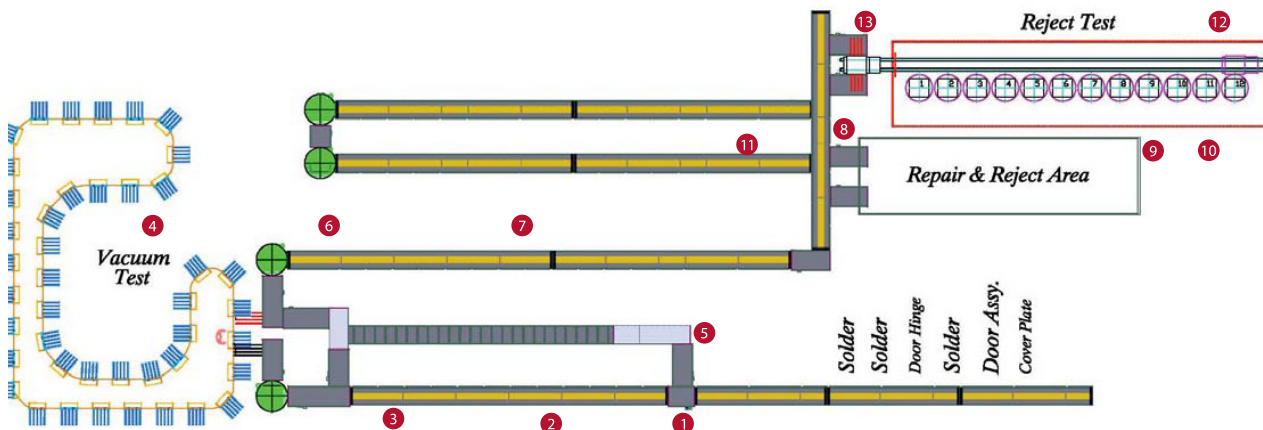
- > Temperature inside the refrigerator
- > Compressor suction and unload temperature
- > Refrigerator power supply voltage
- > Absorbed current, power and energy
- > Current-voltage displacement factor (power factor)
- > Temperature check on the whole functional test process

### 12. Audit room (off-line test room)

- > Fresh-food temperature inside the refrigerator
- > Freezer temperature
- > Compressor suction and unload temperature
- > Power supply voltage
- > Absorbed current, power and energy
- > Current-voltage displacement factor (power factor)
- > Temperature check on the whole test process

### 13. End of line electrical safety test

Electrical safety test on the refrigerators coming from the functional test line and on which a metal cover has been assembled





3. The system

## RESEARCH@INDUSTRY

**Research@industry** is a laboratory equipped with the most innovative test systems. From the research of functional and aesthetic testing strategies, to the measurement techniques that better suit different needs, up to the most challenging requests for product development, the laboratory is at our clients' disposal to carry on **test campaigns** and feasibility studies.

The research projects carried out by our **research@industry** lab arise from the meeting between our researchers and the direct requests of our clients. Flexibility, free initiative, responsibility, imagination and integration of competences with Universities and research Centers represent the core of Loccioni innovation process.

### Solutions for

- > Products
- > Processes
- > Buildings



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