

# TEST REPORT: Nr.155

Date: July 06, 2021

## CHILLER EFFICIENCY PERFORMANCE WITH THE INTELLIGENT ADIABATIC CHILLER-BOOSTING SYSTEM **SMART COOLING™** PRO10 FOR CARRIER 30XA1002 CHILLERS

### Test Participants:

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Swiss Integrated Energy Technologies: Armands Muceniks

Project name: Al Baywa Greenhouse

Location: Alain, United Arab Emirates

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## Introduction

Type of building: Al Baywa Greenhouse, Alain, United Arab Emirates

Cooling units: Air-cooled water Carrier 30XA1702 chillers

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.

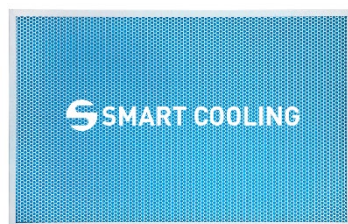
Protective membranes are installed outside the condenser and cover its entire surface, preventing water mist from coming into direct contact with the condenser.

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.



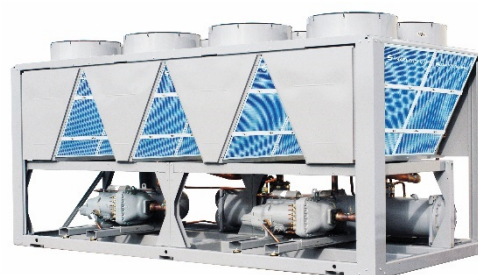
## Measuring instruments

An RIF600 ultrasonic water flow meter was used to measure the effectiveness of the chiller.  
An Enscope Analytics energy monitoring equipment (BEST) was used to measure electricity consumption.

Equipment tested: **Air-cooled Carrier 30XA1702 water chillers**



Chiller without **Smart Cooling™** system



Chiller with **Smart Cooling™** system



## Testing procedures

Testing was conducted on chillers No.1, No.2, No.3 and No.4

Testing period: 06/15/2021 - 06/21-2021 adiabatic system **Smart Cooling™** switched ON

Testing period: 06/22/2021 –06/28/2021 adiabatic system **Smart Cooling™** switched OFF

### **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 a an Eniscope Analytics temperature sensor.

### **Eniscope:**





## Step 2

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

## Step 3

During the period between 06/15/2021 and 06/21/2021, the test measured electricity usage data by the chillers with the intelligent adiabatic **Smart Cooling™** system in operation. During this period, the chiller consumed **47.67 MW/h** of electricity, while water consumption was **280 m³** and the average temperature during the period was **42° C**.

## Step 4

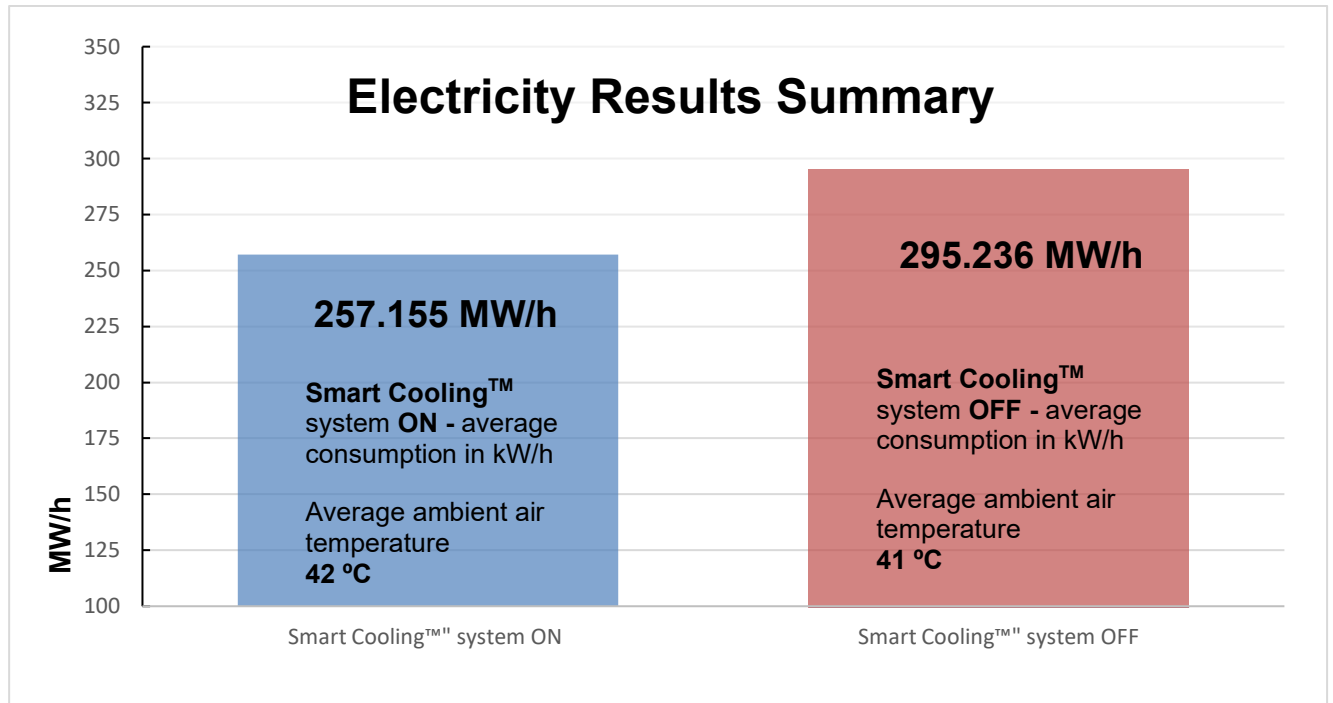
The **Smart Cooling™** system is switched OFF.

## Step 5

During the period between 06/23/2021 and 06/29/2021 the test measured electricity usage data by chillers with the intelligent adiabatic **Smart Cooling™** system not in operation. During

this, period the chiller consumed **295.236 MW/h** of electricity, while water consumption was **0 m<sup>3</sup>** and the average temperature during the period was **41° C**

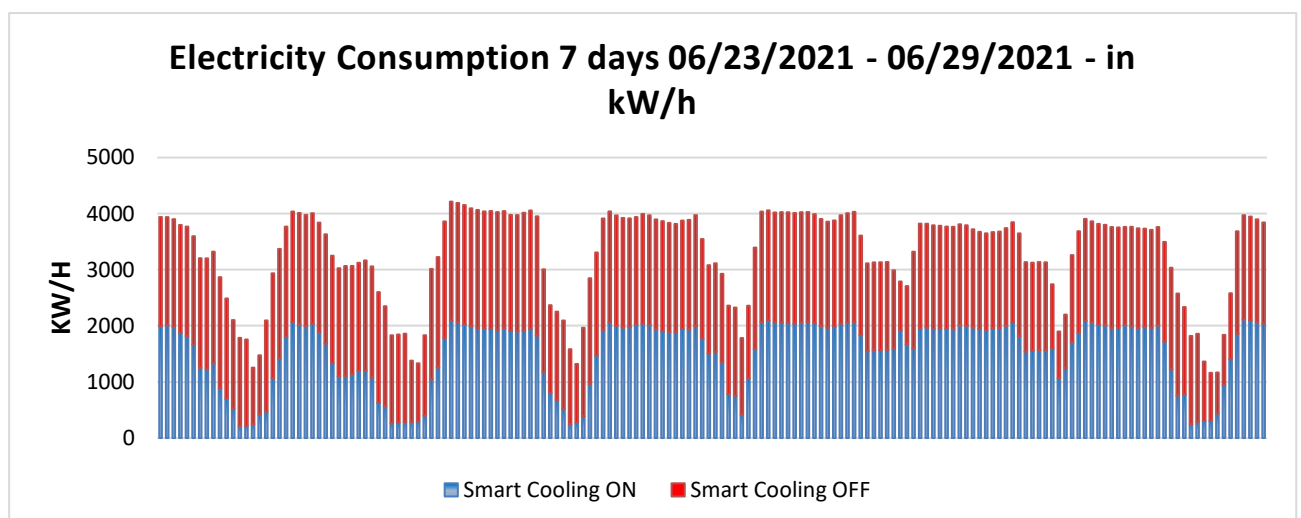
## Testing Results



Post-analysis of data monitoring shows the electricity savings generated by the **Smart Cooling™** system in 7 operation days is **38 MW/h** of electricity

Within these 7 days, the customer saved **38,081 kw/h of electricity**. At an electricity rate of AED 0.30 per kw/h, the total savings amount to AED 11,424.

To achieve this result, 280 m<sup>3</sup> of water were used, with water expenses of AED 10 per m<sup>3</sup>. In total AED 2800 were spent on water.



## Testing Summary

| TEST RESULTS   |             |            |             |                          |     |
|--|-------------|------------|-------------|--------------------------|-----|
| Smart Cooling™ Test Report Al Baywa Greenhouse, Alain, UAE |             |            |             | Electrical Consumption % |     |
| Status of Smart Cooling™                                   | ON          |            | OFF         |                          | 15% |
| Test Duration  | 7 Days      |            | 7 Days      |                          |     |
|  | From        | To         | From        | To                       |     |
|  | 15.06.2021  | 21.06.2021 | 23.06.2021  | 29.06.2021               |     |
| Average Ambient Temperature "°C"                           | 42 °C       |            | 41 °C       |                          |     |
| Total Electrical Consumption "KWH"                         | 257 155 KWH |            | 295 236 KWH |                          |     |
| Average Electrical Consumption Per Hour "KWH"              | 1 531 KWH   |            | 1 757 KWH   |                          |     |
| Total Water Consumption "m3"                               | 280,0 m³    |            | 0,0 m³      |                          |     |

### ROI:

|                                  |        |      |         |
|----------------------------------|--------|------|---------|
|                                  | kw/h   | AED  | Summary |
| Actual Chiller savings in 7 Days | 38 081 | 0,32 | 12 186  |

|                                    |                |      |         |
|------------------------------------|----------------|------|---------|
|                                    | M <sup>3</sup> | AED  | Summary |
| Actual water consumption in 7 Days | 280            | 7,81 | 2 187   |

|  |           |      |         |
|--|-----------|------|---------|
|  | kw/h      | AED  | Summary |
| Projected Chillers savings per season (240 days) | 1 218 603 | 0,32 | 389 953 |

|   |                |      |         |
|---|----------------|------|---------|
|   | M <sup>3</sup> | AED  | Summary |
| Projected water consumption per season (240 days) | 8 960          | 7,81 | 69 978  |

|                      |     |      |        |
|----------------------|-----|------|--------|
|                      | QTY | AED  | Total  |
| Maintenance per year | 4   | 7623 | 30 492 |

|  |     |         |
|--|-----|---------|
| Net savings after all running costs for 4 Chillers | AED | 289 483 |
|--|-----|---------|

|   |     |           |
|---|-----|-----------|
| Cost of 4 adiabatic Smart Cooling™, delivered & installed | AED | 506822,00 |
|---|-----|-----------|

|  |           |
|--|-----------|
| ROI Period (in calendar years, after all running costs for 4 Chillers) | 1,75 year |
|--|-----------|

|   |     |     |
|---|-----|-----|
| Reduction of CO2 Emissions for 4 Chillers | Ton | 509 |
|---|-----|-----|

**Note:** For more details about test please refer to the supported document (Excel File).

## Brief review on cooling capacity improvements based on customer's plant management system

Below Table data:  
 Ambient Temperature & Humidity collected from smartcooling temperature & humidity sensors.  
 Produced Cooling load & Plant cooling set point collected from customer realtime chiller monitoring system.  
 Electrical Consumption collected from smartcooling electrical meters.

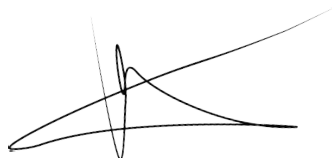
Table Summary: As you can see in below table requested, Cooling Capacity required by plant is more than actually plant cooling capacity so chillers at these moments are working at 100% load. As you can see with Smartcooling ON the chillers are producing more cooling capacity than with smartcooling being OFF at higher ambient temperatures

| Plant Cooling Capacity: 6.8 MWH |                   |      |  |                              |                              |                        |                   |      |                                      |  |                              |                              |
|---------------------------------|-------------------|------|--|------------------------------|------------------------------|------------------------|-------------------|------|--------------------------------------|--|------------------------------|------------------------------|
| Smartcooling OFF                |                   |      |  |                              |                              | Smartcooling ON        |                   |      |                                      |  |                              |                              |
| Date Time                       | Ambient TEMP (°C) | RH % | Actual Cooling Load Produced by chillers (MWH) | Plant Cooling Setpoint (MWH) | Electrical Consumption (KWH) | Date Time              | Ambient TEMP (°C) | RH % | Air Entering Condensers with SC (°C) | Actual Cooling Load Produced By Chillers (MWH) | Plant Cooling Setpoint (MWH) | Electrical Consumption (KWH) |
| 28/6/2021 21:05:00 GST          | 35                | 31.5 | 5.4  | 8                            | 1799                         | 16/6/2021 21:05:00 GST | 43.5              | 25   | 28.61039                             | 6.0  | 7.1                          | 2064                         |
| 28/6/2021 21:10:00 GST          | 34.7              | 31.9 | 5.3  | 8                            |                              | 16/6/2021 21:10:00 GST | 43.8              | 25.9 | 28.60568                             | 6.0  | 7.1                          |                              |
| 28/6/2021 21:15:00 GST          | 34.7              | 31.8 | 5.5  | 8                            |                              | 16/6/2021 21:15:00 GST | 43.6              | 28   | 28.96935                             | 6.2  | 7.1                          |                              |
| 28/6/2021 21:20:00 GST          | 34.7              | 31.6 | 5.3  | 8                            |                              | 16/6/2021 21:20:00 GST | 43.1              | 27.1 | 28.41104                             | 6.0  | 7.1                          |                              |
| 28/6/2021 21:25:00 GST          | 34.7              | 32.5 | 5.5  | 8                            |                              | 16/6/2021 21:25:00 GST | 42.7              | 28.7 | 28.01046                             | 6.2  | 7.1                          |                              |
| 28/6/2021 21:30:00 GST          | 33.9              | 33.2 | 5.3  | 8                            |                              | 16/6/2021 21:30:00 GST | 42.5              | 29   | 28.78182                             | 6.1  | 7.6                          |                              |
| 28/6/2021 21:35:00 GST          | 33.9              | 32.3 | 5.4  | 8                            |                              | 16/6/2021 21:35:00 GST | 42.3              | 29   | 28.4832                              | 6.3  | 7.3                          |                              |
| 28/6/2021 21:40:00 GST          | 33.9              | 32.5 | 5.5  | 8                            |                              | 16/6/2021 21:40:00 GST | 42.3              | 29.3 | 28.52087                             | 6.1  | 7.3                          |                              |
| 28/6/2021 21:45:00 GST          | 33.8              | 32.7 | 5.4  | 8                            |                              | 16/6/2021 21:45:00 GST | 41.9              | 30.3 | 28.39536                             | 6.1  | 7.5                          |                              |
| 28/6/2021 21:50:00 GST          | 33.8              | 32.5 | 5.5  | 8                            |                              | 16/6/2021 21:50:00 GST | 41.6              | 30.9 | 27.89654                             | 6.2  | 7.6                          |                              |
| 28/6/2021 21:55:00 GST          | 33.9              | 32.2 | 5.4  | 8                            |                              | 16/6/2021 21:55:00 GST | 41.9              | 30.4 | 27.88874                             | 6.2  | 7.6                          |                              |
| 28/6/2021 22:00:00 GST          | 34.1              | 32.8 | 5.4  | 8                            | 1797                         | 16/6/2021 22:00:00 GST | 42                | 30.1 | 28.32797                             | 6.1  | 7.6                          | 2025                         |
| 28/6/2021 22:05:00 GST          | 34                | 34.5 | 5.4  | 8                            |                              | 16/6/2021 22:05:00 GST | 41.9              | 28.5 | 28.19959                             | 6.2  | 7.8                          |                              |
| 28/6/2021 22:10:00 GST          | 33.8              | 33   | 5.4  | 8                            |                              | 16/6/2021 22:10:00 GST | 40.5              | 30.7 | 28.33894                             | 6.2  | 7.8                          |                              |
| 28/6/2021 22:15:00 GST          | 33.8              | 34.5 | 5.5  | 8                            |                              | 16/6/2021 22:15:00 GST | 40.6              | 30.8 | 27.52135                             | 6.2  | 7.8                          |                              |
| 28/6/2021 22:20:00 GST          | 34                | 32.7 | 5.4  | 8                            |                              | 16/6/2021 22:20:00 GST | 41                | 31.1 | 27.26993                             | 6.3  | 8                            |                              |
| 28/6/2021 22:25:00 GST          | 34.4              | 31.5 | 5.5  | 8                            |                              | 16/6/2021 22:25:00 GST | 41.2              | 30.2 | 27.64418                             | 6.1  | 8                            |                              |
| 28/6/2021 22:30:00 GST          | 34.5              | 31.5 | 5.4  | 8                            |                              | 16/6/2021 22:30:00 GST | 40.8              | 29.7 | 27.60685                             | 6.4  | 8                            |                              |
| 28/6/2021 22:35:00 GST          | 34.4              | 32.4 | 5.3  | 8                            |                              | 16/6/2021 22:35:00 GST | 40.5              | 28.4 | 27.17851                             | 6.3  | 8                            |                              |
| 28/6/2021 22:40:00 GST          | 34                | 33.5 | 5.5  | 8                            |                              | 16/6/2021 22:40:00 GST | 39.8              | 29   | 26.91247                             | 6.2  | 8                            |                              |
| 28/6/2021 22:45:00 GST          | 34                | 32.9 | 5.5  | 8                            |                              | 16/6/2021 22:45:00 GST | 39.9              | 29   | 26.29323                             | 6.3  | 8                            |                              |
| 28/6/2021 22:50:00 GST          | 34.5              | 32   | 5.5  | 8                            |                              | 16/6/2021 22:50:00 GST | 39.6              | 29.5 | 26.03853                             | 6.3  | 8                            |                              |
| 28/6/2021 22:55:00 GST          | 34.7              | 31.9 | 5.4  | 8                            | 1794                         | 16/6/2021 22:55:00 GST | 39.1              | 31.9 | 26.32088                             | 6.3  | 8                            | 1985                         |
| 28/6/2021 23:00:00 GST          | 34.6              | 32.7 | 5.3  | 8                            |                              | 16/6/2021 23:00:00 GST | 39.1              | 32.8 | 26.03853                             | 6.3  | 8                            |                              |
| 28/6/2021 23:05:00 GST          | 33.9              | 34.9 | 5.6  | 8                            |                              | 16/6/2021 23:05:00 GST | 38.8              | 34.5 | 25.97264                             | 6.3  | 8                            |                              |
| 28/6/2021 23:10:00 GST          | 34                | 33.3 | 5.4  | 8                            |                              | 16/6/2021 23:10:00 GST | 38.8              | 36.2 | 26.3301                              | 6.3  | 8                            |                              |
| 28/6/2021 23:15:00 GST          | 34.5              | 33.6 | 5.5  | 8                            |                              | 16/6/2021 23:15:00 GST | 38.7              | 37.6 | 26.27326                             | 6.5  | 8                            |                              |
| 28/6/2021 23:20:00 GST          | 34.2              | 33.2 | 5.5  | 8                            |                              | 16/6/2021 23:20:00 GST | 38.2              | 37.9 | 26.98974                             | 6.4  | 8                            |                              |
| 28/6/2021 23:25:00 GST          | 34.6              | 32.4 | 5.4  | 8                            |                              | 16/6/2021 23:25:00 GST | 37.9              | 38.6 | 27.12432                             | 6.5  | 8                            |                              |
| 28/6/2021 23:30:00 GST          | 34.5              | 32.7 | 5.6  | 8                            |                              | 16/6/2021 23:30:00 GST | 37.3              | 39.8 | 26.48387                             | 6.4  | 8                            |                              |
| 28/6/2021 23:35:00 GST          | 34.3              | 33.3 | 5.4  | 8                            |                              | 16/6/2021 23:35:00 GST | 37.1              | 38.3 | 26.3716                              | 6.4  | 8                            |                              |
| 28/6/2021 23:40:00 GST          | 34                | 33.7 | 5.5  | 8                            |                              | 16/6/2021 23:40:00 GST | 37.2              | 35.8 | 26.27173                             | 6.4  | 8                            |                              |
| 28/6/2021 23:45:00 GST          | 33.9              | 33.4 | 5.4  | 8                            |                              | 16/6/2021 23:45:00 GST | 37.2              | 35.8 | 25.99869                             | 6.4  | 8                            |                              |
| 28/6/2021 23:50:00 GST          | 33.8              | 34   | 5.3  | 8                            |                              | 16/6/2021 23:50:00 GST | 37                | 34.1 | 25.73241                             | 6.5  | 8                            |                              |
| 28/6/2021 23:55:00 GST          | 33.3              | 35.2 | 5.6  | 8                            |                              | 16/6/2021 23:55:00 GST | 37                | 34.7 | 25.47893                             | 6.4  | 8                            |                              |

### Conclusion:

Test results data shows that the intelligent adiabatic **Smart Cooling™** system decreased the chiller electricity consumption by 15 %, on average, during 24 operational hours.

Armands Muceniks  
July 06, 2021



## Annex



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### RIF600 | Clamp-on Ultrasonic Meter Calibration Report

|                             |   |        |            |
|-----------------------------|---|--------|------------|
| Pipe diameter               | DN80  | Date   | 15/12/2018 |
| Ambient temperature         | 29°C  | Model: | RIF600W    |
| Standard Device before test | Normal  |        |            |
| Standard Device After Test  | Normal  |        |            |
| Test result                 | Qualified   |        |            |
| Measured Medium             | Water   |        |            |
| Accuracy                    | 1%  |        |            |
| Signal Strength             | UP: 90<br>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       | 0,759 | -0,146        | 0,147 |
|         | 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       | 0,759 | -0,132        | 0,147 |
|         | 26,36               |        | 25,0        | 0,300    | 26,56             |        | 0,759       |       |               |       |
|         | 26,39               |        | 25,0        | 0,300    | 26,58             |        | 0,720       |       |               |       |

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



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

Diametro tubazione DN80  
Temperatura ambiente 29°C  
Dispositivo standard prima del test Normale  
Dispositivo standard dop il test Normale  
Risultato del test Qualified  
Liquido Acqua  
Accuratezza 1%  
Potenza dei segnali UP: 90  
DOWN: 90

Date 15/12/2018  
Model: RIF600W

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