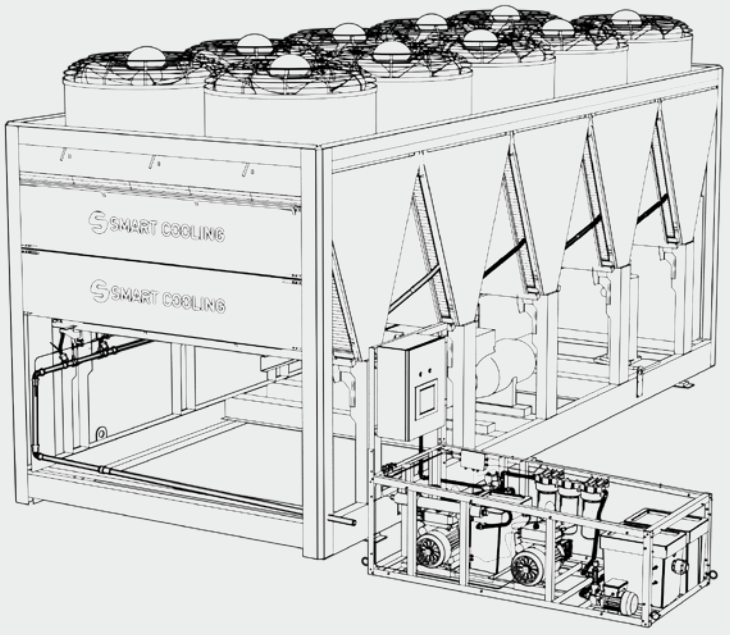
06 July 2021

TEST REPORT
155



SMART COOLING™ PRO10 SYSTEM

Al Baywa Greenhouse

Test Participants:
Project name: **AL BAYWA GREENHOUSE** Location: **Alain, UAE**
Customer: **MOHAMMAD JEBRIL**
Gerab Energy Engineer: **Ali Soufan**
Swiss Integrated Energy Technologies: **Armands Mucenieks**

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Introduction:

Type of structure: Al Baywa Greenhouse, Alain, United Arab Emirates.
Cooling units: Air cooled water chiller **Carrier 30XA1702.**
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**.

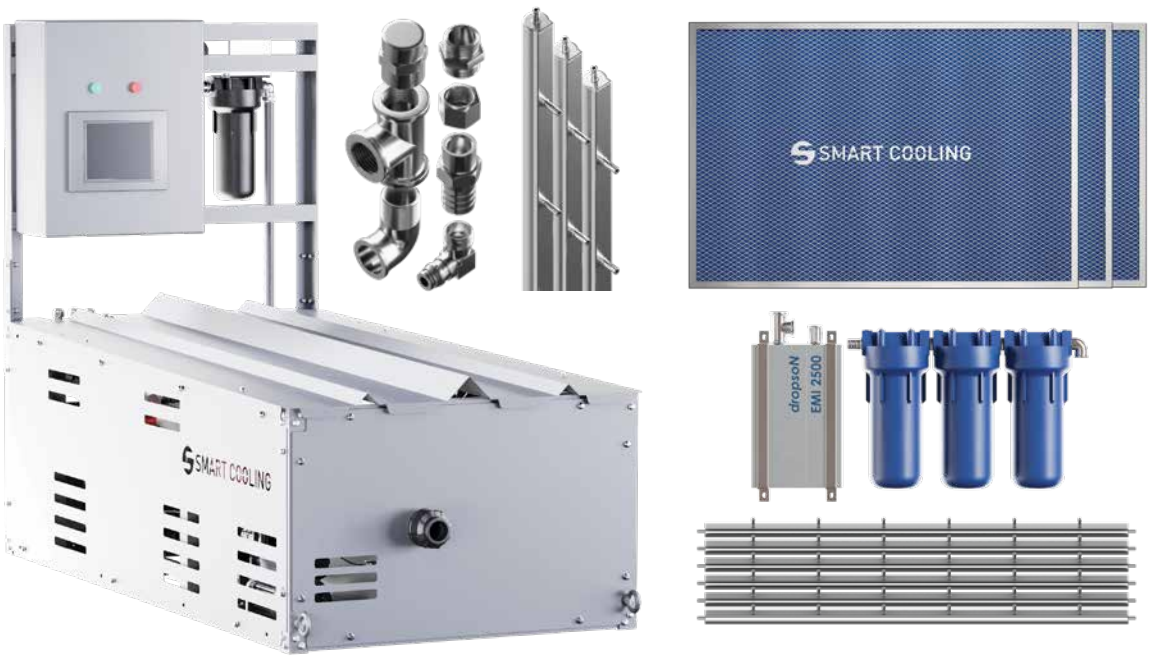
The intelligent adiabatic *Smart Cooling™* system combines an **adiabatic evaporative pre-cooling process** and **condenser protection with mechanical air filtration**. The intelligent adiabatic *Smart Cooling™* system is mounted externally in front of the **condensers** of the cooling equipment. *Smart 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 within the cooling circuit.

Smart Cooling™ ensures 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** cover the condenser surface, preventing direct water contact.
- **Water system** purifies and sterilizes water to prevent mineral buildup and bacteria.
- **Pump** provides 70 bar pressure.
- **Control unit** regulates operation via real-time data (temperature, humidity, chiller parameters).
- **Nozzles** spray 5–40 µm 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 Eniscope Analytics energy monitoring equipment (BEST) was used to measure electricity consumption.

Chiller **with** *Smart Cooling™ system*

Chiller **without** *Smart Cooling™ system*

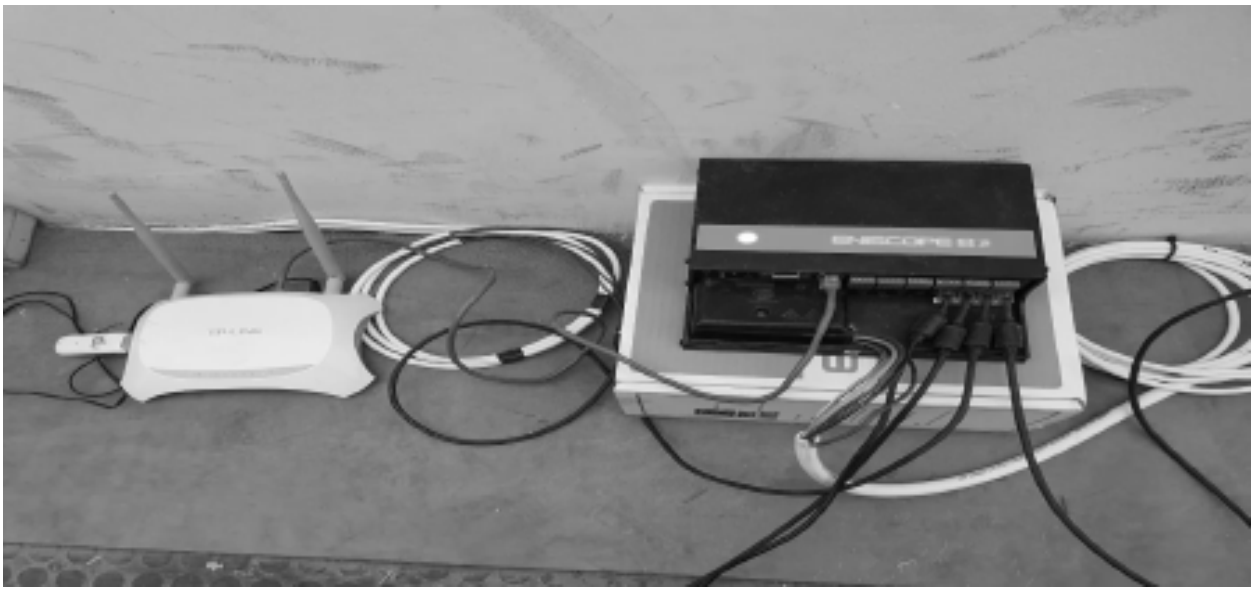
- **Equipment tested:** Air-cooled water chillers, **CARRIER 30XA1702**.

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 an *Eniscope Analytics temperature sensor*.



- **Step 2**

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 m^3, and the average temperature during the period was **42° C**.

- **Step 4**

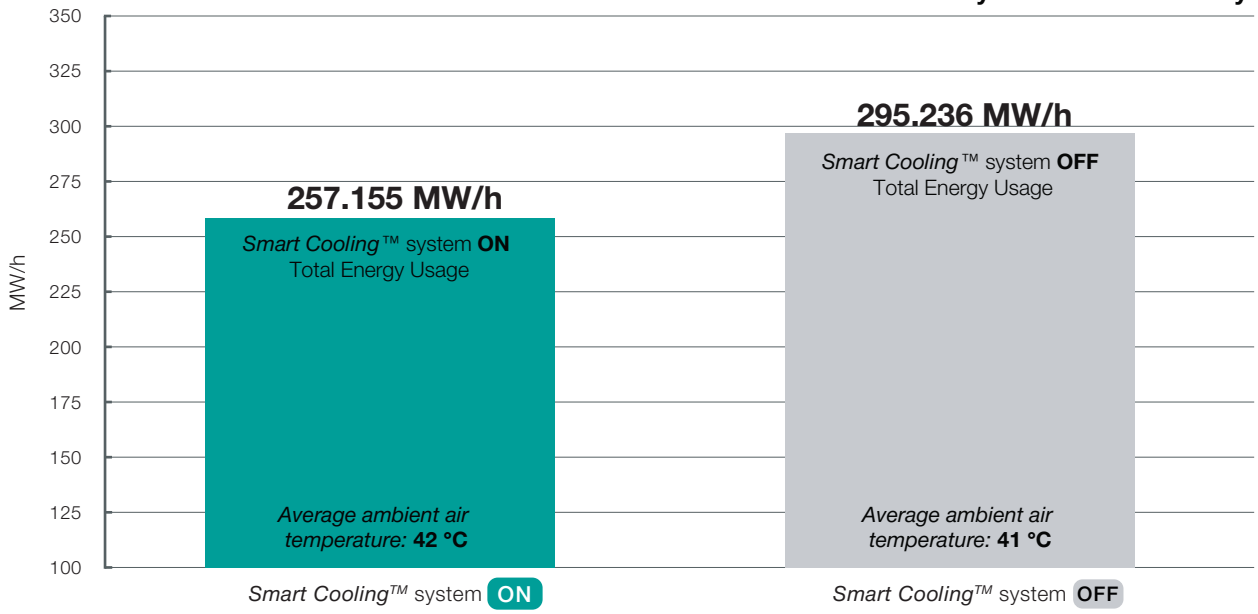
Smart Cooling™ system is switched **OFF**

- **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 m³** and the average temperature during the period was **41° C**.

Testing Results

Electricity Results Summary

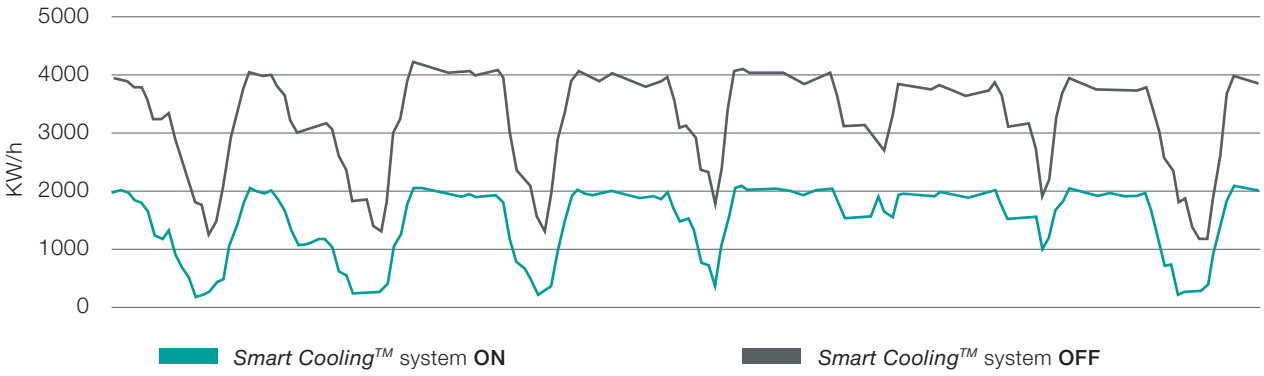


Post-analysis of data monitoring shows the electricity savings generated by the *Smart Cooling™* system in 7 operation days is **38 MW/h** of electricity.
Within these 7 days, the customer **saved 38,081 kW/h of electricity**.
At an electricity rate of **AED 0.30 per kW/h**, the total savings amount to **AED 11,424**.

To achieve this result, **280 m³ of water were used**, with water expenses of AED 10 per m³.
In total, **AED 2800** were spent on water.

Electricity Consumption 7days

06/23/2021 - 06/29/2021 - in kW/h



Testing Summary

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	42 °C		41 °C		
Total Electrical Consumption	257,155 kW/h		295,236 kW/h		
Average Electrical Consumption Per Hour	1,531 kW/h		1,757 kW/h		
Total Water Consumption	280.0 m³		0.0 m³		

Electricity Results Summary

	kW/h	AED	Summary
Actual Chiller savings in 7 Days	38,081 kW/h	0.32	12,186

	m³	AED	Summary
Actual water consumption in 7 Days	280 m³	7.81	2,187

	kW/h	AED	Summary
Projected Chillers savings per season (240 days)	1,218,603 kwh	0.32	389,953

	m³	AED	Summary
Projected water consumption per season (240 days)	8,960 m³	7.81	69,978

	QTY	AED	Total
Maintenance per year	4	7,623	30,492

- Net savings after all running costs for 4 Chillers: **AED 289,483**
- Cost of 4 adiabatic Smart Cooling™ delivered & installed: **AED 506,822.00**
- ROI Period (in calendar years, after all running costs for 4 Chillers): **1.75 year**
- Reduction of CO2 Emissions for 4 Chillers: **509 Ton**

**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

Summary below table:

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.

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 ***Smart cooling***™ electrical meters.

Smart Cooling™ system **ON**

DATE / TIME	AMBIENT TEMP °C	RH %	ACTUAL COOLING LOAD PRODUCED BY CHILLERS MW/h	PLANT COOLING SETPOINT MW/h	ELECTRICAL CONSUMPTION kW/h
28/6/2021 21:05:00 GST	35	31.5	5.4	8	
28/6/2021 21:10:00 GST	34.7	31.9	5.3	8	
28/6/2021 21:15:00 GST	34.7	31.8	5.5	8	
28/6/2021 21:20:00 GST	34.7	31.6	5.3	8	
28/6/2021 21:25:00 GST	34.7	32.5	5.5	8	
28/6/2021 21:30:00 GST	33.9	33.2	5.3	8	1799
28/6/2021 21:35:00 GST	33.9	32.3	5.4	8	
28/6/2021 21:40:00 GST	33.9	32.5	5.5	8	
28/6/2021 21:45:00 GST	33.8	32.7	5.4	8	
28/6/2021 21:50:00 GST	33.8	32.5	5.5	8	
28/6/2021 21:55:00 GST	33.9	32.2	5.4	8	
28/6/2021 22:00:00 GST	34.1	32.8	5.4	8	
28/6/2021 22:05:00 GST	34	34.5	5.4	8	
28/6/2021 22:10:00 GST	33.8	33	5.4	8	
28/6/2021 22:15:00 GST	33.8	34.5	5.5	8	
28/6/2021 22:20:00 GST	34	32.7	5.4	8	
28/6/2021 22:25:00 GST	34.4	31.5	5.5	8	1797
28/6/2021 22:30:00 GST	34.5	31.5	5.4	8	
28/6/2021 22:35:00 GST	34.4	32.4	5.3	8	
28/6/2021 22:40:00 GST	34	33.5	5.5	8	
28/6/2021 22:45:00 GST	34	32.9	5.5	8	
28/6/2021 22:50:00 GST	34.5	32	5.5	8	
28/6/2021 22:55:00 GST	34.7	31.9	5.4	8	
28/6/2021 23:00:00 GST	34.6	32.7	5.3	8	
28/6/2021 23:05:00 GST	33.9	34.9	5.6	8	
28/6/2021 23:10:00 GST	34	33.3	5.4	8	
28/6/2021 23:15:00 GST	34.5	33.6	5.5	8	
28/6/2021 23:20:00 GST	34.2	33.2	5.5	8	
28/6/2021 23:25:00 GST	34.6	32.4	5.4	8	1794
28/6/2021 23:30:00 GST	34.5	32.7	5.6	8	
28/6/2021 23:35:00 GST	34.3	33.3	5.4	8	
28/6/2021 23:40:00 GST	34	33.7	5.5	8	
28/6/2021 23:45:00 GST	33.9	33.4	5.4	8	
28/6/2021 23:50:00 GST	33.8	34	5.3	8	
28/6/2021 23:55:00 GST	33.3	35.2	5.6	8	

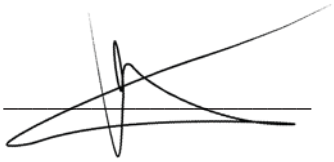
Smart Cooling™ system **OFF**

DATE / TIME	AMBIENT TEMP °C	RH %	AIR ENTERING CONDENSERS °C	ACTUAL COOLING LOAD PRODUCED BY CHILLERS MW/h	PLANT COOLING SETPOINT MW/h	ELECTRICAL CONSUMPTION kW/h
16/6/2021 21:05:00 GST	43.5	25	28.61039	6.0	7.1	
16/6/2021 21:10:00 GST	43.8	25.9	28.60568	6.0	7.1	
16/6/2021 21:15:00 GST	43.6	28	28.96935	6.2	7.1	
16/6/2021 21:20:00 GST	43.1	27.1	28.41104	6.0	7.1	
16/6/2021 21:25:00 GST	42.7	28.7	28.01046	6.2	7.1	
16/6/2021 21:30:00 GST	42.5	29	28.78182	6.1	7.6	2064
16/6/2021 21:35:00 GST	42.3	29	28.4832	6.3	7.3	
16/6/2021 21:40:00 GST	42.3	29.3	28.52087	6.1	7.3	
16/6/2021 21:45:00 GST	41.9	30.3	28.39536	6.1	7.5	
16/6/2021 21:50:00 GST	41.6	30.9	27.89654	6.2	7.6	
16/6/2021 21:55:00 GST	41.9	30.4	27.88874	6.2	7.6	
16/6/2021 22:00:00 GST	42	30.1	28.32797	6.1	7.6	
16/6/2021 22:05:00 GST	41.9	28.5	28.19959	6.2	7.8	
16/6/2021 22:10:00 GST	40.5	30.7	28.33894	6.2	7.8	
16/6/2021 22:15:00 GST	40.6	30.8	27.52135	6.2	7.8	
16/6/2021 22:20:00 GST	41	31.1	27.26993	6.3	8	
16/6/2021 22:25:00 GST	41.2	30.2	27.64418	6.1	8	2025
16/6/2021 22:30:00 GST	40.8	29.7	27.60685	6.4	8	
16/6/2021 22:35:00 GST	40.5	28.4	27.17851	6.3	8	
16/6/2021 22:40:00 GST	39.8	29	26.91247	6.2	8	
16/6/2021 22:45:00 GST	39.9	29	26.29323	6.3	8	
16/6/2021 22:50:00 GST	39.6	29.5	26.03853	6.3	8	
16/6/2021 22:55:00 GST	39.1	31.9	26.32088	6.3	8	
16/6/2021 23:00:00 GST	39.1	32.8	26.03853	6.3	8	
16/6/2021 23:05:00 GST	38.8	34.5	25.97264	6.3	8	
16/6/2021 23:10:00 GST	38.8	36.2	26.3301	6.3	8	
16/6/2021 23:15:00 GST	38.7	37.6	26.27326	6.5	8	
16/6/2021 23:20:00 GST	38.2	37.9	26.98974	6.4	8	
16/6/2021 23:25:00 GST	37.9	38.6	27.12432	6.5	8	1985
16/6/2021 23:30:00 GST	37.3	39.8	26.48387	6.4	8	
16/6/2021 23:35:00 GST	37.1	38.3	26.3716	6.4	8	
16/6/2021 23:40:00 GST	37.2	35.8	26.27173	6.4	8	
16/6/2021 23:45:00 GST	37.2	35.8	25.99869	6.4	8	
16/6/2021 23:50:00 GST	37	34.1	25.73241	6.5	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 Mucenieks
July 06, 2021



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 | test Report

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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		-0,147	
	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	0,759	-0,146	0,147
	71,19		25,0	0,300	71,65		0,646			
	71,34		25,0	0,300	71,86		0,729			
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