

NITZBA HOTEL AIR PORT CITY *GHP SYSTEMS FOR HVAC*



November 2018 ►

► **BY : Eng. Giorgio Raptis**

The Technology

Gas Engine Heat Pumps

Range GEHP

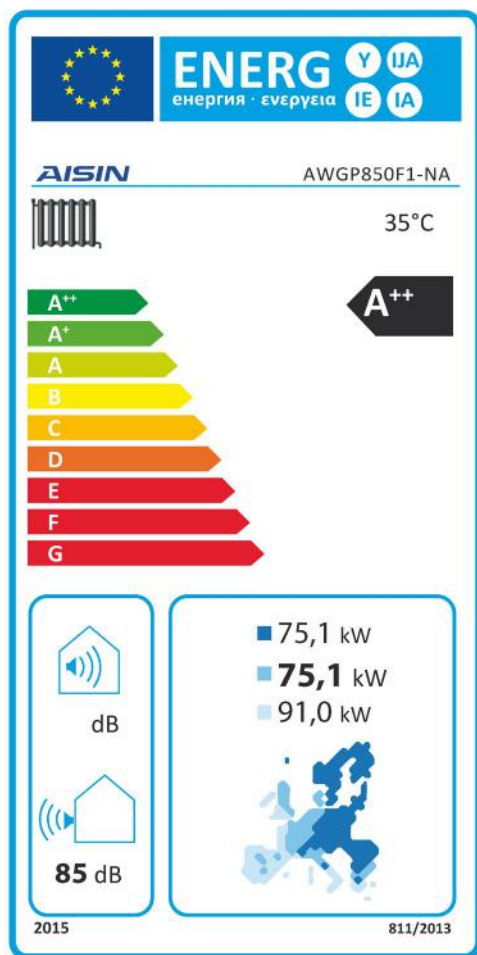
Models: 6, 8, 10 RT



Models: 13,16,20, 24 RT



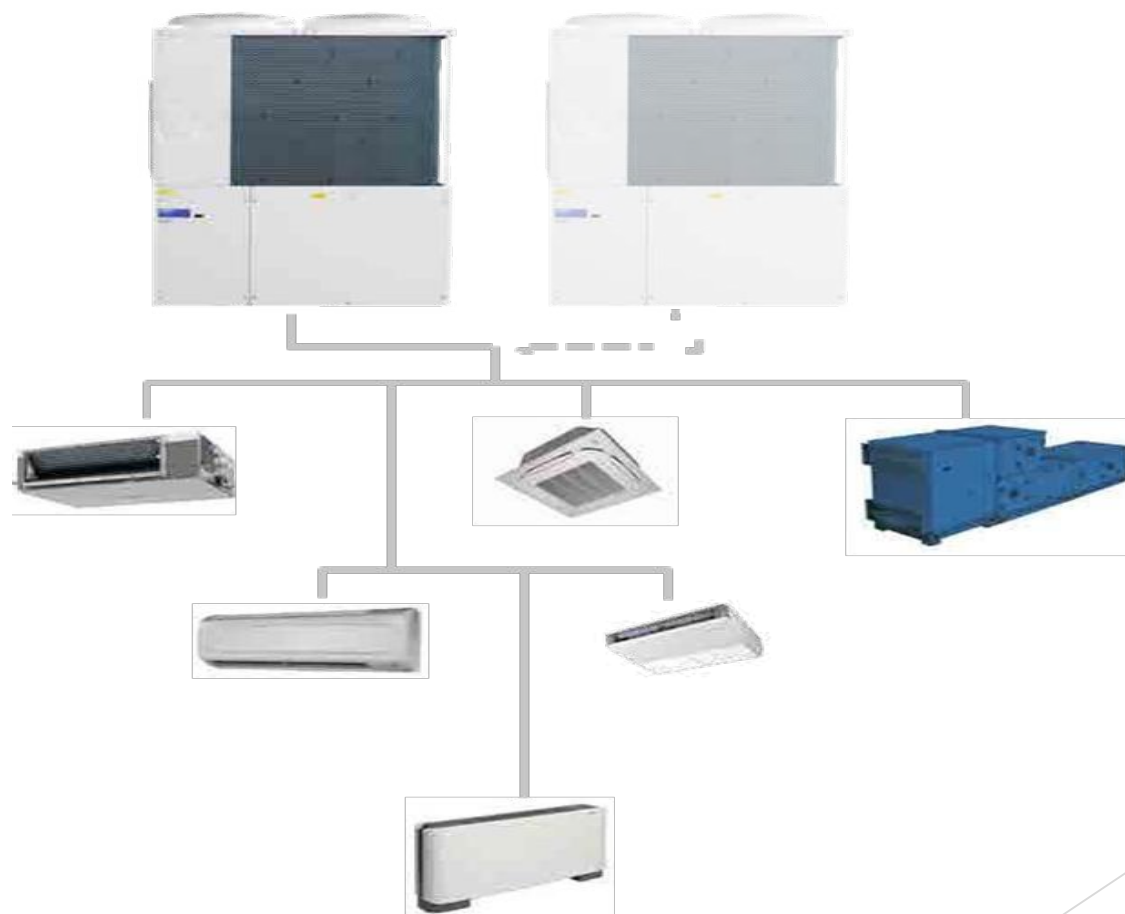
Energy label



HVAC with WATER



HVAC with Direct Expansion (VRF)



Weight distribution

Weight of one GEHP: 870Kg

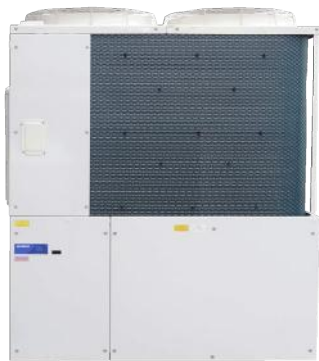
Weight of one Electric Chiller: 4.200Kg

Even weight distribution on the roof

Sound pressure



Sound pressure
of the system of
625RT is **68db** at
10 mt



Sound pressure
of the system of
625RT is **63db** at
10 mt



How much it cost to produce 1 kWh of cooling using GEHP

GAS HEAT PUMP with Dx											
		kW	RT	cons KW	cons m3/h	cost €/kWhc	cost €/RThc		GUE	cost of kwh energy produced (cost of kwh NG/GUE)	cost of RT energy produced (cost in KWh x 3,517)
GHP AISIN	GHP8	22,4	6,4	15	1,6	0,01621	0,057		1,493	0,01621	0,057
	GHP10	28	8,0	19,2	2,0	0,01659	0,058		1,46	0,01659	0,058
	GHP13	35,5	10,1	26,4	2,8	0,01800	0,063		1,34	0,01800	0,063
	GHP16	45	12,8	31	3,3	0,01667	0,059	NIS 45%	1,45	0,01667	0,059
	GHP20	56	15,9	40,7	4,3	0,01759	0,062		1,38	0,01759	0,062
	GHP25	71	20,2	55,1	5,8	0,01878	0,066		1,29	0,01878	0,066
	GHP30	85	24,2	67,8	7,2	0,01930	0,068	0,285	1,25	0,01930	0,068
GAS HEAT PUMP with AWS											
		kW	RT	cons KW	cons m3/h	cost €/kWhc	cost €/RThc		GUE	cost €/kWhc	cost €/RThc
GHP AISIN	GHP8	21	6,0	15	1,6	0,01729	0,061		1,400	0,0173	0,061
	GHP10	26,5	7,5	19,2	2,0	0,01753	0,062		1,380	0,0175	0,062
	GHP13	33,5	9,5	26,4	2,8	0,01907	0,067		1,269	0,0191	0,067
	GHP16	41,5	11,8	31	3,3	0,01808	0,064		1,339	0,0181	0,064
	GHP20	52	14,8	40,7	4,3	0,01894	0,067		1,278	0,0189	0,067
	GHP25	63	17,9	55,1	5,8	0,02117	0,074		1,143	0,0212	0,074
	GHP30	74,5	21,2	67,8	7,2	0,02202	0,077	0,323	1,099	0,0220	0,077
ELECTRIC HEAT PUMP with Dx											
		kW	RT	cons KW		cost €/kWhc	cost €/RThc		COP	cost €/kWhc	cost €/RThc
DAIKIN RYYQ	EHP8HP	22,4	6,4	5,21		0,0285	0,100		4,30	0,0285	0,100
	EHP10HP	28	8,0	7,29		0,0319	0,112		3,84	0,0319	0,112
	EHP13HP	35,5	10,1	10,5		0,0363	0,128		3,38	0,0363	0,128
	EHP16HP	45	12,8	13		0,0354	0,125		3,46	0,0354	0,125
	EHP20HP	56	15,9	18,5		0,0405	0,142	NIS	3,03	0,0405	0,142
	EHP25HP	71	20,9	20		0,0345	0,117		3,55	0,0345	0,121
	EHP30HP	83,9	23,9	24		0,0351	0,123	0,516	3,50	0,0351	0,123
Prices as at May 2019											
	cost of electricity	€/kwh	0,1226	0,515	NIS/kWh						
	cost NG	€/m3	0,2284							€/KWh	€/m3
		€/kwh	0,024	0,102	NIS/KWh						
						cost NG: USD\$ 8 / MMBTU = 26NIS					
						cost of ELECTR: 0,152 US\$/KWh= 0,55NIS				0,1266/kwh	
						cost of LPG: US\$ 0,97 / Kg=3,5NIS				0,80€/kg	

Energy recovery to produce Hot Sanitary Water at no cost and 60°C

***Total quantity of hot water produced per minute, at GHP nominal capacity (=100% capacity) expressed in liter:**

MODEL	HEAT RECOVERY - kW/h	water flow lt/minute at ΔT 25 / 60 °C	water flow lt/minute at ΔT 30 / 60 °C	water flow lt/minute at ΔT 35 / 60 °C	water flow lt/minute at ΔT 40 / 60 °C	water flow lt/minute at ΔT 45 / 60 °C	water flow lt/minute at ΔT 50 / 60 °C	water flow lt/minute at ΔT 55 / 60 °C
WKJT8HP	8	3,28	3,83	4,60	5,75	7,66	1149	22,99
WKJT10HP	10	4,11	4,79	5,75	7,18	9,58	1437	28,74
WKJT13HP	13,5	5,54	6,47	7,76	9,70	12,93	1940	38,79
WKJT16HP	16,5	6,77	7,90	9,48	11,85	15,80	2371	47,41
WKJT20HP	20	8,21	9,58	11,49	14,37	19,16	2874	57,47
WKJT25HP	25	10,26	11,97	14,37	17,96	23,95	3592	71,84
WKJT30HP	41,5	17,04	19,88	23,85	29,81	39,75	5963	119,25

Case study

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The Hotel



- ❑ 250 hotel rooms
- ❑ 1,500m² conference hall
- ❑ 5 stars hotel with 7 floors
- ❑ 16,000m² above ground level
- ❑ 15,000m² 2 underfloor parking level, -1,-2
- ❑ Total cooling capacity 625T.R (2,200kw) at 0.65 D.F
- ❑ 375kw heating capacity for the hotel sanitary water

AMISRAGAZ PROPOSAL

- ❑ 25 AISIN GHP units for the production of 625T.R as well as 375kw sanitary hot water recovery, based on natural gas engines equipped with TOYOTA 4Y engines.
- ❑ The HVAC system can be a 2 pipe water system or DX VRF system for the hotel consultant decision
- ❑ Sanitary hot water distribution for the hotel rooms, laundry and kitchen.
- ❑ Training of the hotel maintenance staff
- ❑ Spare parts and high quality service team
- ❑ Connection to natural gas pipe network





GEHP SYSTEM ADVANTAGES

- ❑ High Seasonal efficiency SPF at partial loads compared to electrical system.
- ❑ Hot water production from the engine heat recovery
- ❑ In heat pump mode using the air as renewable heat source
- ❑ Reduction of CO2 emission
- ❑ High efficiency $E_{\text{Energy Efficiency Ratio}} = 5.50$ ($P_{\text{Primary Energy Ratio}} = 1,72 \times 3,5$)

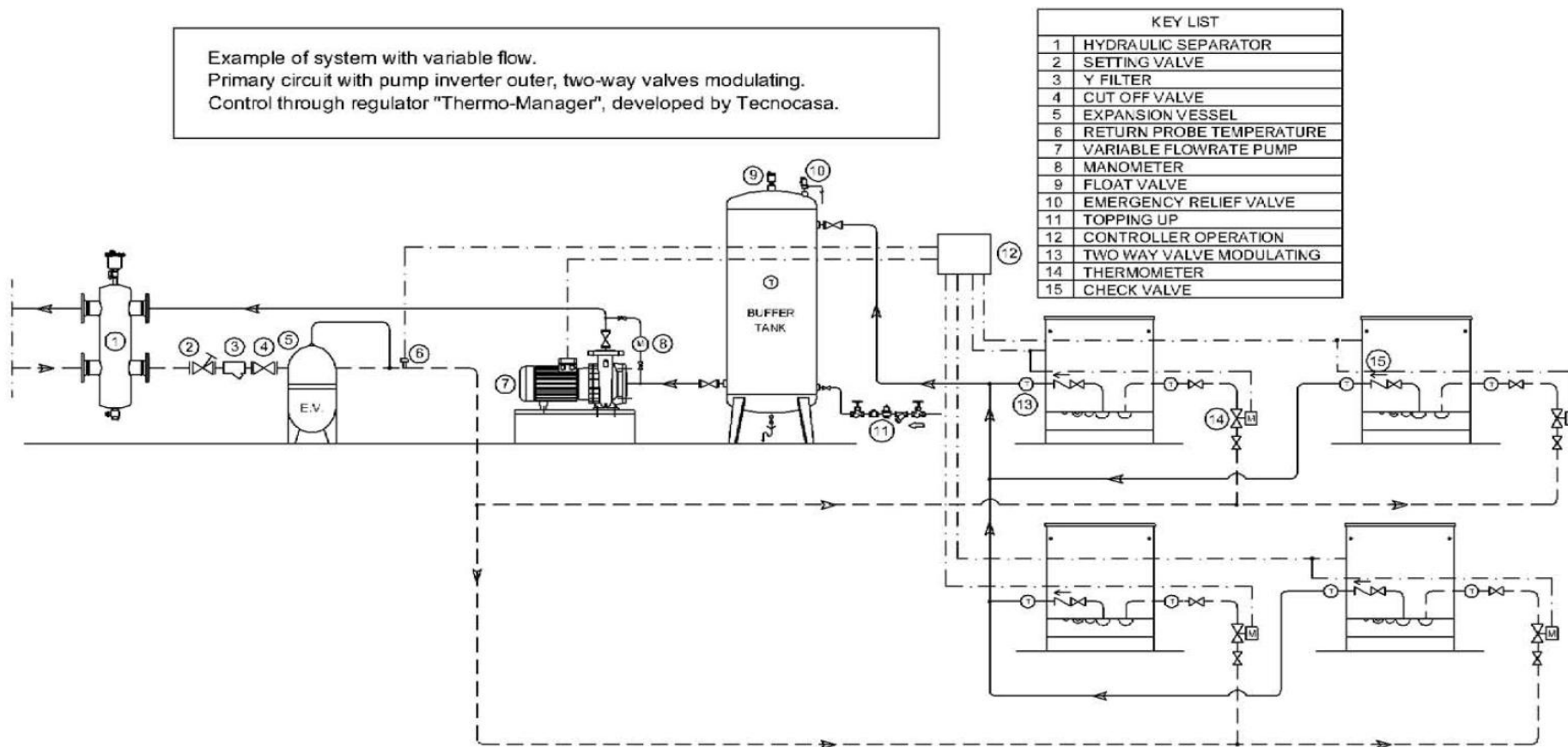


GEHP SYSTEM ADVANTAGES

- ❑ Low operation cost and LCC (*Life Cycle Cost*)
- ❑ System flexibility that can operate as chiller or VRF alternatives according to the project needs
- ❑ Very low power supply, only 37kW (1,49kwx25 units) required for the production of 625TR
- ❑ Toyota gas engines are extremely reliable with high LCC

Hot and Cold water diagram

Example of system with variable flow.
Primary circuit with pump inverter outer, two-way valves modulating.
Control through regulator "Thermo-Manager", developed by Tecnocasa.



Modello Model		AWS16HP-F1(J)	AWS20HP-F1(J)	AWS25HP-F1(J)	AWS30HP-F1(J)	
Modello GEHP collegabile Connectable GEHP		AWGP450F1	AWGP560F1	AWGP710F1	AWGP850F1	
Capacità nominale raffreddamento Rated cooling capacity	kW	42,5	53,0	63,5	74,5	
Consumo nominale raffreddamento (GEHP) Rated cooling consumption (GEHP)		30,0	43,0	56,0	70,7	
GUE raffreddamento GUE cooling		1,42	1,23	1,13	1,05	
Temperatura minima uscita acqua Minimum water temperature out		7				
Capacità nominale riscaldamento Rated heating capacity		50,0	62,5	77,0	87,5	
Capacità massima riscaldamento (2°C) Maximum heating capacity (2°C)		53,5	68,0	77,0	91,0	
Consumo nominale riscaldamento (GEHP) Rated heating consumption (GEHP)		34,0	42,5	54,2	61,5	
Consumo massimo riscaldamento (GEHP) (2°C) Maximum heating consumption (GEHP) (2°C)		37,3	53,2	58,5	75,7	
GUE riscaldamento GUE heating		1,47	1,47	1,42	1,42	
Recupero calore motore max. Maximum engine heat recovery		19,5	23,5	30,5	44,5	
Temperatura massima uscita acqua Maximum water temperature out		50				
SPER raffreddamento SPER cooling		1,89	1,89	1,87	1,91	
SPER riscaldamento SPER heating		1,57	1,55	1,54	1,51	
Portata acqua Water flow rate		mc/h	8	10	12	14
Modulazione potenza Capacity modulation rate		%	35 – 100	28 – 100	23 – 100	22 - 100
Unità con pompa Built in pump unit		Alimentazione elettrica Power supply	V/Ph/Hz	230/1/50		
		Consumo nominale (pompa opzionale) Rated consumption (optional pump)	W	550 (770)		700 (900)
		Corrente di spunto Starting current	A	4		
		Prevalenza disponibile (pompa opzionale) Available static pressure (optional pump)	mca	7,5 (11,0)	6,0 (7,0)	3,7 (6,5)
Unità senza pompa (J) Unit without pump (J)		Alimentazione elettrica Power supply	V/Ph/Hz	230/1/50		
	Consumo nominale Rated consumption	W	190			
	Corrente di spunto Starting current	A	1			
	Perdita di carico scambiatore Heat exchanger pressure drop	mca	2,2	3,3	4,6	4,8
Attacchi idraulici Water ports	mm	40				
Diametro tubazioni circuito primario Primary circuit piping diameter	mm	DN40		DN50		
Attacchi circuito frigorifero gas-liquido Refrigerant gas ports gas-liquid	mm	Ø 28,6 – 18,0			Ø 35,0-18,0	
Diametro tubazioni GEHP-AWS gas-liquido GHP-AWS piping diameter gas-liquid	mm	Ø 28,6 - 15,88		Ø 35,0 – 15,88	Ø 35,0 – 19,0	
Dimensioni (AxLxD) Dimensions (HxWxD)	mm	915 X 710 X 1.020				
Peso (senza pompa) Weight (without pump)	kg	204 (177)			207 (180)	
Numero interne collegabili Connectable indoor units number		1				





The Economical Model

- ❑ The model build the hotel yearly cooling and heating consumption profile based on monthly data.
- ❑ The model compare between the energy consumption, electricity versus natural gas based on system EER and ESEER for a cooling capacity of 625T.R
- ❑ The Model calculate the total system heating capacity potential at a temperature of 55°C ,recovery for the GHP system and determine the 375kw and the energy storage in order to supply the hotel needs.
- ❑ The model use the cost of energy for each alternative, kwhr and natural gas cost
- ❑ The model use the cost of power connection to the grid and natural gas connection to the network.
- ❑ The model calculate the CO2 reduction
- ❑ The model determine finally the systems cost difference and the energy saving in order to calculate the ROI



Running costs - Pay back

- Running costs - Payback -

Brand	AISIN				COMPETITOR'S INSTALLATION			
Description	GEHP 30hp + AWS/EHP 30hp + AW				AERMEC NRA - 2000			
Q.ty	16	12		TOT. 28	4			4
Annual electricity fixed costs	€ -	€ -	€ -	€ -	€ -	€ -	€ -	€ -
Annual maintenance costs	€ 6.884,4	€ 5.570,9	€ -	€ 12.455,3	€ -	€ -	€ -	€ -
Fill in manually maintenance costs					WRITE BELOW	WRITE BELOW	WRITE BELOW	€ -
					€ 6.000,00			€ 6.000,0

Cost of electricity consumption:								
Total cost electr. consumption	3.185	1.170		14.174,3				288.697,3
Cost of gas consumption:								
Total costs of gas consumption	3.185	1.170		149.685,6				-
TOT. ANNUAL WORKING HOURS	4.355							
TOT. ANNUAL RUNNING COSTS				€ 176.315,2				294.697,3
ANNUAL CO2 PRODUCTION (fuel+electrical) in Tn				987,6				1.110,4

- Payback -

Initial cost difference	€		164.000,00
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	CO ₂ SAVINGS / YEAR	tonn	-123
	CO ₂ savings/year compared	%	-11%
	to competitor's system		
Payback in €		€	118.382
		%	40%
Payback time		Years	1,39
Primary Energy Savings		kWh	564.194

	CO ₂ SAVINGS / YEAR	tonn	-312
TOT energy recovery/year		kWh	879.198
Economic savings [€] /year with W-KIT		€	148.720
		%	45%
Payback time with W-KIT		Years	1,10
Primary Energy Savings		kWh	1.519.844

CO₂ savings - 123TN

40%

1,4 y

CO₂ savings - 313TN

45%

1 y

Software sviluppato da

TECNOCASA
CLIMATIZZAZIONE
Sole European Distributor **AISIN**
Gas Heat Pump (GHP) / Microcogenerator (MCHP)

Version 00 EN
13/07/2018

YEARLY RUNNING SAVINGS: 497.000 ILS

YEARLY RUNNING SAVINGS with HSW: 625.000 ILS



Comparison Table

CO2 yearly saving Tons	Infrastructure connection €	System Cost €	Energy Cost	Total yearly operation hours	Sanitary water at 55 °C	Cooling Capacity T.R	HVAC Type
1.100 123 - 312	80,000	530,000	13Cent€/kwhr	5,482		625	Air cooled chillers
987	52,000	775,000	30Cent€/m ³	5,482	375kw	625	GHP

Payback period for the ROI between the 2 system is ONE YEAR and 4 months for cooling & heating only

Payback period for the ROI between the 2 system is ONE year for cooling. heating and sanitary water.

תודה לך על תשומת הלב