25 March 2022

TEST REPORT

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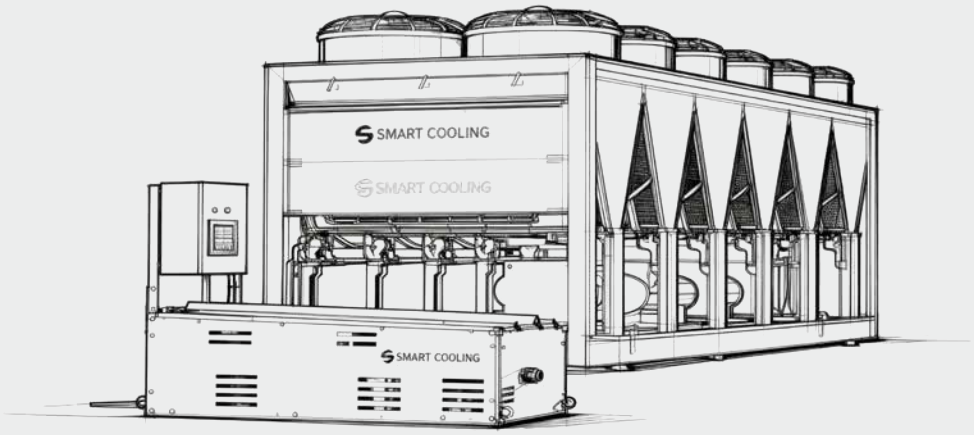

SMART COOLING™ PRO10 SYSTEM

Microsoft Lavalle

Test Participants:
Project name: **MICROSOFT LAVALLE** Location: **Karnataka, India**
Carrier Engineer: **Ravi Kiran**
CBRE, Facility Engineer: **Heggappa M.A.**
Swiss Integrated Energy Technologies: **Armands Mucenieks**

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

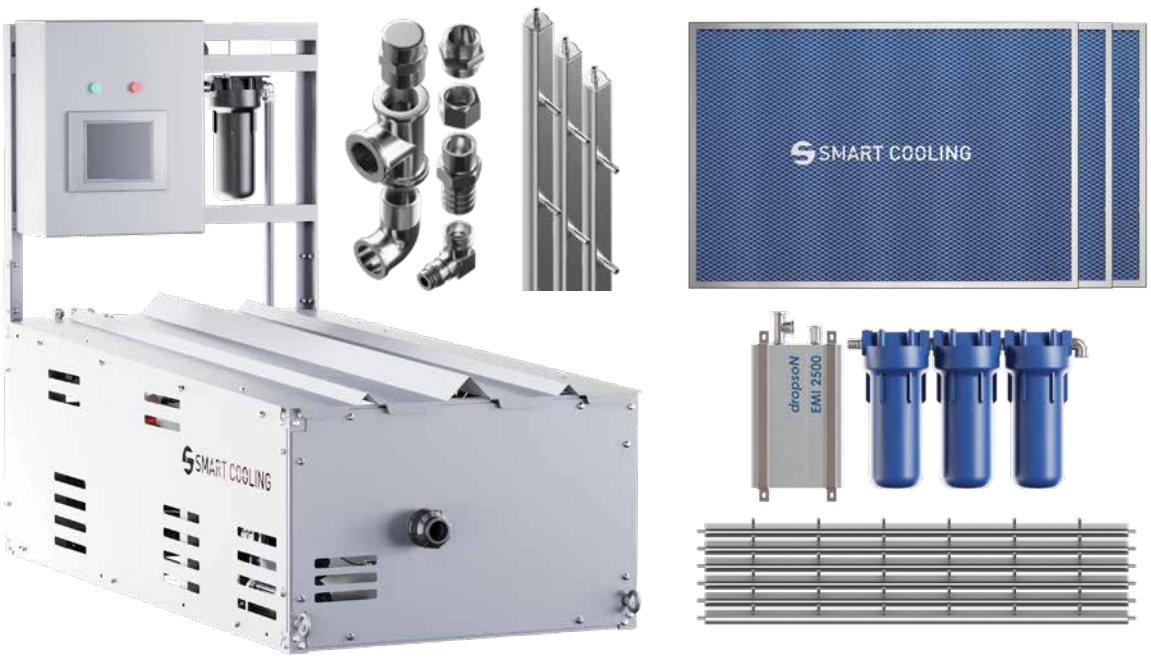
Water filtration, purification, and sterilization: the system purifies water from minerals and sterilizes water to prevent bacterial occurrence.

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, **Trane RTAC 500**

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 ON
Testing period: *2022/03/10 to 2022/03/18* – 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 and BTU reader.

Step 2:
The *Smart Cooling*™ system is switched ON

BTU Reader

Temperature and Humidity Reader

Eniscope (Energy Reader)

Step 3:
During the period between *09/07/2022* and *12/07/2022*, the test measured energy used by the chillers with the intelligent adiabatic system *Smart Cooling*™ turned ON (Chiller #1 was in operation). During this period, the chiller consumed **8.617 MW/h** of electricity, produced **16.125 MW/h** of cooling, with average ambient temperature **25.57 °C**.

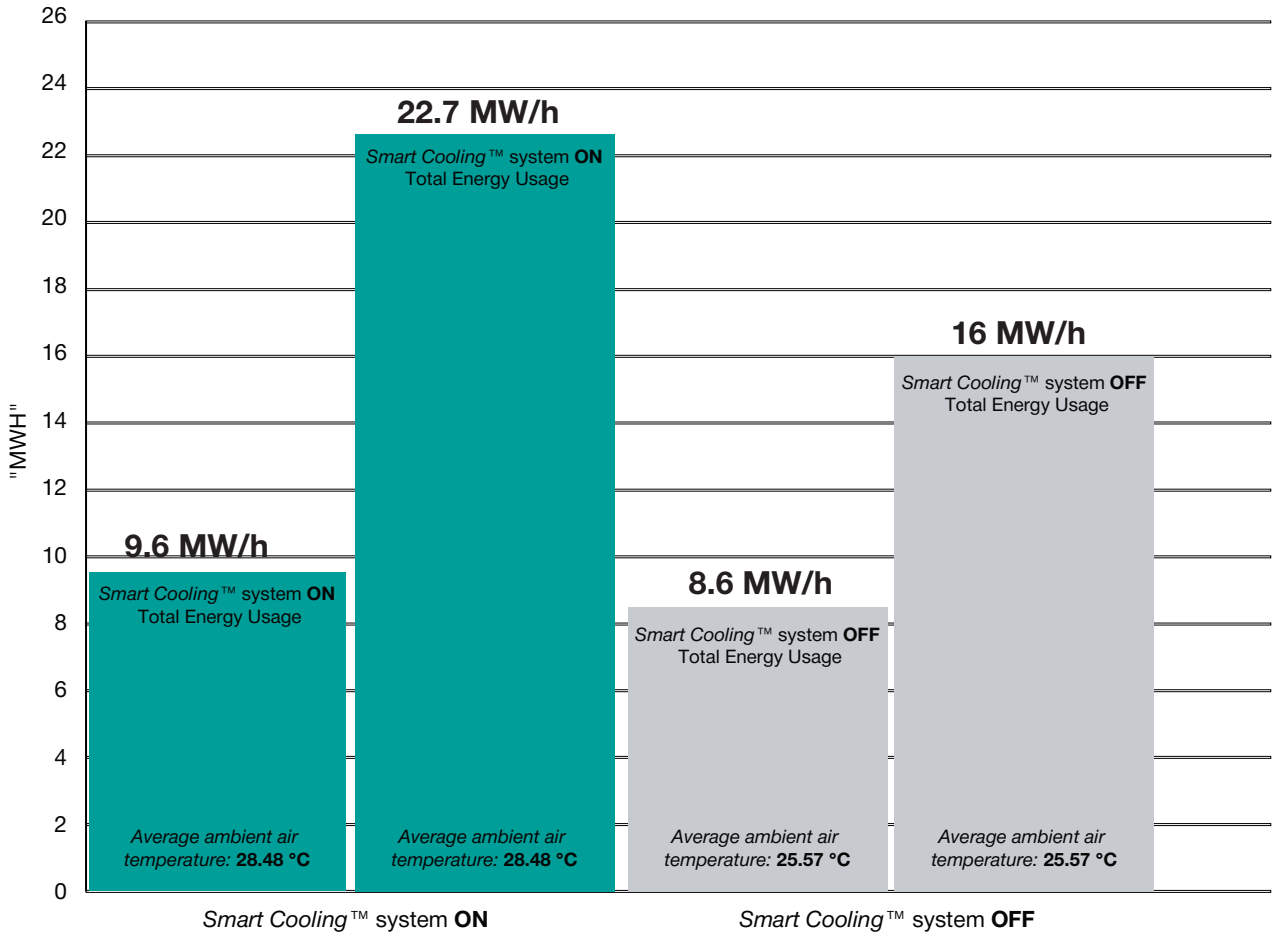
Step 4:
The *Smart Cooling*™ system is switched OFF

Step 5:

During the period from *10/03/2022 - 18/03/2022*, the test measured energy used by the chiller without the intelligent adiabatic system *Smart Cooling*™ unit turned **OFF** (Chiller #1 was in operation). During this period, the chiller consumed **9.617 MW/h** of electricity, and produced **22.775 MW/h** of cooling, with average ambient temperature **29.04 °C**.

Test Results Comparison

Smart Cooling™ system **OFF** – Total Energy Usage: **1.83 kW/h**
Smart Cooling™ system **ON** – Total Energy Usage: **2.38 kW/h**



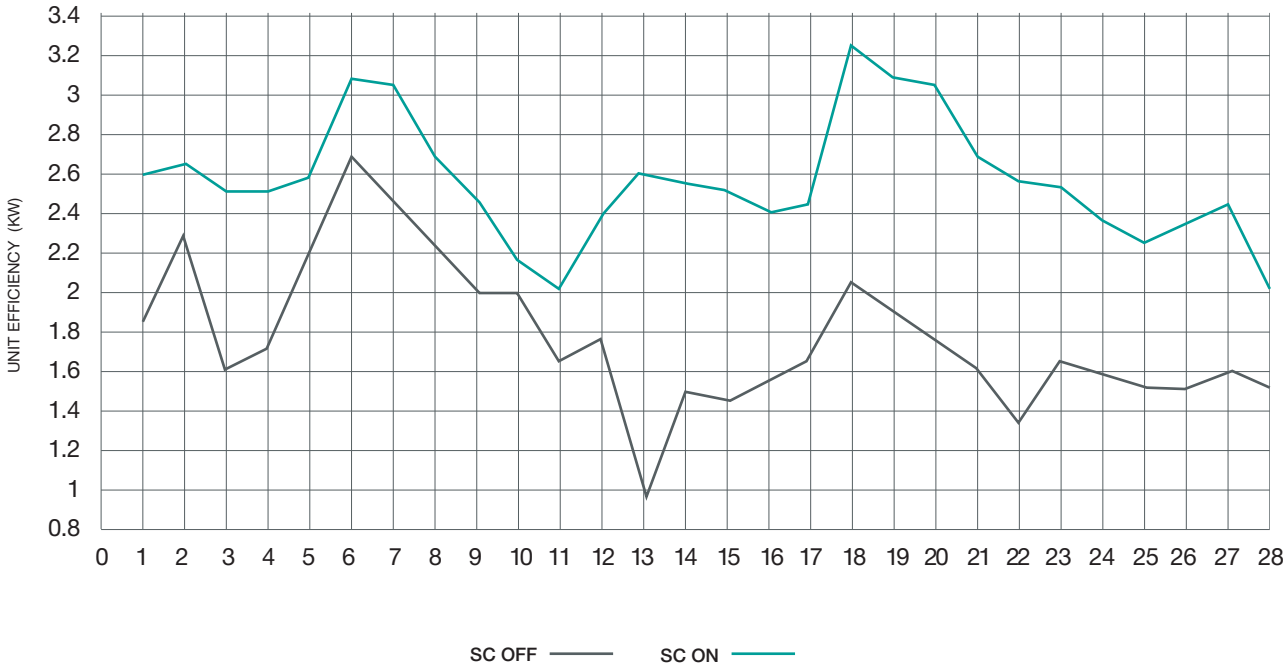
Post-analysis of data monitoring shows **30.3 % improvement** in chiller performance achieved by the *Smart Cooling*™ system during 7 working days.

Testing Results Overview:

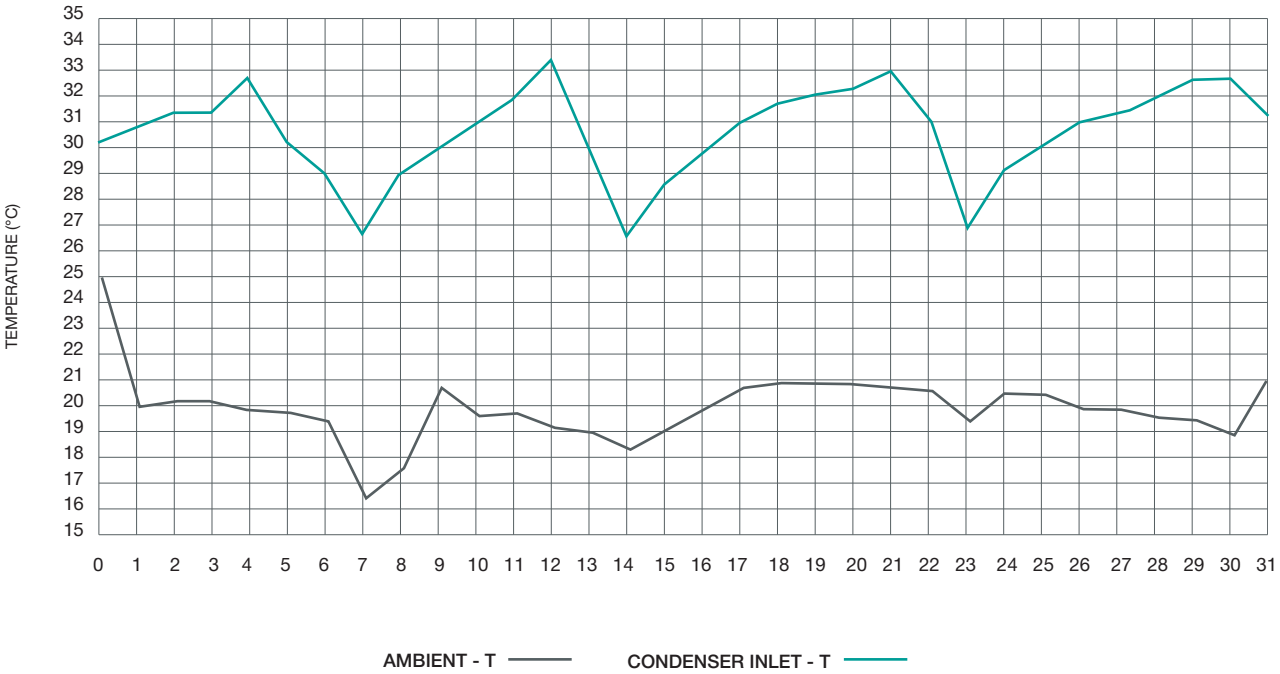
Smart Cooling™ Test Report in Chiller 1 **– Microsoft Lavalle Road Office Building, Bangalore, India**

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
AVG. AMBIENT TEMPERATURE (°C)	25.57 °C	29.04 °C
SC OPERATING HOURS (”hrs”)	0 hrs	62 hrs
TOTAL ENERGY USAGE (kWh)	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 (%)	30.3% improvement	

Unit Efficiency Overview



Chiller Operating Hours Avg. Ambient



Date	Chiller Operational	Ambient T	Avg. Condenser Air Entering T	Total Chiller 1 E	Avg. C.W Flow	Avg. C.W Return T	Avg. C.W Supply T	Total Cooling Capacity	Avg. Unit Efficiency EER
DD/MM/YY	*Hrs*	*°C*	*°C*	*kWh*	*m^3/hr*	*°C*	*°C*	*kWh*	*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	1106,15272	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	3514,3619	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

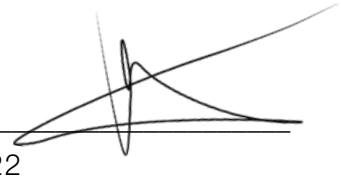
Note During the period of 17/02/2022 till 20/02/2022: Chiller circuits A & B were working, during this period Smart Cooling™ was OFF*
Notes During the period of 21/02/2022 till 25/02/2022: Chiller circuits A & C were working, during this period Smart cooling™ was OFF*

Date	Chiller Operational	SC Operating	Avg. Ambient T	Average Humidity	Avg. Condenser Air Entering T	Total Chiller 1 E	Avg. C.W. Flow	Avg. C.W. Return T	Avg. C.W. Supply T	Total Cooling Capacity	Avg. Unit Efficiency EER
DD/MM/YY	*Hrs*	*Hrs*	*°C*	*%*	*°C*	*kWh*	*m^3/hr*	*°C*	*°C*	*kWh*	*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	29,2	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	36,8	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.

Ali Soufan 

July 18, 2022

Annex:

Riels instruments srl
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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

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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