# TEST REPORT: Nr.158

Date: March 25, 2022

# CHILLER EFFICIENCY PERFORMANCE WITH INTELLIGENT ADIABATIC CHILLER BOOSTER **SMART COOLING™** PRO10 SYSTEM FOR CARRIER 30XA1212 CHILLER

**Test Participants:**


Carrier Engineer: Ravi Kiran

CBRE, Facility Engineer: Heggappa M.A

Swiss Integrated Energy Technologies: Armands Mucenieks


Project name: Microsoft Lavalle Road Office Building

Location: Lavelle Road, Ashok Nagar, Bengaluru, Karnataka 560001, India

# Table of Contents

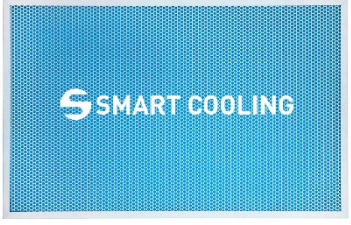
## Introduction:

Type of building: Microsoft office building, India.
Cooling units: air cooled water chiller CARRIER 30XA1212.
Chiller booster: **Smart Cooling™** PRO 10, adiabatic technology with condenser protection.

Chillers were retrofitted with the intelligent adiabatic **Smart Cooling™** system to reduce their electricity consumption and increase COP (Coefficient of Performance) efficiency.
The intelligent adiabatic **Smart Cooling™** system combines an adiabatic evaporative pre-cooling process and condenser protection with mechanical air filtration. The intelligent adiabatic **Smart Cooling™** system is mounted externally in front of the condensers of the cooling equipment. **Smart Cooling™** initiates the adiabatic process even before the mechanical cooling kicks in and the equipment receives a temperature-reducing fine mist of processed water that reduces the temperature of condensation within the cooling circuit.
**Smart Cooling™** ensure 100% condenser protection from direct contact with water.

## Main components:

**Smart Cooling™** comprises the following key components: protective membranes, water treatment and recirculation systems, high-pressure water pump, control unit, high-pressure nozzle panels, fasteners and fixings.
Protective membranes are installed outside the condenser and cover its entire surface, preventing water mist from coming into direct contact with the condenser.
Water filtration, purification and sterilization: the system purifies water from minerals and sterilizes water to prevent bacterial occurrence.
A high-pressure pump provides water pressure of up to 70 bar while a water recirculation system reintroduces non-evaporated water into the water purification and pump system.
The control unit regulates the system according to real-time data sets such as chiller parameters, ambient air temperature and humidity to supply the adiabatic system with the appropriate amount of water.
A high-pressure nozzle provides water spray with 5- to 40-micron droplets.
A set of fasteners and fixings ensure the compatibility of the equipment with the chiller.




## Measuring instruments:

A RIF600 ultrasonic water flow meter was used to measure the effectiveness of the chiller.
The energy monitoring equipment Enicope analytics (BEST), was used to measure energy consumption.
The Temperature & Humidity monitoring data logger (Elitech) was used to measure ambient temperature, humidity & air entering temperature into the condenser coils.

Chiller without **Smart Cooling™** system

Chiller with **Smart Cooling™** system

Equipment tested: **Air-cooled water chillers, Carrier 30XA1212**


## Testing procedures:

Testing has been carried out on chiller No.1.

Testing period: 2022/02/17 to 2022/02/25 - adiabatic system **Smart Cooling™** switched OFF

Testing period: 2022/03/10 to 2022/03/18 - adiabatic system **Smart Cooling™** switched ON

### Step 1

A data logger is installed on the subject HVAC equipment to collect all applicable real-time energy consumption and unit performance information. Data is collected by using an Eniscope Analytics temperature sensor and BTU reader.

| BTU Reader | Temperature & Humidity Reader: | Eniscope (Energy reader) |
|---|---|---|
|  |  |  |

### Step 2

The **Smart Cooling™** system is switched OFF.

### Step 3

During the period from **2022**/02/17 - 2022/02/25 of the test measured energy used by the condenser without the **Smart Cooling™** unit **(Chiller # 1 was in operation).** During this period the chiller consumed **8.617 MW/h** of electricity and produced **16.125 MW/h** cooling, the average temperature during this period was **25.57 °C**

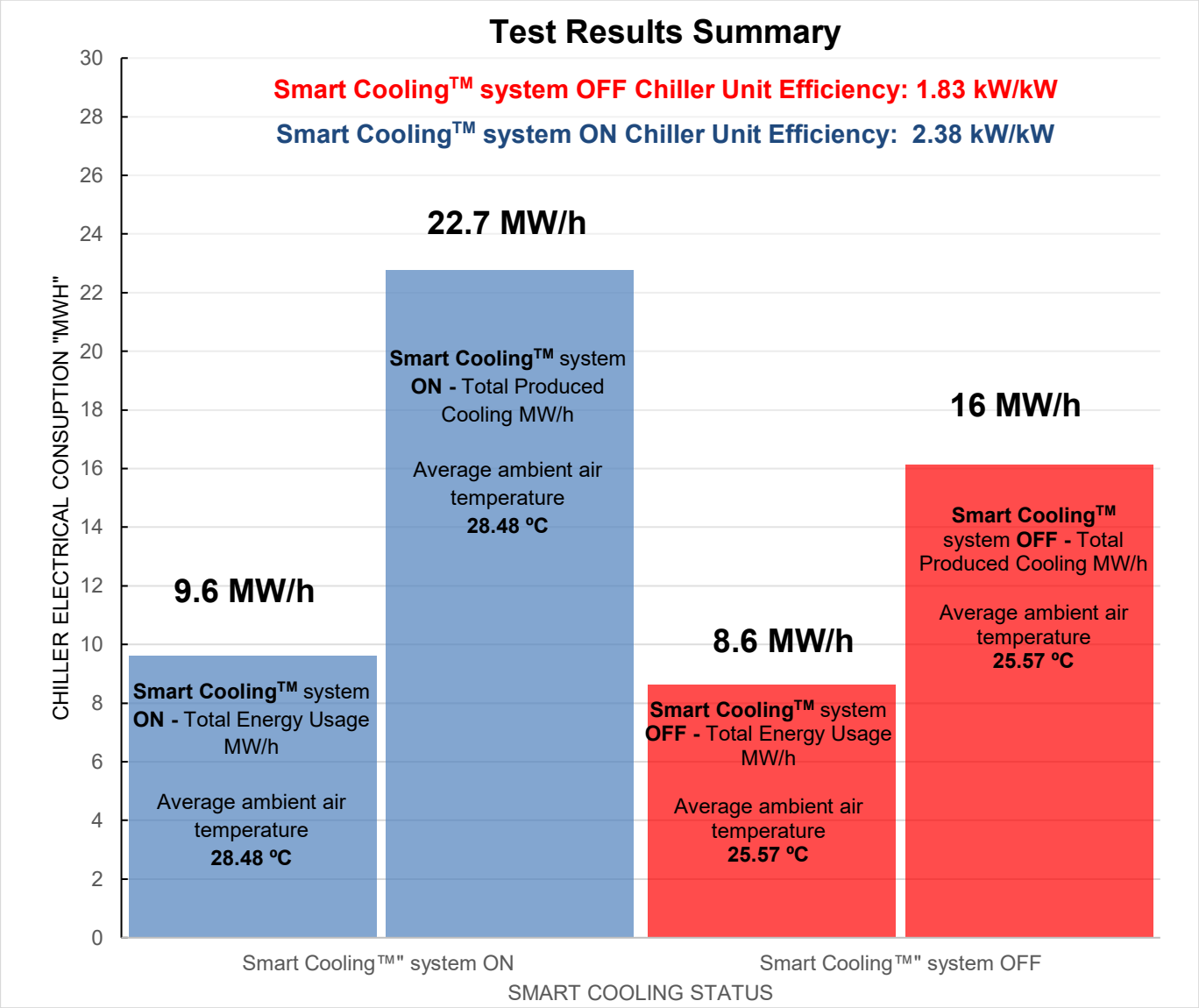
During the period between 17/02/2022 and 17/02/2022, the test measured electricity usage data by chiller with the intelligent adiabatic **Smart Cooling™** system turned OFF (and with chiller #1 in operation). During this period the chiller consumed **8.617 MW/h** of electricity produced **16.125 MW/h of** cooling, the average temperature during the period was **25.57 °C.**

### Step 4

The **Smart Cooling™** system is switched ON.

**Step 5**

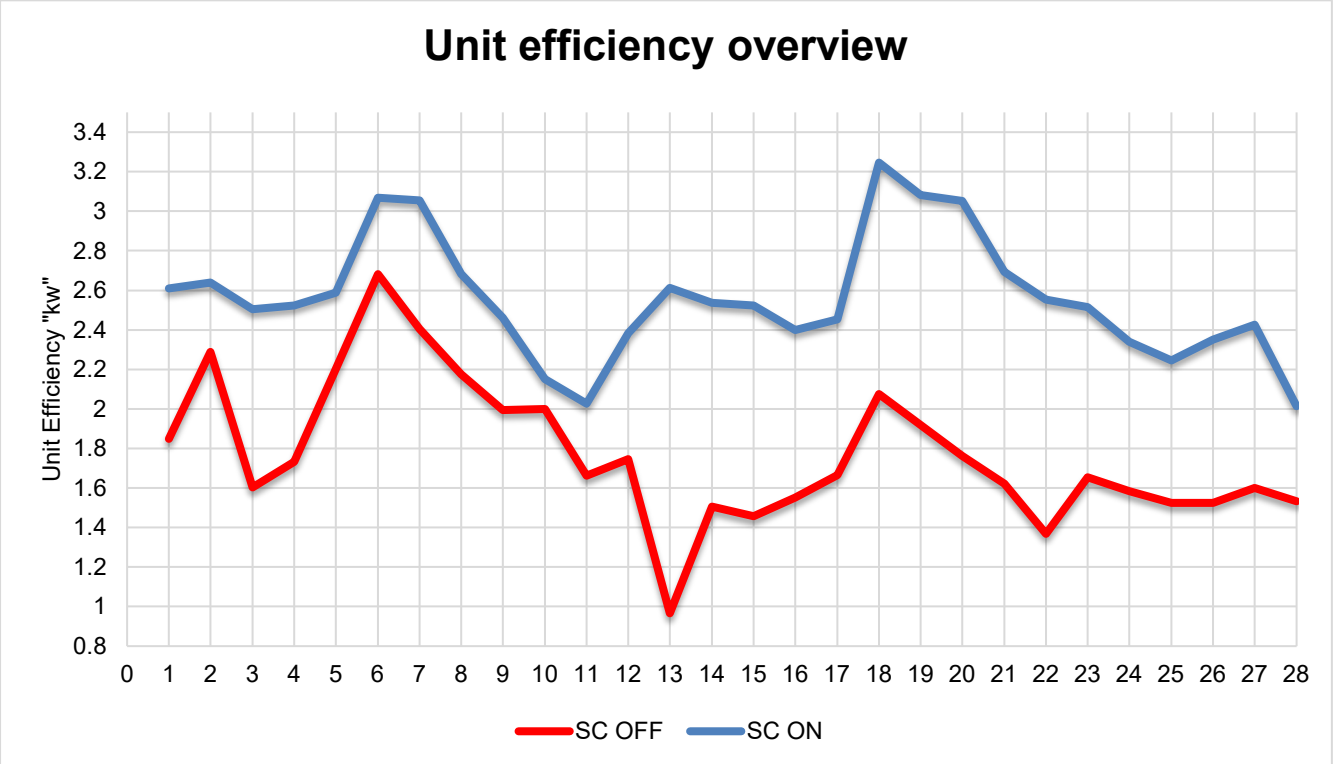
During the period between 10/03/2022 and 18/03/2022, the test measured electricity usage by the chillers with the intelligent adiabatic system **Smart Cooling™** turned ON. During this period the chiller consumed **9.617 MW/h** of electricity, produced **22.775 MW/h** of cooling, and the average temperature during the period was **29.04 °C.**

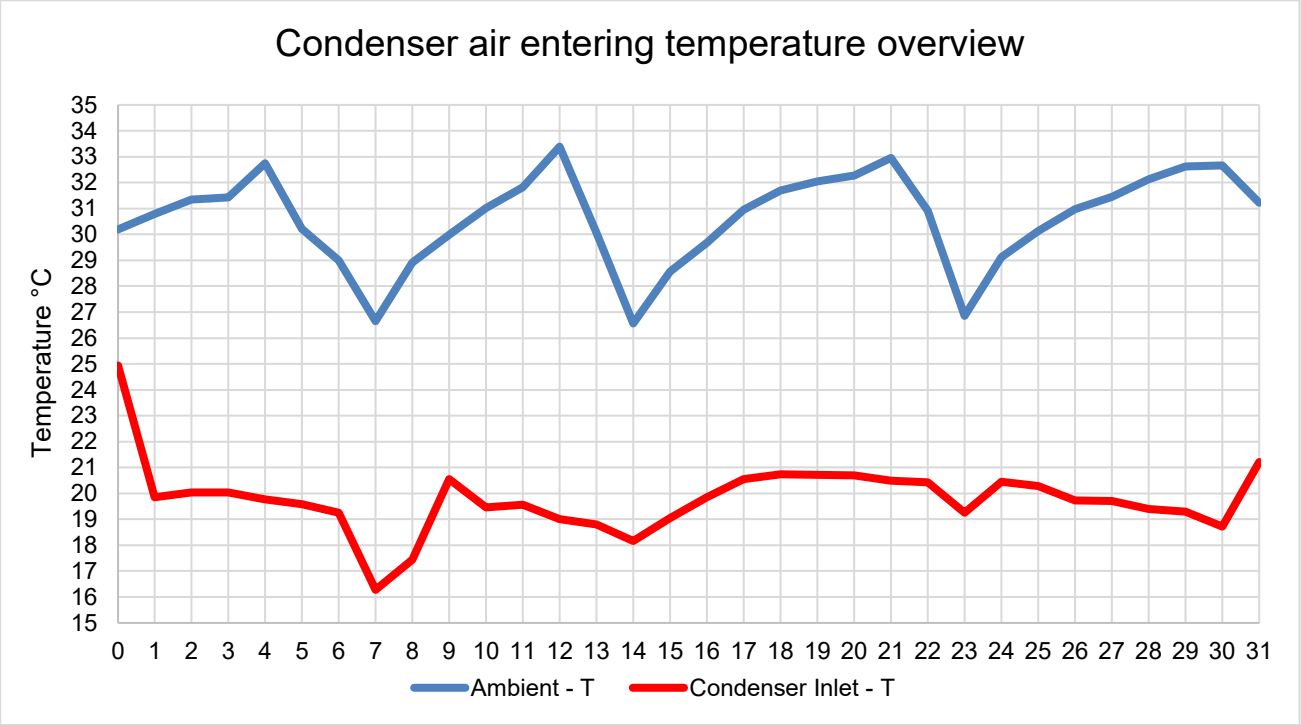



Post-analysis of data monitoring shows **30.3 %** improvement in chiller performance achieved by **Smart Cooling™** system during 7 working days.

## Testing Results Overview:

| Smart Cooling™ Test Report in Chiller 1 - Microsoft Lavalle Road Office Building, Bangalore, India | | |
|---|---|---|
| SC Status | **SC OFF** | **SC ON** |
| Test Period | 17/02/2022 Thu - 25/02/2022 Fri | 10/03/2022 Thu - 18/03/2022 Fri |
| Chiller Operating Hours "hrs" | 58 hrs | 73 hrs |
| SC Operating Hours "hrs" | 0 hrs | 62 hrs |
| Avg. Ambient temperature | 25.57 °C | 29.04 °C |
| Total Energy Usages | 8,617 kWh | 9,617 kWh |
| Total Produced Cooling "kWh" | 16,125 kWh | 22,775 kWh |
| Avg. Unit Efficiency "kW/kW" | 1.83 kW/kW | 2.38 kW/kW |
| Chiller Efficiency Improvements "%" | **30.3%** | |






| DATE | Chiller Operating Hours | Avg. Ambient - T (°C) | Avg. Condenser Air Entering - T (°C) | Total Chiller 1 - E (kWh) | Avg. C.W Flow (m3/hr) | Avg. C.W Return Temp (°C) | Avg. C.W Supply Temp (°C) | Total Cooling Capacity (kWh) | Avg. Unit Efficiency "EER" (KW/KW) |
|---|---|---|---|---|---|---|---|---|---|
| 17.02.2022 | 10 | 25,71333351 | 25,83062496 | 1211,837102 | 208,9354833 | 12,32866333 | 11,30855733 | 2521,641417 | 2,098634034 |
| 18.02.2022 | 8 | 23,37122381 | 23,31992173 | 1106,152721 | 205,0766563 | 12,51935313 | 11,29998167 | 2389,184068 | 2,168155484 |
| 19.02.2022 | 2 | 22,44348955 | 22,20585938 | 36,74612957 | 144,69825 | 22,50055417 | 22,4204875 | 58,38325 | 1,581573622 |
| 20.02.2022 | 0 | 24,93369492 | 24,93926497 | 0 | 0 | 23,52220876 | 23,51964175 | 0 | 0 |
| 21.02.2022 | 6 | 29,22343715 | 29,05017376 | 763,8693288 | 167,1894167 | 15,23421014 | 14,58079181 | 1188,876045 | 1,552791494 |
| 22.02.2022 | 12 | 27,44262155 | 27,31041662 | 2204,872464 | 206,2142708 | 11,48708014 | 10,18113243 | 3790,149545 | 1,731486614 |
| 23.02.2022 | 11 | 25,8029356 | 25,37935604 | 1912,21205 | 211,4195606 | 10,34770023 | 9,062722576 | 3514,36197 | 1,808262407 |
| 24.02.2022 | 9 | 24,99386586 | 24,60324075 | 1380,963519 | 209,0569167 | 13,12962991 | 11,92116028 | 2662,76575 | 1,870459699 |
| 25.02.2022 | 0 | 24,21302084 | 24,16315103 | 0 | 0 | 15,15617326 | 15,76555451 | 0 | 0 |

Note* During the period of 17/02/2022 till 20/02/2022: Chiller circuits A & B were working, during this period Smart Cooling™ was OFF

Notes* During the period of 21/02/2022 till 25/02/2022: Chiller circuits A & C were working, during this period Smart cooling™ was OFF

| DATE | Chiller Operating Hours | SC Operating Hours | Avg. Ambient - T (°C) | Average Humidity (%) | Avg. Condenser Air Entering - T (°C) | Total Chiller 1 - E (kWh) | Avg. C.W Flow (m3/hr) | Avg. C.W Return Temp (°C) | Avg. C.W Supply Temp (°C) | Total Cooling Capacity (kWh) | Avg. Unit Efficiency "EER" (KW/KW) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.03.2022 | 13 | 8 | 28,43 | 32,65 | 21,08 | 1589,4 | 209,8 | 11,2 | 10,0 | 4027,9 | 2,53 |
| 11.03.2022 | 12 | 11 | 29,22 | 24,66 | 20,92 | 1273,1 | 208,8 | 12,0 | 11,0 | 3265,1 | 2,51 |
| 12.03.2022 | 0 | 0 | 26,62 | 36,02 | 26,16 | 0,0 | 0,5 | 22,2 | 22,9 | 0,0 | 0,00 |
| 13.03.2022 | 0 | 0 | 26,49 | 36,87 | 26,19 | 0,0 | 0,6 | 23,9 | 24,8 | 0,0 | 0,00 |
| 14.03.2022 | 13 | 11 | 28,74 | 37,00 | 20,43 | 1760,3 | 207,4 | 11,4 | 9,9 | 4772,3 | 2,74 |
| 15.03.2022 | 12 | 10 | 28,89 | 36,28 | 19,91 | 1604,6 | 194,4 | 11,6 | 10,2 | 4296,1 | 2,68 |
| 16.03.2022 | 12 | 2 | 28,95 | 43,67 | N.A | 2129,0 | 198,5 | 11,6 | 10,5 | 3418,8 | 1,67 |
| 17.03.2022 | 12 | 12 | 29,86 | 37,79 | N.A | 1654,0 | 171,0 | 12,4 | 11,5 | 2844,3 | 1,79 |
| 18.03.2022 | 11 | 10 | 29,08 | 46,02 | N.A | 1736,0 | 195,1 | 12,2 | 11,0 | 3569,0 | 2,06 |

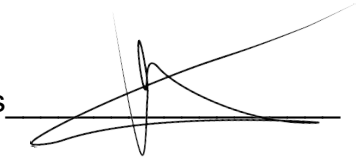
Note* During the period of 10/03/2022 till 15/03/2022: Chiller circuits A & B were working, Smart Cooling™ was working on Circuit A & B

Note* The date 16/03/2022 is not included in the analysis as during this period Smart Cooling™ operates for 2 hours only, due to a chiller condenser fan issue

Note* During the period of 17/03/2022 till 18/03/2022: Chiller circuits A & C were working, Smart Cooling™ was working on Circuit C only

# Conclusion:

Test results data show that the adiabatic equipment **Smart Cooling™** increases chiller performance, on average, by **30.3%** during 7 operating days.

Armands Mucenieks 

March 25, 2022

# Annex

Riels instruments srl
Viale Spagna, 16
35020 Ponte San Nicolò (PD) - ITALY
Ph. +39 0498961771 | info@riels.it

## RIF600 | Clamp-on Ultrasonic Meter Calibration Report

| | | | | |
|---|---|---|---|---|
| Pipe diameter | DN80 | | Date | 15/12/2018 |
| Ambient temperature | 29°C | | | |
| Standard Device before test | Normal | | Model: | RIF600W |
| Standard Devide After Test | Normal | | | |
| Test result | Qualified | | | |
| Measured Medium | Water | | | |
| Accuracy | 1% | | | |
| Signal Strength | UP: | 90 | | |
| | DOWN: | 90 | | |
| Standard device name | Static volumetric method/standard Meter Method Water Flow/Standard Device | | | |
| Standard device accuracy | 0,20% | | | |

| Test | Standard Meter flow | | Temperature | Pressure | Tested Meter Flow | | Basic Error | | Repeatability | |
|---|---|---|---|---|---|---|---|---|---|---|
| Point | m3/h | | °C | Mpa | m3/h | | % | | % | |
| Point 1 | 101,52 | 101,47 | 25,0 | 0,300 | 102,27 | 102,10 | 0,739 | 0,759 | -0,147 | 0,147 |
| | 101,47 | | 25,0 | 0,300 | 102,07 | | 0,591 | | | |
| | 101,42 | | 25,0 | 0,300 | 101,97 | | 0,542 | | | |
| Point 2 | 71,27 | 71,27 | 25,0 | 0,300 | 71,75 | 71,75 | 0,673 | | -0,146 | |
| | 71,19 | | 25,0 | 0,300 | 71,65 | | 0,646 | | | |
| | 71,34 | | 25,0 | 0,300 | 71,86 | | 0,729 | | | |
| Point 3 | 26,32 | 26,36 | 25,0 | 0,300 | 26,51 | 26,55 | 0,722 | | -0,132 | |
| | 26,36 | | 25,0 | 0,300 | 26,56 | | 0,759 | | | |
| | 26,39 | | 25,0 | 0,300 | 26,58 | | 0,720 | | | |

Verification Based on JJG 1030-2007 < Ultrasonic flowmeter verification procedures >
Scale Factor=1

Riels instruments srl
Viale Spagna, 16
35020 Ponte San Nicolò (PD) - ITALY
Ph. +39 0498961771 | info@riels.it

# RIF600 |Test Report misuratore di portata ad ultrasuoni clamp on

| | | | | |
|---|---|---|---|---|
| Diametro tubazione | DN80 | | Date | 15/12/2018 |
| Temperatura ambiente | 29°C | | | |
| Dispositivo standard prima del test | Normale | | Model: | RIF600W |
| Dispositivo standard dop il test | Normale | | | |
| Risultato del test | Qualified | | | |
| Liquido | Acqua | | | |
| Accuratezza | 1% | | | |
| Potenza dei segnali | UP: | 90 | | |
| | DOWN: | 90 | | |
| Tipo di dispositivo standard | Metodo volumetrico statico/Misuratore di portata volumetrico | | | |
| Accuratezza del dispositivo standa | 0,20% | | | |

| Test | Misuratore standard | | Temperatura | Pressione | Misuratore testato | | errore base | | Ripetibilità | |
|---|---|---|---|---|---|---|---|---|---|---|
| Punti | m3/h | | °C | Mpa | m3/h | | % | | % | |
| Punto 1 | 101,52 | 101,47 | 25,0 | 0,300 | 102,27 | 102,10 | 0,739 | 0,759 | -0,147 | 0,147 |
| | 101,47 | | 25,0 | 0,300 | 102,07 | | 0,591 | | | |
| | 101,42 | | 25,0 | 0,300 | 101,97 | | 0,542 | | | |
| Punto 2 | 71,27 | 71,27 | 25,0 | 0,300 | 71,75 | 71,75 | 0,673 | | -0,146 | |
| | 71,19 | | 25,0 | 0,300 | 71,65 | | 0,646 | | | |
| | 71,34 | | 25,0 | 0,300 | 71,86 | | 0,729 | | | |
| Punto 3 | 26,32 | 26,36 | 25,0 | 0,300 | 26,51 | 26,55 | 0,722 | | -0,132 | |
| | 26,36 | | 25,0 | 0,300 | 26,56 | | 0,759 | | | |
| | 26,39 | | 25,0 | 0,300 | 26,58 | | 0,720 | | | |

Verification Based on JJG 1030-2007 < Ultrasonic flowmeter verification procedures >
Scale Factor=1