Eaton-Williams

IPAC Air Handling Units

Short-form version - extracted from Section 2 of the Installation, Operation and Maintenance Manual

Technical Product Guide

(Invicta Precision Air Control)

15 to 120 kW, Upflow, Downflow,

Direct Expansion, Water-Cooled Direct Expansion, Chilled Water

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SECTION CONTENTS

Introduction

This section provides information about the main components of Invicta Precision Air Control (IPAC) standard range air handling units (AHUs).

Application

IPAC units are designed as a modular range of both upflow and downflow, floor-standing, air handling units for operation at room temperatures from 18 °C to 30 °C as standard. Factory-added options can enable operation outside this range.
These units provide highly reliable air handling systems for space-cooling, where the air must be conditioned to be:

- **Temperature controlled** (heating is optional)
- **Humidity controlled** (optional)
- **Filtered clean of particulates**

Duty Range

Basic duty sizes for standard units in the IPAC range are as shown in Table 1-1, which also identifies which are single or twin module units, together with matching condenser options.
Twin module units can be positioned separately, offering flexibility according to installation requirements; refer to Fig. 1-3 for dimensions and weight data.

Table 1-1 : Duty range and matching air-cooled condensers

NOMINAL DUTY kW	UNIT	SINGLE / TWIN MODULE UNIT	Matching Air-cooled Condenser Models	
			Primary	Secondary
15	IPAC 15-1	Single	ICV1-18P	-
22	IPAC 22-1	Single	ICV1-40P	-
30	IPAC 30-1	Single	ICV2-40P	-
30	IPAC 30-2	Twin	ICV1-18P	ICV1-18P
40	IPAC 40-1	Single	ICV2-70P	-
45	IPAC 45-2	Twin	ICV2-40P	ICV1-18P
50	IPAC 50-1	Single	ICV3-70P	-
55	IPAC 55-2	Twin	ICV2-70P	ICV1-18P
60	IPAC 60-1	Single	ICV3-70P	-
60	IPAC 60-2	Twin	ICV2-40P	ICV2-40P
70	IPAC 70-2	Twin	ICV2-70P	ICV2-40P
80	IPAC 80-2	Twin	ICV2-70P	ICV2-70P
90	IPAC 90-2	Twin	ICV3-70P	ICV2-70P
100	IPAC 100-2	Twin	ICV3-70P	ICV3-70P
110	IPAC 110-2	Twin	ICV3-70P	ICV3-70P
120	IPAC 120-2	Twin	ICV3-70P	ICV3-70P

By offering a selection of various combinations of unit configuration, duty requirements can be matched accurately. The various standard unit configurations available are as illustrated in Fig. 1-3, while airflow path configurations are illustrated in Fig. 1-11.
Units are manufactured with either upflow or downflow air direction, to provide optimum comfort levels.

For a dual module pair, the electrical section of the larger unit contains the controls and switchgear for control of the other.
All dual module interconnecting wiring is made to numbered terminal rails in each unit for easy connection at site.
To ease installation, an interconnecting wiring loom is available as an optional extra.
IPAC air handling units are designed for indoor installation only. Units can either be mounted within the space to be conditioned, or mounted elsewhere with air ducted to the room.
As well as the standard unit configurations, a variety of customising options can be factory-fitted or site-fitted, to provide a system that precisely matches user requirements.

Temperature Control

Temperature can be precisely controlled, with cooling provided by the cooling coil(s).
Where heating is required, mutli-stage electrical heating, or low pressure hot water (LPHW) are available as options.
Air temperature is controlled by two PID (Proportional Integral and Derivative) algorithms, one for heating, the other for cooling.
Each algorithm includes the same adjustable dead band, which equally spans each side of the room temperature set point.
If I (Integral) and D (Derivitive) values are zero, control is proportional only.
Proportional units are in °C.

Humidity Control

Where dehumidification is required, a cooling coil is operated below the dew point of the air to condense and remove water content from the air.
To ensure optimum temperature control in conjunction with dehumidification, the options of hot gas or electric reheat are available.
Where humidification is required, a factory-fitted **Vapac®** humidifier unit is available as an option. This is a proportional-output humidifier that produces clean, sterile steam, that is entrained into the airflow to increase its humidity.
The humidifier responds to a changing demand, using the water level (WL) system of modulation. Output is varied by increasing or decreasing the level of water in the cylinder.
Air humidity is similarly is controlled by two PID algorithms, one for humidification, the other for dehumidification.
Each algorithm includes the same adjustable dead band, which equally spans each side of the room humidity set point.
If I (Integral) and D (Derivitive) values are zero, control is proportional only. Proportional units are in % RH.

Reliability

IPAC units are designed for high reliability with a calculated mean-time between failure of not less than four years, provided that routine maintenance procedures are carried out at prescribed intervals.

Serviceability

The maximum time required replacing Service Items, and returning the unit to operational condition is approximately 1 hour, excluding refrigeration circuit items, provided of course, that recommended service parts are held ready to use.
For details of recommended service parts for each unit, together with contact and ordering details, please contact the Eaton-Williams Head Office.

Unit Identification

Vital data on a unit can be obtained from the serial number plate, which can be found inside the cabinet, just below the electrical chassis on the left hand side.

Fig. 1-1 : Serial No. plate (typical)

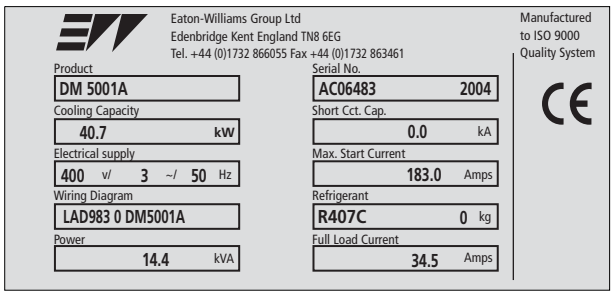
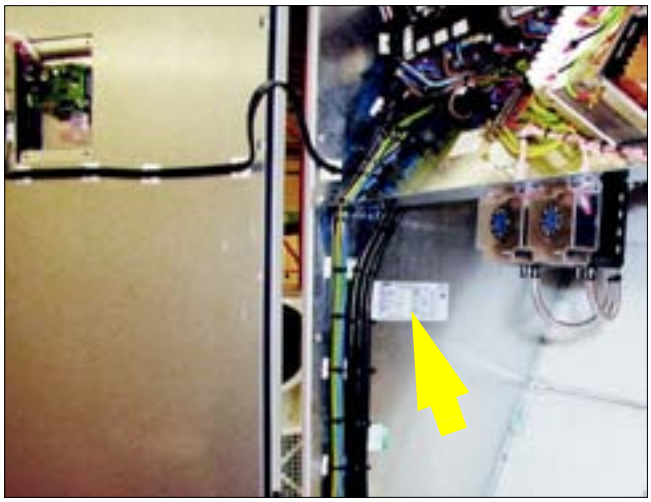


Fig. 1-2 : Approximate position of serial No. plate



The following data is normally shown on the serial number plate:

Product - EW code number.

Cooling Capacity - design cooling capacity in kW.

Electrical Supply - for which the unit is rated.

Wiring Diagram - relevant to the unit.

Power - consumption at maximum load in kVa.

Serial Number - of the unit.

Short Circuit Capacity - in kA.

Maximum Start Current - consumption in Amps.

Refrigerant - type and quantity in kg, to be filled when known; i.e on completion of commissioning.

Full Load Current - consumption in Amps.

Temperature Control

The temperature of supply air passing through the unit is monitored by an Eaton-Williams InvictaNET AHU controller, which applies cooling or heating (optional) control strategy to correct and maintain room air temperature at a predetermined set point.

- The Cooling Process is described below.
- The Humidity Control is described on page 19.

The air passage through the unit is the same, whether in heating or cooling mode.

Cooling Process

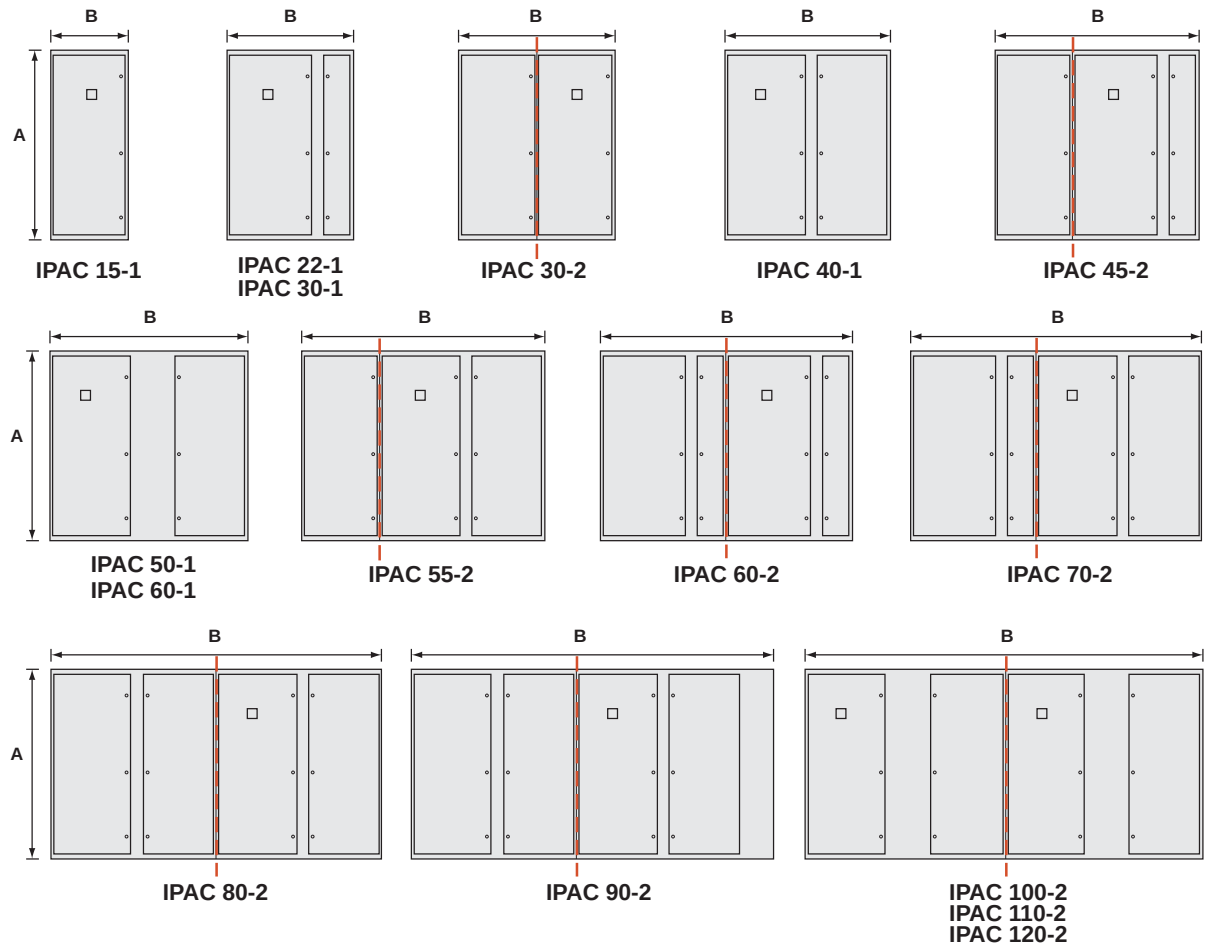
The cooling process is used for air cooling and/or dehumidification and is achieved by one of three types of cooling process:

- Air-cooled Direct Expansion (DX) System on page 15, using refrigerant, normally R 407C
- Water-cooled DX System on page 16 using water/glycol as a primary refrigerant, normally containing corrosion inhibitor additive (recommended)
- Chilled Water Cooling System on page 17, or other similar cooled medium

The type of cooling process required must be specified at the time of ordering.

Fig. 1-3 : IPAC Range unit configurations, dimensions and weights

IPAC Range Unit Configurations, Dimensions and Weights



NOTES
Dual units are shown with cabinets mated side-by-side; dashed red lines show unit mating positions.
Unit mating positions can be left or right handed as required, and cabinets can be positioned separately to suit room layout.

Unit		15-1	22-1	30-1	30-2	40-1	45-2	50-1	55-2	60-1	60-2	70-2	80-2	90-2	100-2	110-2	120-2
Single and dual unit composition (P = Primary, S = Secondary)																	
Unit Composition	**P**	15	22	30	15	40	30	50	40	60	30	40	40	50	50	60	60
	S	-	-	-	15	-	15	-	15	-	30	30	40	40	50	50	60
Module Widths (mm)	**P**	800	1300	1300	800	1700	1300	2050	1700	2050	800	1700	1700	2050	2050	2050	2050
	S	-	-	-	800	-	800	-	800	-	800	1300	1700	1700	2050	2050	2050
A - Height mm		1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950	1950
B - Width mm		800	1300	1300	1600	1700	2100	2050	2500	2050	2600	3000	3400	3750	4100	4100	4100
Depth mm		800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800
Weight * kg (combined)		270	380	402	520	472	652	580	722	620	784	922	916	1027	1135	1170	1210

NOTE * Weights are estimated, dry and may vary according to unit configuration and options fitted, please contact Eaton-Williams for further assistance if required.

Table 1-2 : Technical data

Technical Data									
IPAC Model		**15-1**	**22-1**	**30-1**	**30-2**	**40-1**	**45-2**	**50-1**	**55-2**
DX unit - Total cooling[1]	kW	16.0	22.0	30.0	32.0	40.7	46.0	53.0	56.0
DX unit - Gross sensible cooling[1]	kW	14.8	20.9	28.1	29.6	37.4	42.9	46.1	52.2
DX unit - Sensible heat ratio		0.92	0.95	0.94	0.92	0.92	0.93	0.86	0.93
DX unit - Net sensible cooling	kW	13.7	18.5	25.6	27.6	33.7	39.3	43.7	47.4
CW unit - Total cooling[1 & 2]	kW	23.6	32.1	42.5	47.2	59.8	66.1	67.4	83.4
CW unit - Gross sensible cooling	kW	18.5	24.7	33.5	37.0	47.2	52.0	53.8	65.7
CW unit - Sensible heat ratio		0.78	0.77	0.79	0.78	0.79	0.78	0.81	0.78
CW unit - Net sensible cooling	kW	17.3	23.0	30.9	34.6	43.5	48.2	50.8	60.8
CW unit - Chilled water flow rate	l/s	1.12	1.53	2.02	2.24	2.85	2.65	3.21	3.97
CW unit - water pressure drop	kPa	49	48	84	49	67	49	69	67
Airflow	m^3/s	1.25	1.70	2.25	2.50	3.20	3.50	3.50	4.65
	m^3/h	4,500	6,120	8,100	9,000	11,520	12,600	12,600	16,020
Design external pressure	Pa	70							
Maximum external pressure[3]	Pa	400	400	400	400	360	400	400	360
Air filter quality		G4							
Compressors - number fitted		1	1	1	2	1	2	1	2
Refrigerant[4]		R 407C							
Estimated initial refrigerant charge[5]	kg	3.5	6.5	7.0	3.5 + 3.5	10.0	7.0 + 3.5	16.0	10.0 + 3.5
Estimated initial refrigerant charge with Water Cooled Condenser	kg	3.2	5.3	5.5	3.2 + 3.2	7.3	5.5 + 3.2	9.2	7.3 + 3.2
Humidifier output - Vapac® 6	kg/hr	5	9	9	5	9	9	12	9
Electric heating[6] - at 230 V	kW	5	10	10	5	15	10	22	15
Standard colour - cabinet and doors		BS 4800 Grey 00A05							
Noise level[3 & 7] **- IPAC unit**	dB(A)	55	56	61	58	68	63	65	67
Condenser - matched Model ICV		1-18P	1-40P	2-40P	1-18P + 1-18P	2-70P	2-40P + 1-18P	3-70P	2-70P + 1-18P
Noise level[8] - outdoor condenser	dB(A)	58	58	61	58	61	61		61

NOTES

[1] Unit ratings at 24 °C / 50 % RH internal and 35 °C external ambient air conditions.

[2] Maximum duty rated at 7/12 ºC water on/off temperatures. For other water on/off temperatures consult Eaton-Williams.

[3] Higher external pressures are achievable by altering the supply fan speed by fitting a different ratio drive pulley (client to specify at time of ordering). This may result in a larger drive motor than standard being required, and increased noise level.

[4] In compliance with the Montreal Protocol, units are designed for use with refrigerant R 407C. For non-compliant countries, Eaton-Williams can supply units specially designed for use with R22. Do not mix refrigerants.

[5] Based on a pipe run length of 10 metres.

[6] Optional equipment.

[7] Sound pressure level, per cabinet, at a distance of 3 metres from the unit, with floor return and ducted supply (estimated).

[8] Sound pressure level, per condenser, at a distance of 3 metres from the unit, free-field conditions.

Table 1-2 : Technical data

Technical Data									
IPAC Model		**60-1**	**60-2**	**70-2**	**80-2**	**90-2**	**100-2**	**110-2**	**120-2**
DX unit - Total cooling[1]	kW	61.7	60.0	70.6	81.4	93.7	106.0	114.7	123.4
DX unit - Gross sensible cooling[1]	kW	51.9	56.2	65.5	74.8	83.5	92.1	98.8	103.8
DX unit - Sensible heat ratio		0.84	0.94	0.93	0.92	0.89	0.86	0.85	0.84
DX unit - Net sensible cooling	kW	47.9	51.2	59.3	67.4	76.9	86.4	91.1	95.8
CW unit - Total cooling[1 & 2]	kW	74.6	85.0	102.0	119.6	127.1	134.9	141.9	149.2
CW unit - Gross sensible cooling	kW	58.9	67.0	80.7	94.4	101.0	107.6	112.7	117.8
CW unit - Sensible heat ratio		0.79	0.79	0.79	0.79	0.80	0.81	0.80	0.79
CW unit - Net sensible cooling	kW	54.9	61.8	74.4	87.0	94.3	101.6	105.7	109.8
CW unit - Chilled water flow rate	l/s	3.56	4.04	4.87	5.70	5.45	6.42	6.77	7.12
CW unit - water pressure drop	kPa	82	49	67	67	69	69	82	82
Airflow	m^3/s	4.0	4.50	5.45	5.70	6.06	6.42	6.77	7.12
	m^3/h	14,400	16,200	19,620	23,040	24,300	25,200	27,000	28,800
Design external pressure	Pa	70							
Maximum external pressure[3]	Pa	400	400	360	360	400	400	400	400
Air filter quality		G4, cleanable							
Compressors - number fitted		1	2	2	2	2	2	2	2
Refrigerant[4]		R 407C							
Estimated initial refrigerant charge[5]	kg	17	7 + 7	10 + 7	10 + 10	16 + 10	16 + 16	17 + 16	17 + 17
Estimated initial refrigerant charge with Water Cooled Condenser	kg	9.5	5.5 + 5.5	7.3 + 5.5	7.3 + 7.3	9.2 + 7.3	9.2 + 9.2	9.5 + 9.2	9.5 + 9.5
Humidifier output - Vapac® 6	kg/hour	15	12	9	9	12	12	12	12
Electric heating[6] - at 230 V	kW	22	22	15	15	22	22	22	22
Standard colour - cabinet and doors		BS 4800 Grey 00A05							
Noise level[3 & 7] **- IPAC unit**	dB(A)	70	70	70	70	72	72	72	73
Condenser(s) - matched Model ICV		3-70P	2-40P + 2-40P	2-70P + 2-40P	2-70P + 2-70P	3-70P + 2-70P	3-70P + 3-70P	3-70P + 3-70P	3-70P + 3-70P
Noise level[8] - outdoor condenser	dB(A)	64	64	61	61	64	64	64	64

NOTES

[1] Unit ratings at 24 °C / 50 % RH internal and 35 °C external ambient air conditions.

[2] Maximum duty rated at 7/12 ºC water on/off temperatures. For other water on/off temperatures consult Eaton-Williams.

[3] Higher external pressures are achievable by altering the supply fan speed by fitting a different ratio drive pulley (client to specify at time of ordering). This may result in a larger drive motor than standard being required, and increased noise level.

[4] In compliance with the Montreal Protocol, units are designed for use with refrigerant R 407C. For non-compliant countries, Eaton-Williams can supply units specially designed for use with R22. Do not mix refrigerants.

[5] Based on a pipe run length of 10 metres.

[6] Optional equipment.

[7] Sound pressure level, per cabinet, at a distance of 3 metres from the unit, with floor return and ducted supply (estimated).

[8] Sound pressure level, per condenser, at a distance of 3 metres from the unit, free-field conditions.

Table 1-3 : Design conditions - DX units

Design Conditions - DX Units [a] with air on at 24 °C / 50 % RH			
		R 407C	R 22
Normal working pressures at 35 °C external ambient	HP side:	22.0 bar g (319 psi g)	19.5 bar g (283 psi g)
	LP side:	5.9 bar g (86 psi g)	5.9 bar g (86 psi g)
Normal working pressures at 40 °C external ambient	HP side:	24.0 bar g (348 psi g)	21.5 bar g (312 psi g)
	LP side:	5.9 bar g (86 psi g)	5.9 bar g (86 psi g)

a. Nominal working pressures are shown averaged across the IPAC range. Actual design values vary according to unit size. Please contact the technical department for specific pressures.

Table 1-4 : Safety pressure switch settings - DX units

Safety Pressure Switch Settings - DX Units				
	Cut-out	Tolerance	Cut-in	Tolerance
LP - low pressure safety	0.5 bar g (7 psi g)	5%	1.4 bar g (21 psi g)	5%
HP - high pressure safety	28 bar g (400 psi g)	5%	21 bar g (300 psi g)	5%

Table 1-5 : Current ratings

Current Ratings in Amps[1]									
UNIT TYPE			IPAC MODEL						
			15-1	22-1	30-1	30-2	40-1	45-2	50-1	55-2
DX / A-C	Cooling-only unit	Max. running current	14	20	30	24	35	40	42	45
		Fuse Rating	25	32	35	32	50	50	63	63
		Max Starting Current	72	108	137	83	184	148	217	194
	Temperature unit	Max. running current	14	25	30	24	35	40	45	45
		Fuse Rating	25	35	35	32	50	50	63	63
		Max Starting Current	72	113	137	83	184	148	220	194
	Full air conditioning unit	Max. running current	24	37	42	34	55	56	74	65
		Fuse Rating	32	40	50	35	63	63	80	80
		Max Starting Current	82	125	150	93	204	164	249	214
DX / W-C	Cooling-only unit	Max. running current	12	18	23	22	29	34	33	39
		Fuse Rating	25	32	35	32	50	50	63	63
		Max Starting Current	70	106	131	80	177	142	208	188
	Temperature unit	Max. running current	13	25	26	22	29	34	43	39
		Fuse Rating	25	35	335	32	50	50	63	63
		Max Starting Current	71	113	134	80	178	142	217	188
	Full air conditioning unit	Max. running current	21	37	42	31	49	53	66	59
		Fuse Rating	32	40	50	35	63	63	80	80
		Max Starting Current	79	125	150	89	197	161	241	208
CW	Cooling-only unit	Max. running current	4	6	7	6	9	10	13	12
		Fuse Rating	10	16	16	10	20	16	25	20
		Max Starting Current	16	28	44	18	59	47	82	62
	Temperature unit	Max. running current	13	25	26	15	29	29	45	32
		Fuse Rating	16	32	32	16	32	32	50	35
		Max Starting Current	25	47	63	27	79	66	114	82
	Full air conditioning unit	Max. running current	17	35	36	17	40	36	66	40
		Fuse Rating	20	40	40	20	50	40	80	50
		Max Starting Current	29	57	74	29	89	74	135	89

NOTE All ratings shown are for units having standard configuration and operating at design conditions.

Table 1-5 : Current ratings

Current Ratings in Amps[1]									
UNIT TYPE			IPAC MODEL						
			60-1	60-2	70-2	80-2	90-2	100-2	110-2	120-2
DX / A-C	Cooling-only unit	Max. running current	49	52	57	62	76	83	90	97
		Fuse Rating	80	63	63	80	100	100	100	100
		Max Starting Current	247	160	206	211	250	258	287	295
	Temperature unit	Max. running current	56	52	57	62	76	83	90	97
		Fuse Rating	80	63	63	80	100	100	100	100
		Max Starting Current	253	160	206	211	250	258	287	295
	Full air conditioning unit	Max. running current	93	72	77	82	108	115	133	141
		Fuse Rating	100	63	80	100	125	125	160	160
		Max Starting Current	290	180	226	231	283	290	331	338
DX / W-C	Cooling-only unit	Max. running current	41	46	51	56	61	65	73	81
		Fuse Rating	80	63	63	80	100	100	100	100
		Max Starting Current	239	154	200	205	236	240	271	279
	Temperature unit	Max. running current	56	46	51	56	61	65	73	81
		Fuse Rating	80	63	63	80	100	100	100	100
		Max Starting Current	253	154	200	205	236	240	271	279
	Full air conditioning unit	Max. running current	85	65	71	76	93	98	117	125
		Fuse Rating	100	63	80	100	125	125	160	160
		Max Starting Current	282	173	220	225	268	273	314	322
CW	Cooling-only unit	Max. running current	13	13	16	18	21	24	24	24
		Fuse Rating	25	20	25	25	25	32	32	32
		Max Starting Current	82	51	65	67	90	93	93	93
	Temperature unit	Max. running current	56	32	36	38	53	57	67	67
		Fuse Rating	63	35	40	40	50	63	80	80
		Max Starting Current	125	70	85	87	122	126	136	136
	Full air conditioning unit	Max. running current	77	36	40	40	66	66	77	77
		Fuse Rating	80	40	50	50	80	80	100	100
		Max Starting Current	146	74	89	89	135	135	146	146

NOTE All ratings shown are for units having standard configuration and operating at design conditions.

Table 1-6 : Pipework connection sizes

Pipework Connection Sizes									
LINE		**IPAC MODEL**							
		15-1	**22-1**	**30-1**	**30-2**	**40-1**	**45-2**	**50-1**	**55-2**
Indoor liquid	in.	3/8	1/2	1/2	3/8 3/8	5/8	1/2 3/8	7/8	5/8 3/8
Outdoor liquid	in.	3/8	1/2	1/2	3/8 3/8	5/8	1/2 3/8	3/4	5/8 3/8
Indoor discharge	in.	1/2	3/4	3/4	1/2 1/2	7/8	3/4 1/2	1 3/8	7/8 1/2
Outdoor discharge	in.	3/4	7/8	7/8	3/4 3/4	7/8	7/8 3/4	1 1/8	7/8 3/4
Chilled water	mm	28	35	35	28 28	42	35 28	42	42 28
Humidifier water	mm	15							
Condensate and humidifier drain, tube i/d	mm	13							
LINE		**IPAC MODEL**							
		60-1	**60-2**	**70-2**	**80-2**	**90-2**	**100-2**	**110-2**	**120-2**
Indoor liquid	in.	7/8	1/2 1/2	5/8 1/2	5/8 5/8	7/8 5/8	5/8 5/8	7/8 7/8	7/8 7/8
Outdoor liquid	in.	3/4	1/2 1/2	5/8 1/2	5/8 5/8	3/4 5/8	5/8 5/8	5/8 5/8	5/8 5/8
Indoor discharge	in.	1 3/8	3/4 3/4	7/8 3/4	7/8 7/8	1 3/8 7/8	1 1/8 1 1/8	1 3/8 1 3/8	1 3/8 1 3/8
Outdoor discharge	in.	1 1/8	7/8 3/4	7/8 7/8	7/8 7/8	1 1/8 1 1/8	1 1/8 1 1/8	1 1/8 1 1/8	1 1/8 1 1/8
Chilled water	mm	42	35 35	42 35	42 42	42 42	42 42	42 42	42 42
Humidifier water	mm	15							
Condensate and humidifier drain, tube i/d	mm	13							

NOTES

Except for the humidifier water supply and drain lines, all pipe connections are brazed as standard (options are available on request).

Humidifier water feed line connection is push-fit for copper pipe.

Each module of dual cabinets have independant service connections.

Table 1-7 : Discharge line and liquid line sizes guide - DX units

Discharge Line and Liquid Line Sizes Guide - DX Units

PIPE RUN LENGTH	LINE		IPAC MODEL													
			15-1	22-1	30-1	30-2		40-1	45-2		50-1	55-2				
<10 m	Liquid	in.	1/2	1/2	1/2	1/2	1/2	5/8	1/2	1/2	7/8	5/8	1/2			
	Discharge	in.	3/4	3/4	3/4	3/4	3/4	7/8	3/4	3/4	1 3/8	7/8	3/4			
10 m to 30 m	Liquid	in.	5/8	5/8	3/4	5/8	5/8	3/4	3/4	5/8	7/8	3/4	5/8			
	Discharge	in.	7/8	1 1/8	1 1/8	7/8	7/8	1 1/8	1 1/8	7/8	1 3/8	1 1/8	7/8			
30 m to 50 m	Liquid	in.	5/8	5/8	3/4	5/8	5/8	7/8	3/4	5/8	7/8	7/8	5/8			
	Discharge	in.	7/8	1 1/8	1 1/8	7/8	7/8	1 3/8	1 1/8	7/8	1 3/8	1 3/8	7/8			
PIPE RUN LENGTH	LINE		IPAC MODEL													
			60-1	60-2		70-2		80-2		90-2		100-2		110-2		120-2	
<10 m	Liquid	in.	7/8	1/2	1/2	1/2	5/8	5/8	5/8	7/8	5/8	3/4	3/4	7/8	7/8	7/8	7/8
	Discharge	in.	1 3/8	3/4	3/4	3/4	7/8	7/8	7/8	1 3/8	7/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8
10 m to 30 m	Liquid	in.	7/8	3/4	3/4	3/4	3/4	3/4	3/4	7/8	3/4	7/8	7/8	7/8	7/8	7/8	7/8
	Discharge	in.	1 3/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8
30 m to 50 m	Liquid	in.	1 1/8	3/4	3/4	3/4	7/8	7/8	7/8	7/8	7/8	7/8	7/8	1 1/8	7/8	1 1/8	1 1/8
	Discharge	in.	1 5/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 3/8	1 5/8	1 5/8

NOTES:

All pipe connections are brazed as standard (options are available on request).

Sizes are provided for guidance only. Qualified personnel should specify pipework, subject to site layout and conditions.

Each module of dual cabinets have independant service connections.

Table 1-8 : Water flow rates for integrated plate heat exchanger condensers

Standard Water Flow Rates for Integrated Plate Heat Exchanger Condensers									
Water Flow Rates at 35 °C Supply and 45 °C Return									
	IPAC MODEL	**15-1**	**22-1**	**30-1**	**30-2**	**40-1**	**45-2**	**50-1**	**55-2**
Water Flow Rate	l/s	0.46	0.69	0.93	0.93	1.26	1.4	1.7	1.12
Pressure Drop	kPa	52	46	63	52	68	63	97	68
Optional Glycol Pressure Drop	kPa	t.b.a	t.b.a	t.b.a	t.b.a	t.b.a	t.b.a	t.b.a	t.b.a
	IPAC MODEL	**60-1**	**60-2**	**70-2**	**80-2**	**90-2**	**100-2**	**110-2**	**120-2**
Water Flow Rate	l/s	1.90	1.85	2.18	2.52	2.96	3.39	3.59	3.79
Pressure Drop	kPa	109	63	68	68	97	97	109	109
Optional Glycol Pressure Drop	kPa	t.b.a	t.b.a	t.b.a	t.b.a	t.b.a	t.b.a	t.b.a	t.b.a

Optional Water Flow Rates for Integrated Plate Heat Exchanger Condensers									
Water Flow Rates at 20 °C Supply and 40 °C Return									
	IPAC MODEL	**15-1**	**22-1**	**30-1**	**30-2**	**40-1**	**45-2**	**50-1**	**55-2**
Water Flow Rate	l/s	0.23	0.34	0.46	0.46	0.63	0.69	0.85	0.86
Pressure Drop	kPa	18	13	19	18	20	19	34	20
	IPAC MODEL	**60-1**	**60-2**	**70-2**	**80-2**	**90-2**	**100-2**	**110-2**	**120-2**
Water Flow Rate	l/s	0.95	0.93	1.09	1.26	1.48	1.70	1.80	1.90
Pressure Drop	kPa	33	19	20	20	34	34	34	33
Water Flow Rates at 40 °C Supply and 50 °C Return									
	IPAC MODEL	**15-1**	**22-1**	**30-1**	**30-2**	**40-1**	**45-2**	**50-1**	**55-2**
Water Flow Rate	l/s	0.46	0.69	0.93	0.93	1.26	1.4	1.70	1.72
Pressure Drop	kPa	52	46	63	52	68	63	97	68
	IPAC MODEL	**60-1**	**60-2**	**70-2**	**80-2**	**90-2**	**100-2**	**110-2**	**120-2**
Water Flow Rate	l/s	1.90	1.85	2.18	2.52	2.96	3.39	3.59	3.79
Pressure Drop	kPa	109	63	68	68	97	97	109	109

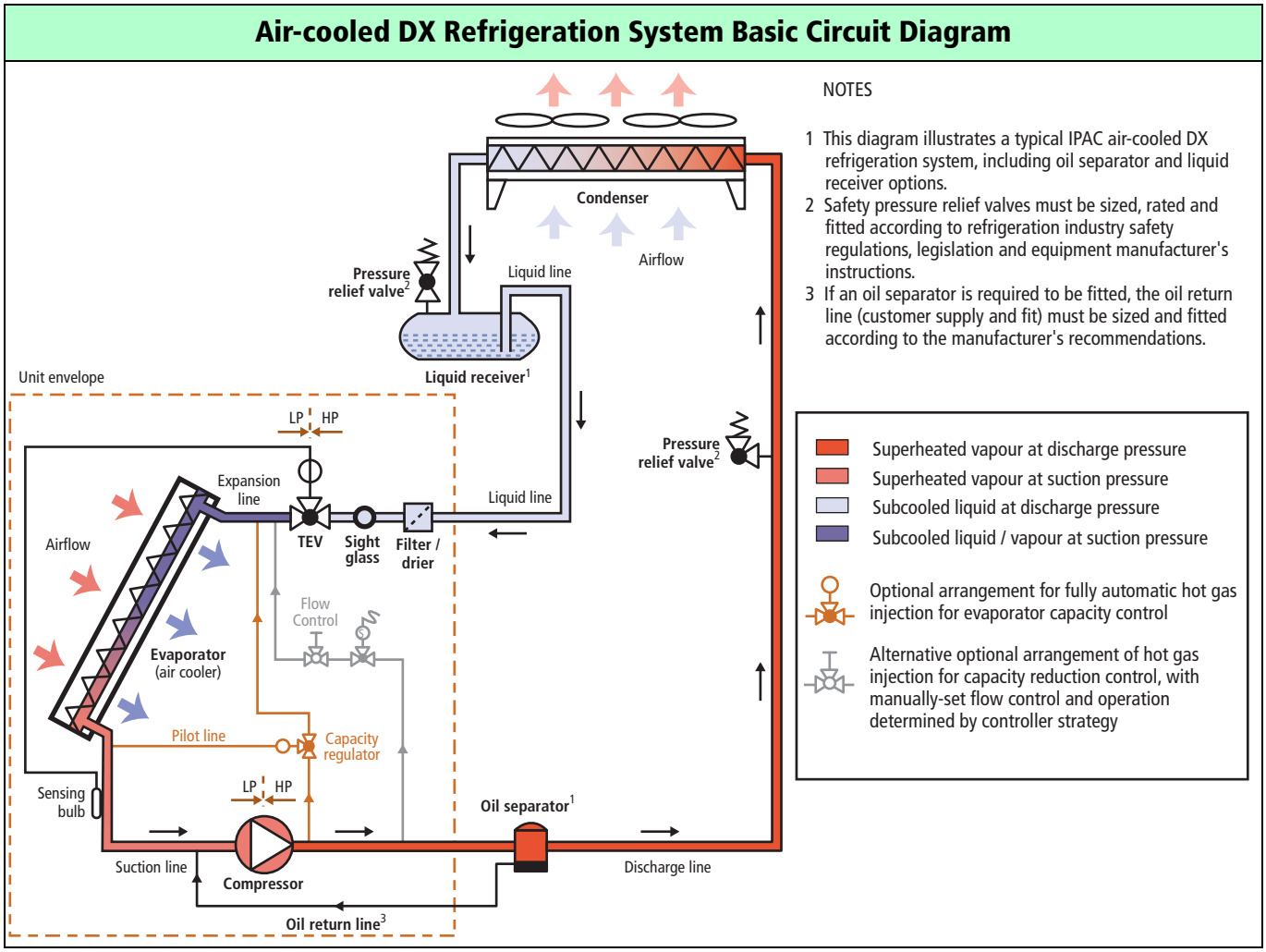
NOTES
Supply temperatures shown are typical for open loop water systems. 40 °C is typical for closed-loop water systems.
For alternative water temperatures, refer to Eaton-Williams.

Table 1-9 : Service electrical connections - all units

Service Electrical Connections - All Units	
Power supply	400 V, 3 ph, 50 Hz
Indoor unit power supply cable	5 core, 3ph / N / E
Outdoor (condenser) unit power supply cable	3 core, L / N / E

Air-cooled Direct Expansion (DX) System

Fig. 1-4 : Air-cooled DX refrigeration system basic circuit diagram



From the suction line, the compressor draws refrigerant gas (normally R 407C), compresses it and then discharges it into the discharge line.

The high pressure, superheated discharge gas flows through the discharge line to the condenser, where the gas is cooled and condensed by relatively cool air flowing on the other side of the heat exchange surface.

The resulting liquid, still at high pressure, flows through the liquid line and through a filter/drier before reaching the thermostatic expansion valve.

NOTE

Depending on system design external to the unit, it may be necessary to fit a liquid receiver in the liquid line, after the condenser; refer to "Liquid Receiver" on page 6-6 of Section 6 of the full IOM manual.

To ensure that only liquid reaches the thermostatic expansion valve, the liquid line continues from the liquid receiver via a dip tube arrangement.

The thermostatic expansion valve meters the flow of refrigerant entering the evaporator in response to the temperature of refrigerant leaving the evaporator.

On entering the evaporator, the refrigerant is a saturated vapour and liquid mixture at low pressure.

As the refrigerant passes through the evaporator, any liquid present is vaporised by extracting heat from the relatively high temperature supply air flowing on the other side of the heat exchange surface.

From the evaporator, the superheated, low pressure gas enters the suction line and flows to the compressor again.

The process is continuous while the compressor is operating.

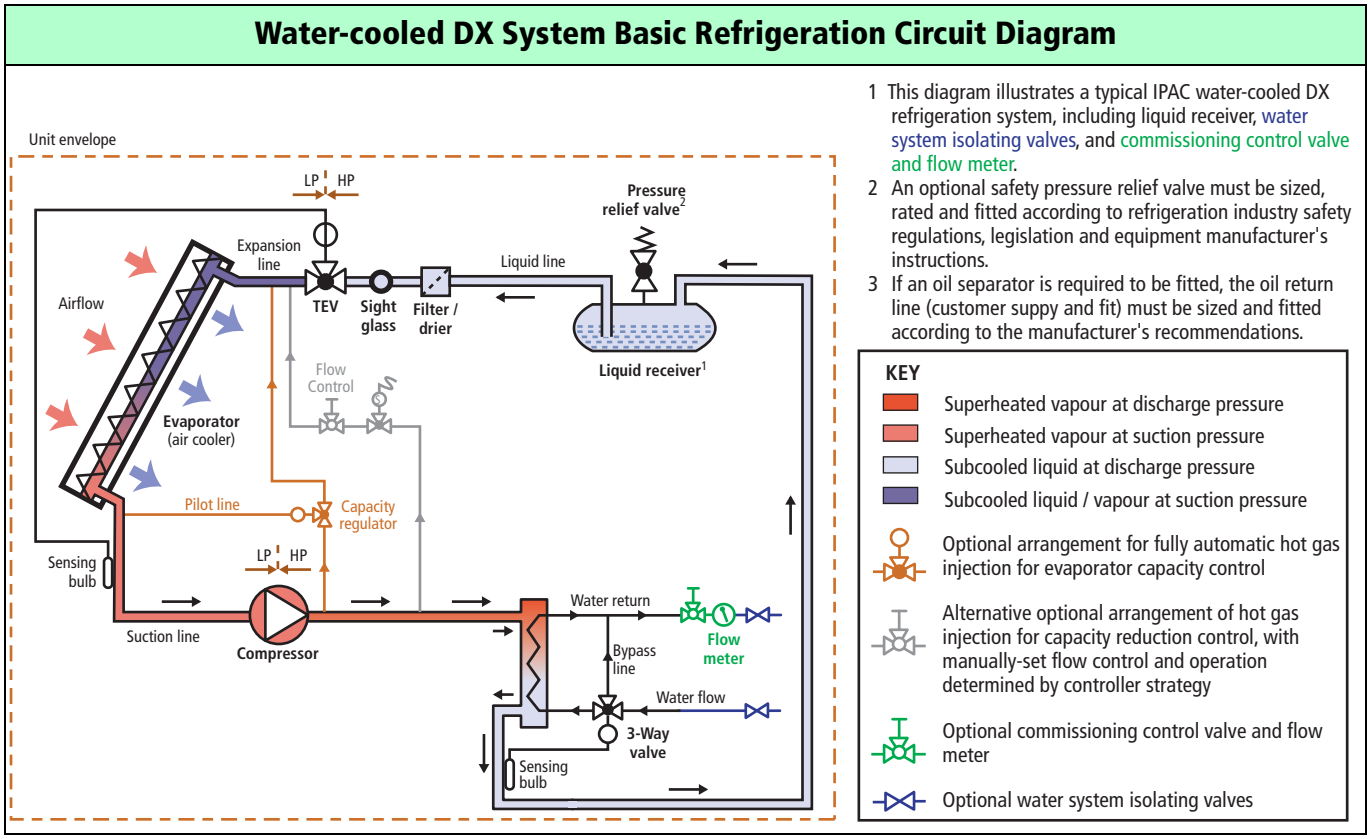
To achieve evaporator capacity control, one of two types of Capacity Control Hot Gas Injection System arrangements may be fitted; refer to page 28 for more details.

Depending on the unit model, there may be two independent refrigeration systems fitted, so that high demand conditions can be met.

The controller has been designed to enable refrigeration system operation to be tempered to meet demand without inefficient short-cycling of equipment.

Water-cooled DX System

Fig. 1-5 : Water-cooled DX refrigeration system basic diagram



Cooling water (glycol solution or similar primary refrigerant) at a specified rate and temperature (see Table 1-2) is pump-circulated (by customer system) through the plate heat exchanger.

From the suction line, the compressor draws refrigerant gas (normally R 407C), compresses it and then discharges it into the discharge line.

The high pressure, superheated discharge gas flows through the discharge line to the plate heat exchanger condenser, where the gas is cooled and condensed by relatively cool water (glycol solution or similar primary refrigerant) flowing on the other side of the heat exchange surface.

The resulting liquid, still at high pressure, flows through the liquid line to the liquid receiver (fitted as standard), which is designed to accommodate all excess liquid not required in the evaporator (air cooler) when the unit is operated at below maximum load conditions.

To ensure that only liquid reaches the thermostatic expansion valve, the liquid line exits the liquid receiver via a dip tube arrangement.

Note that because the liquid receiver cannot be isolated, there is no requirement for a pressure relief valve. However, it is recommended that a suitably sized and rated fire-hazard safety pressure relief valve is fitted as an option.

The thermostatic expansion valve meters the flow of refrigerant entering the evaporator in response to the temperature of refrigerant leaving the evaporator.

On entering the evaporator, the refrigerant is a saturated vapour and liquid mixture at low pressure.

As the refrigerant passes through the evaporator, any liquid present is vaporised by extracting heat from the relatively high temperature supply air flowing on the other side of the heat exchange surface.

From the evaporator, the superheated, low pressure gas enters the suction line and flows to the compressor again.

The process is continuous while the compressor is operating.

To achieve evaporator capacity control, one of two types of Capacity Control Hot Gas Injection System arrangements may be fitted; refer to page 28 for more details.

Depending on unit model, there may be two independent refrigeration systems fitted, so that high demand conditions can be met.

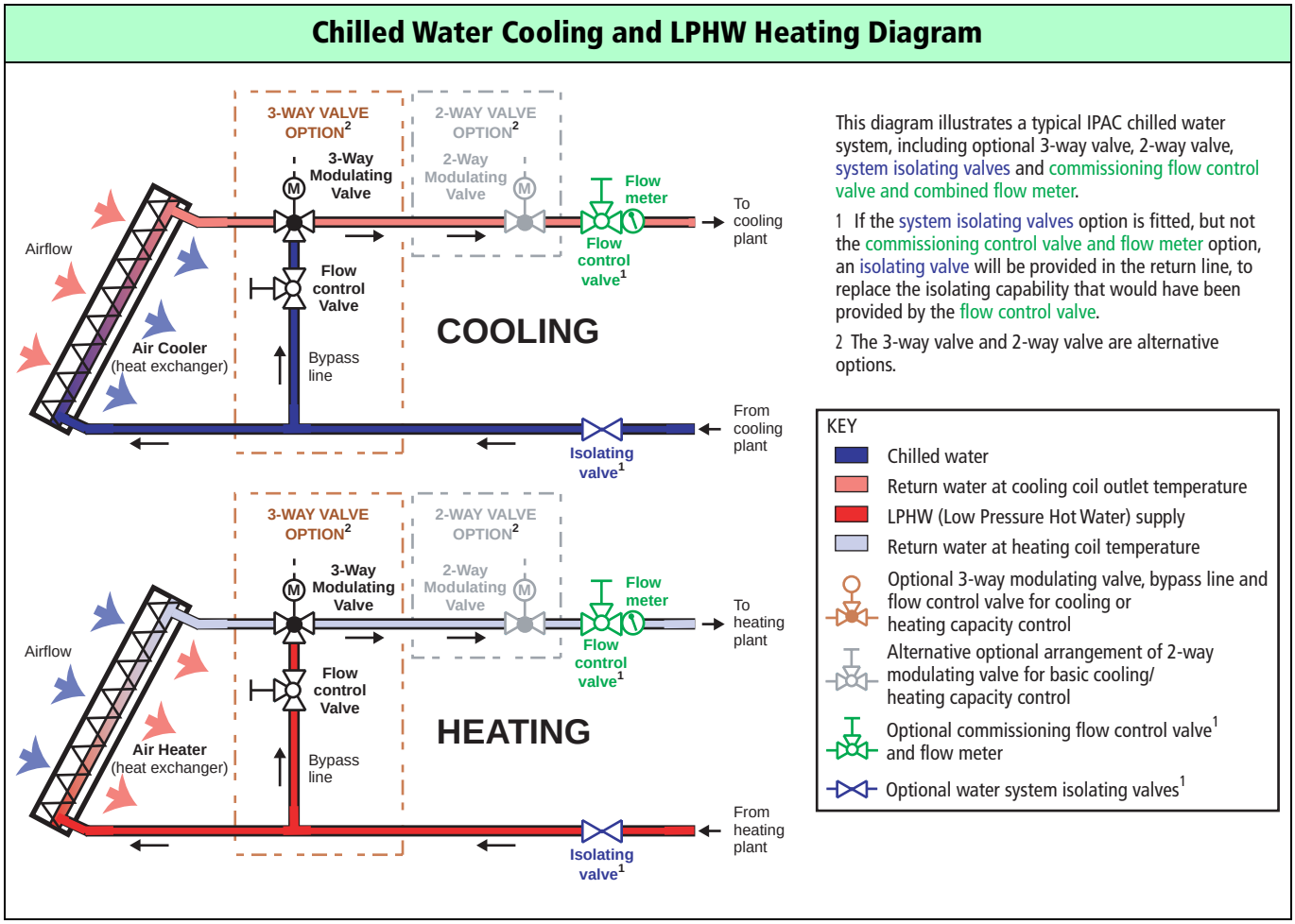
The controller has been designed to enable refrigeration system operation to be tempered to meet demand without inefficient short-cycling of equipment.

Cooling water flow and return connections are on the same face of the plate heat exchanger and are arranged to contraflow the direction of refrigerant flow.

Because the DX refrigerant system is close-coupled within the unit and velocities are sufficient to carry oil round the system, an oil separator arrangement is not required.

Chilled Water Cooling System

Fig. 1-6 : Chilled water cooling and LPHW heating diagram



This system is illustrated in Fig. 1-6 - Chilled water cooling and LPHW heating diagram.
In response to the temperature of air entering the unit, the InvictaNET controller modulates a flow control valve to meter the flow of chilled water (or other suitable chilled medium) entering the heat exchange coil.

NOTE
Effective control of air temperature relies upon the supply of low pressure chilled water at a specified constant temperature being available to the unit.

As the chilled water passes through the cooling coil, heat is extracted from the relatively high temperature supply air flowing on the other side of the coil's heat exchange surface.
Having passed through the cooling coil, the water then returns to the water chilling plant for re-cooling, before returning to the unit again.
Depending on the unit model, there may be two independent flow control valve / cooling coil systems fitted, so that high demand conditions can be met.
As can be seen in Fig. 1-6, there is a choice of two types of optional modulating flow control valve arrangement:

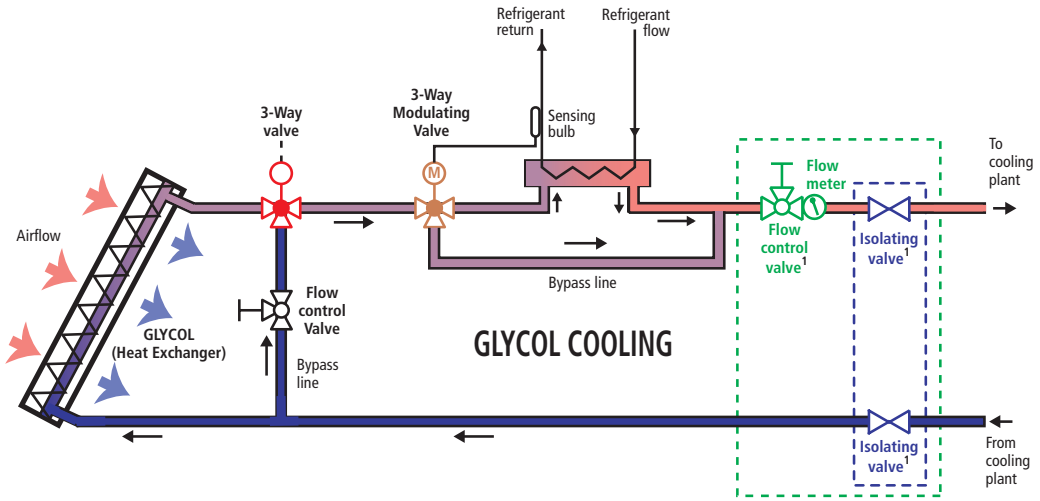
- **2-way valve**
- **3-way valve**

For details of the modulating control valve, see page 24.

Economy Cooling Options

Fig. 1-7 : Glycol Economy Cooling Circuit Diagram

Glycol Economy Cooling Circuit Diagram



Chilled water
Return water at condenser coil outlet temperature
Return water at glycol cooling coil temperature
3-way modulating valve, bypass line and flow control valve for cooling or heating capacity control
3-way valve, bypass line and on/off control for cooling and heating
Optional commissioning flow control valve[1] and flow meter
Optional water system isolating valves[1]

This diagram illustrates a typical IPAC Glycol Economy cooling system, including 3-way valve, 2-way valve, system isolating valves and commissioning flow control valve and combined flow meter.

1 If the system isolating valves option is fitted, but not the commissioning control valve and flow meter option, an isolating valve will be provided in the return line, to replace the isolating capability that would have been provided by the flow control valve.

There are two types of economy cooling option available for the IPAC range of AHUs, Fresh-Air Economy Cooling and Glycol Economy Cooling.
Both can be optimised to use the relevant cooling medium, where conditions allow, to achieve the required air condition, whilst minimising the running time of the compressor or cooling plant.
The pay-back return period for the initial additional equipment cost is achieved within two to three years typically.

Fresh-Air Economy Cooling Option

Fresh-air economy cooling can be applied to either DX or chilled water units, where the unit is either installed with its back against an outside wall (louvre required), or fitted with fresh-air duct (room pressure relief required).
This system requires a separate modulating damper box fitted in the return air path to the unit, plus an outside air temperature sensor.
The modulating damper box comprises a modulating damper plate and an G2 filter on the fresh-air side. The InvictaNET controller modulates the damper to vary the return-air /fresh-air mix to achieve optimum air temperature at a constant airflow volume.

- For control details, refer to "Economy Cooling Options" on page 19 of Section 4 of the full IOM manual.

Glycol Economy Cooling Option

Glycol (cooling by glycol/water solution cooled medium) economy cooling can be applied to water-cooled DX units, where cooling coil heat rejection is capable of returning the cooling medium at a temperature below that of room air.
For this system, an additional coil, for the glycol / water cooling medium, is included in the cooling heat exchanger coil block and faces the DX cooling coil.

⚠CAUTION

The cooling medium must contain a suitable antifreeze mix otherwise the DX process may freeze the cooling medium and result in damage to the unit. IPAC units have been designed for an 80%/20% Ethylene Glycol mix by volume.

The arrangement is such that the return air passes through the economy cooling coil, where it is pre-cooled, before passing through the DX cooling coil, where the main cooling process, to required temperature, takes place.

The chilled glycol / water primary cooling medium, first passes through the economy cooling coil, if the water temperature is lower than the return air temperature, prior to passing through the plate heat exchanger to liquefy the refrigerant.
If the water temperature is not lower than the return air temperature, the InvictaNET controller opens a valve to divert the cooling medium straight to the plate heat exchanger.

- For control details, refer to Section 4 of the full IOM.

In this way, additional cooling by the cooling medium, that has already performed its condensing function, is achieved before returning to the cooling plant.

Humidity Control

Humidity control is an option for all units. The humidity of supply air passing through the unit can also be monitored by the controller, which applies humidity control strategy to correct and maintain air humidity at a predetermined set point.
If a humidifier is fitted (see page 29), this can be controlled to produce an increase in air humidity by introducing steam into the airstream.
Whether in humidifying or dehumidifying mode, the air passage through the unit is the same as for heating or cooling.

Dehumidification

For environments where high humidity is a problem, the refrigeration system is used to reduce and control air relative humidity (RH %).
This is achieved by passing the supply air across the evaporator coil, where moisture condenses onto the relatively cold surface of the heat exchanger.
As the condensate accumulates, it forms water droplets, which then fall into the condensate drip tray. All resulting water then drains from the condensate tray and passes, via a trap, to external drains.

NOTE
Because of the nature of the dehumidification process, unless the heating option is fitted, accurate dehumidification may not achievable without overcooling the supply air.

Therefore, depending on unit application, after dehumidification, reheating of the air may be necessary to control air temperature.

Hot Gas Reheat

This option is only applicable for DX units only and provides reheat of the air following dehumidification, when air temperature is reduced to below the required set point.

NOTE
If primary heating is required (i.e other than for dehumidification reheat, electric heating must be installed in the second module (therefore not available on single module units).

When the controller evaluates that, because the air has been cooled to below the set point during dehumidification, reheat is required, a solenoid valve is energised (opened) to admit compressor discharge gas (at high temperature and pressure) to enter the heating coil.
In this way, air is reheated after cooling, by reclaiming heat dissipated from the compressor, which also saves energy compared to electrical or LPHW heating.

Network Control System

In multi-unit applications, where there is a master unit controlling several network slave units, each unit operates independently, but under the central control of the master unit. This ensures optimum performance of the total system and that failure of one unit will not affect the continued operation of other units, provided that the power supply to the master unit controller remains live.
To prevent excessive current from being drawn during starting, the controller starts units and their equipment in a staggered, delay-timed sequence.

- For details of the starting sequence, refer to page 4-15 of the full IOM.

Main Components

Table 1-10 : Standard main components

Standard Main Components			
Standard Main Components and Features	**Air-cooled DX**	**Water-cooled DX**	**Chilled Water**
Unit Casing	✓	✓	✓
Finish	✓	✓	✓
Supply Air Fan(s)	✓	✓	✓
'V' Belt Drive on Adjustable Slide-Bases	✓	✓	✓
Air Filters - G4, cleanable	✓	✓	✓
Differential Pressure Switches	✓	✓	✓
Cooling Coil (evaporator / heat exchanger)	✓	✓	✓
Condensate Drip Tray	✓	✓	✓
Eaton-Williams InvictaNET AHU Controller	✓	✓	✓

Table 1-10 : Standard main components

Standard Main Components			
Electrical connections	✓	✓	✓
Volt-free Alarm Contacts	✓	✓	✓
Bottom Connections	✓	✓	✓
Compressor	✓	✓	✓
Filter / Drier	✓	✓	✓
Thermostatic Expansion Valve	✓	✓	✓
Moisture Indicating Sight Glass	✓	✓	✓
Evacuation and Refrigerant Charging Valves	✓	✓	
Pressure Safety Devices	✓	✓	
Modulating Flow Control Valve and Actuator		✓	✓
Key Operated Cam-lock Removable Doors	✓	✓	✓
Airflow Failure Detection	✓	✓	✓
Cardboard Sleeve / Pallet Delivery Protection	✓	✓	✓
Contactors, MCBs and MPCBs	✓	✓	✓
Internal Unit Isolator (Handle Optional)	✓	✓	✓
Interconnecting wiring loom	✓	✓	✓
Integrated Water-Cooled Condenser		✓	

Features and Options			
Options	**Air-cooled DX**	**Water-cooled DX**	**Chilled Water**
Electrical / Control Options			
Phase-failure relay	✓	✓	✓
Control panel cover	✓	✓	✓
Fresh Air Control	✓	✓	✓
Fresh Air Control, Including Smoke Detection	✓	✓	✓
Door-interlocked isolator	✓	✓	✓
Mains filter kit	✓	✓	✓
In-Room Remote Sensors	✓	✓	✓
Duct Remote Sensors	✓	✓	✓
Water Detection Tape	✓	✓	✓
Audible Alarm	✓	✓	✓
Alternate Display Languages	✓	✓	✓
ModBus Network Interface	✓	✓	✓
Trend Controller	✓	✓	✓
Trend Network Interface	✓	✓	✓
Heating Options			
Electric Heating - 5/10/15/22.5/30 kW Electric Finned Element	✓	✓	✓
Low Pressure Hot Water Heating System	✓		
LPHW Heating Coil (heat exchanger) with 0 - 10 V Control Valve	✓	✓	✓
Refrigeration Options			
Capacity Control Hot Gas Injection System	✓	✓	
Liquid Receiver	✓	✓	✓
Modulating Flow Control Valve and Actuator	✓	✓	

Features and Options			
Options	**Air-cooled DX**	**Water-cooled DX**	**Chilled Water**
Oil Separator	✓	✓	
Compressor Acoustic Jacket		✓	✓
Compressor Discharge Non-return Valve	✓	✓	
Split Coil Rapid Dehumidification	✓	✓	
Humidifying Options			
Humidifier	✓	✓	✓
20% - 100% Proportional Output Humidifier	✓	✓	✓
Alarm Diagnostics Tools in Controller	✓	✓	✓
Different Bottle's for Varying Water Qualities	✓	✓	✓
Remote Vapac Options	✓	✓	✓
Second Unit OEM Option to increase dual unit options	✓	✓	✓
General Options			
Rear Cosmetic Cover Panel	✓	✓	✓
Multi-speed motors			✓
Side Gland Plates	✓	✓	✓
Stainless Steel Drip Tray	✓	✓	✓
5 to 10 % fresh air intake, including volume damper control	✓	✓	✓
Anti-vibration mountings	✓	✓	✓
Dual Pulley Drives (standard on modules > 40kW)	✓	✓	✓
Low Display Mounting	✓	✓	✓
Lifting Channels	✓	✓	✓
Condensate Pump	✓	✓	✓
Class 1, energy-efficient motors	✓	✓	✓
Customised colours	✓	✓	✓
Pipework	✓	✓	
Airflow Options			
Upflow - Bottom Return	✓	✓	✓
Upflow - Front Return	✓	✓	✓
Upflow - Rear Return (Not size 4)	✓		✓
Downflow - Top Return	✓	✓	✓
Downflow - Front Return	✓	✓	✓
Downflow - Rear Return (Not size 4)	✓		✓
Filtration Options			
Coil Face Filtration - G4 or F5. F6 or F7 with G4 pre-filter	✓	✓	✓
Remote Filtration - F6-H8 Deep Panel Filter in secondary section	✓	✓	✓
Fluid Control Options			
2 Way or 3 Way Control Valve		✓	✓
Water System Isolating Gate Valves		✓	✓
Upflow Discharge Options			
Flexible duct connectors (upflow units only)	✓	✓	✓
Non-Return Dampers	✓	✓	✓

Unit Casing

The IPAC units are constructed using pre-coated outer panels, light grey finish to BS 00A05.
Internal metalwork is of galvanised steel construction.
External panels are insulated with fire-retardant, vapour-proof, closed-cell, high-density foam, to maximise thermal insulation while minimising noise breakout.

Finish

External metalwork surfaces are coated in a light-grey (BS 4800 Grey 00A05), durable, protective paint as standard.
Internal panels are of galvanised steel.

Customised colours

If an alternative colour option is required, metalwork is primed with etch primer and then given one coat of finish paint.

Supply Air Fan(s)

Each room air supply fan will deliver air against an assumed standard external static resistance pressure of 70 Pa.
Alternative external pressure ratings can be achieved by changing the fan drive ratio and, if necessary, the drive motor.
IPAC 15-1, 22-1, 30-1 and 40-1 units have a single, forward-curved, centrifugal fan, coupled, via a wedge belt drive, to a totally enclosed, fan ventilated, IP54 rated, motor.
IPAC 50-1 and 60-1 units have a duplex fan (two fans driven from one shaft). Each unit has a single motor mounted on an adjustable base to enable correct tensioning of the wedge drive belts.
Each unit has been designed with the recommended number of belts for the shaft motor power. Redundancy in belts is available as an option. Twin module units may have a combination of the above.
These drives contain alternative pulleys/taperlocks, belts and fan motors, where required.

NOTE
This may increase maximum running currents shown in duty tables and increase noise levels.

Multi-speed motors

Multi-speed motors are available. Please contact Eaton WIlliams for further information.

Class 1, energy-efficient motors

As an option, supply fan drive motors are available to Class 1 Energy Efficiency.

'V' Belt Drive

Each supply air fan is driven by 'V' belts for increased performance and reduced loss of power.

Air Filters

As standard, air filters are fitted internal to the unit in the supply air path, prior to the evaporator coil, to filter the air before it is conditioned and then discharged into the room, see Table 1-11 on page 22.

- As an option, filters may be installed externally to the unit, in a High-efficiency Filter Section - see page 35

There are various filter grade options, however, it is worth noting that filters above grade F6 would require relatively frequent replacements, as the holding capacity of panel filters at this high efficiency is low.
For applications requiring such high-efficiency filtration, the external High-efficiency Filter Section (see page 35) should be fitted.

NOTE
The fitting of panel filters instead of pad filters is easily carried out and requires only a change of retaining clips, with no alteration necessary to the framework.

Table 1-11 : Alternative air filter options

Alternative Air Filter Options			
Panel	**Description**	**Fitting**	**Notes**
G4 (Standard)	50 mm thick panel G4 panel filter	Two spring clips per filter	Cleanable, synthetic, cut pad, fire-rated to DIN 53438
F5	50 mm thick panel G5 panel filter		-
F6	Cleanable G4 pad pre-filter, with 50 mm thick F6 panel filter		This option initially reduces unit external pressure development by 55 Pa
F7	Cleanable G4 pad pre-filter, with 50 mm thick F7 panel filter		This option initially reduces unit external pressure development by 130 Pa
F8	Cleanable G4 pad pre-filter, with 50 mm thick F8 panel filter		This option initially reduces unit external pressure development by 220 Pa. Where necessary, the reduction in external pressure developed must be compensated by selecting an alternative fan drive to standard.

Differential Pressure Switches

Both airflow detection and dirty filter condition are monitored in both cabinets (where applicable). This is achieved by sensing the differential pressure across the filter / coil section of the units. They are factory set but can be adjusted on site if required.

Cooling Coil

The standard cooling coil is manufactured from copper tubes with aluminium fins.

- As an option, the coil can be supplied as copper/copper, or copper/copper-electro-tinned; note that this will increase the weight of the unit.

A water-tight drip tray, fitted below the coil, collects the condensate. The cooling coil, condensate drain tray, plastic drain pipework and drain trap are illustrated in Fig. 1-8 and Fig. 1-9 on page 23.

As it accumulates, water is drained off via two outlets and passes through the internal drain trap, before exiting the unit to the external drain facility (by others).

NOTE

The unit has an internal drain trap. An external trap should NOT be fitted.

Fig. 1-8 : Drain pipe Layout (DX unit shown)

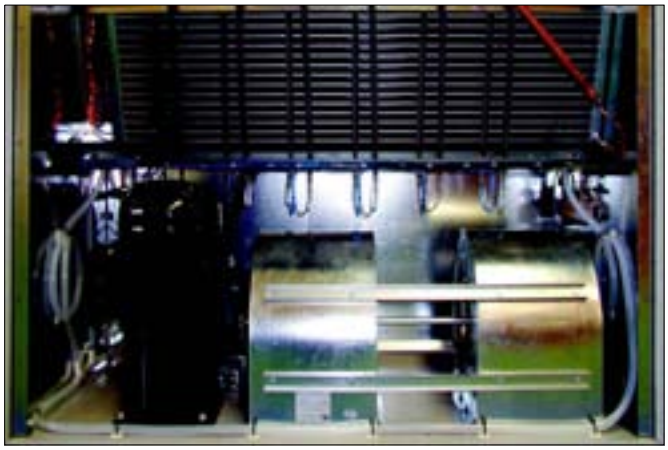


Fig. 1-9 : Condensate drain trap (DX unit shown)

Condensate Drip Tray

As standard, the condensate tray is manufactured from galvanised steel plate, with stainless steel available as an option.

Eaton-Williams InvictaNET AHU Controller

The InvictaNET AHU controller is a purpose-designed LONWORKS™ microprocessor, which fully complies with EEC directives for electromagnetic compatibility (EMC).

The controller includes the following features as standard:

- Temperature and humidity set point adjustment
- Dead band adjustment
- Proportional band adjustment
- Alarm band adjustment
- Fault and service alarm volt-free contacts
- Winter low pressure switch delay timer adjustment
- Start delay timers (to minimise starting current demand)
- Historical alarm logging
- LONWORKS™ network communications
- Stand-alone or Master/Slave control
- Run/standby and duty rotations

The controller is fully described in Section 4 of the full IOM.

Electrical connections

All terminals for customer connection of power supply and control circuits are adjacent to the cable entry point, inside the lower left hand side of the unit.

Volt-free Alarm Contacts

As standard, all IPAC units are fitted with 2 sets of terminal connections for urgent and non-urgent (fault and service alarms). When the controller is in an alarm situation the alarm contacts will be held in the unhealthy condition until the alarm is cleared.

Remote alarms can either be closed or open circuit healthy.

Bottom Connections

The standard service connections are at the bottom of the IPAC units, with the electrical connections located to the left and the service to the right.

Two blind gland plates are provided for site cutting to suit requirements.

As an option, side gland plates can be provided.

Compressor

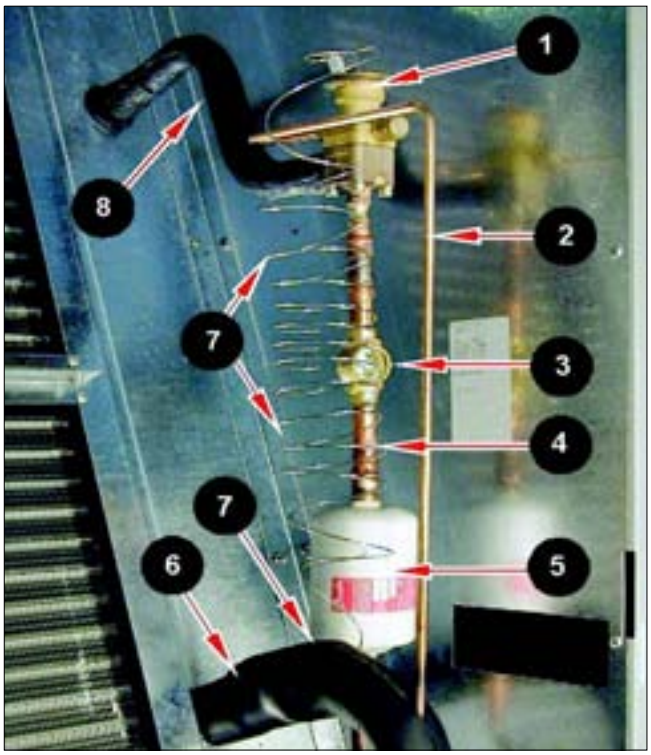
Each unit's refrigeration system uses a high-efficiency scroll-type compressor, fitted with an internally relieving pressure relief device and integral sump.

- Crankcase oil heaters are available as an option, for circumstances that necessitate their use; refer to "Compressor Crankcase Oil Heater(s)" on page 6-7 of Section 6 of the full IOM.

Compressors are installed on anti-vibration mountings to minimise noise and vibration levels.

- Capacity control is as described under Compressor Capacity Control on page 4-16 of Section 4 in the full IOM.

Fig. 1-10 : Liquid line components



1. **Thermostatic expansion valve**
2. **Equalising line**
3. **Moisture indicating sight glass**
4. **Liquid line**
5. **Filter/drier**
6. **Suction line**
7. **Temperature sensing phial location**
8. **Expansion line to evaporator**

Filter / Drier

The filter / drier is located before the sight glass and the thermostatic expansion valve, as shown in Fig. 1-10.

The filter / drier ensures that any moisture, that may have entered the system during charging, is removed.

It is essential to ensure that there is no free moisture circulating round the refrigerant system, otherwise:

- The moisture may otherwise freeze and cause a blockage, usually at the TEV

Or, in the worst case:

- Moisture may affect the insulation of the compressor drive motor, causing a burn-out

Thermostatic Expansion Valve

The thermostatic expansion valve, which has a fixed orifice and adjustable superheat, maintains the design degree of superheat at the evaporator outlet.

Liquid line main components are shown in Fig. 1-10.

A remote sensing bulb is securely fixed to the evaporator outlet piping, in a position where the superheat can be correctly sensed. The thermostatic expansion valve incorporates an external equaliser line.

Moisture Indicating Sight Glass

The sight glass is located between the Filter / Drier and the Thermostatic Expansion Valve, as shown in Fig. 1-10.

The sight glass performs two functions:

- It enables the condition of the refrigerant to monitored and provides visual indication of the presence of any moisture.

  Bubbles in the sight glass could be due to operating under hot gas injection and may not necessarily mean the system is undercharged.

Evacuation and Refrigerant Charging Valves

To facilitate evacuation and refrigerant charging, and to allow monitoring, two Schraeder type valves are fitted to each refrigeration circuit; one each on the high pressure (HP) and low pressure (LP) sides of the system.

Pressure Safety Devices

In adverse operating conditions, excessively high discharge or low suction pressures can develop, which can reach unacceptable levels. To protect against this and consequential damage it may cause, high and low pressure cut-out safety controls are fitted as standard, as described in Section 4 of the full IOM.

These pressure switches are non-adjustable and self-resetting. However, the system should only restart after the cause of the adverse condition has been rectified and the alarm is cleared at the controller.

Modulating Flow Control Valve and Actuator

This electronic valve and actuator illustrated, is used to control the flow of chilled water or low pressure hot water (LPHW) to the cooling coil or heating coil (if fitted).

The InvictaNET AHU Controller uses a Proportion, Integral and Derivative (PID) algorithm to determine control response and provides a 0 to 10 volt signal to modulate the flow control valve according to demand.

The 0 to 10 volt signal provided by the controller is directly proportional to the positioning range of the flow control valve.

The IPAC range offers a choice of either a two-way (standard) or three-way control valve. Two-way valves can be used on systems that have variable spped pumps to maintain constant pressure drop through the circuit.

For constant speed pump systems, the third outlet from the three-way valve is used to bypass the coil.

The bypass leg is designed to produce a balanced pressure drop through the system to match the coil, regardless of operating mode.

Key Operated Cam-lock Removable Doors

Each door is secured shut by means of three door-locking mechanisms, which, compresses the door sealing gasket to preventing air and noise leakage.
After unit installation, all access for maintenance is via the front of the unit. Each unit is supplied with a door lock key.

Airflow Failure Detection

As standard, each unit module is fitted with an air pressure switch to monitor airflow.

Cardboard Sleeve / Pallet Delivery Protection

As standard, units and condensers are packed on pallets and have cardboard protective sleeving and polystyrene corner packing.
Export packing is available on request.

Contactors, MCBs and MPCBs

To protect against electrical damage, all unit electrical plant is individually switched by contactors, MCBs and MPCBs.
As shown in Fig. 1-12 on page 32, these items are located on a fixed chassis, located directly behind the front access door.

Internal Unit Isolator

Positioned within the electrical chassis is a 3 phase isolator for customer connection.
A door-interlocked handle is available as an option.

Interconnecting wiring loom

To facilitate interconnecting wiring between twin modules, easily accessible, rail-mounted terminal blocks for all necessary circuits are provided in each cabinet.
An optional, factory-made interconnecting wiring loom, suitable for adjacent cabinets, is available as an option.

Integrated Water-Cooled Condenser

Any IPAC unit can be fitted with an integral, matched, stainless steel brazed plate heat exchanger, complete with pressure sensing diverter valves and associated pipework; see Fig. 1-5 on page 16.
There are two options for the diverting valve:

- **3-Way Valve** - for constant flow pump systems
- **2-Way Valve** - for variable flow systems

A commissioning set comprising a flow measuring variable orifice double regulating valve and shut-off valves is available for either of the units as an option. Due to space limitations some of these components may need to be fitted on site external to the units.

- Water flow rates for integrated plate heat exchanger condensers are shown in Table 1-8 on page 14.

Features and Options

Phase-failure relay

This option is recommended for any application where the quality of the electrical supply is not guaranteed.
This DIN rail-mounted relay protects units and offers the following features:

- Monitors the phase-to-phase supply
- Adjustable under-voltage and over-voltage trip levels
- Phase sequence and Phase-failure detection
- Adjustable time delay

When the device is triggered, the individual unit enters shut-down mode, allowing other units in a network to operate to compensate for the loss of duty.

Control panel cover

The electrical section is accessible behind a key-locked door. However for added protection (for example, to provide increased electrical safety for a Maintenance Engineer during routine servicing), an additional hinged cover can be fitted over the electrical chassis.

Fresh Air Control

To be used with the 100 % Fresh Air Modulating Section (see page 35) or remote dampers (contact Eaton-Williams), this option utilises an additional sensor to control a 0 to 10 V output for a modulating damper.
This is used to draw in outside air for cooling / heating and used where energy savings can be made compared to only conditioning the return air.
Control set points inhibit use of fresh air in close control applications when either the temperature or humidity are heading out of predetermined limits. If this option is selected, remote room pressure relief is required.

Fresh Air Control, Including Smoke Detection

This option is the same as the Fresh Air Control (see page 25), but includes a smoke detector on the outside air path, as close as possible to the point of entry.
If smoke is detected in the incoming airstream, this control overrides (via hard-wired relays) the unit controller and shuts the fresh air damper to prevent further entry of outside air. An alarm signal is generated by the device, via its own volt-free relay contacts.
When the sensor detects that the air is clear of smoke, the device resets and normal operation resumes.

Door-interlocked isolator

For safe electrical isolation of units, Eaton-Williams recommends that an optional, local door-interlocked isolator is fitted.
This device will isolate the unit when the door handle is turned to open the unit door panel.

Mains filter kit

IPAC units fitted with the InvictaNET controller pass the following EMC tests:

- Immunity: EN61000-6-2:2001
- Emissions: EN61000-6-3:2001

Should an installation have known problems with its electrical supply, then the factory-fitting of an EMC kit is recommended, to minimise any problems with regards to EMC interference.
The EMC kit is also available as a site retro-fit kit, should a unit suffer from EMC susceptibility after installation.

In-Room Remote Sensors

Should the positioning of the IPAC units cause unsuitable room condition readings, a remote room sensor is available to provide accurate location sensing (site fitted and wired).

Duct Remote Sensors

Should the positioning of the IPAC units cause unsuitable room condition readings, a remote duct sensor is available to provide accurate location sensing (site fitted and wired).

Water Detection Tape

water detection tape can be supplied for flood detection which is 5 metres long - one per unit module, plus PCB for the master module.

Audible Alarm

As part of the graphical display assembly, a buzzer can be fitted. This will be activated should the controller be in alarm condition. It can be muted by pressing the OK button (EW Controller only).

Alternate Display Languages

The InvictaNET controller can be configured to display in either English or Chinese. Other languages may be available at a later date, please check with Eaton-Williams Head Office if required.

ModBus Network Interface

When interfacing with the InvictaNET Echelon network via a PC based BMS system, a serial interface board is available.
This is written using the ModBus protocol and has connectivity for RS232 or RS485 (jumper settable).
One interface board is required per network (up to 9 AHU's). The ModBus interrogation software is by others.

Trend Controller

Where required, the IPAC units can be provided with a Trend IQ204 controller with custom designed software to meet the individual site requirements.
Please note, if this option is used, separate documentation will be required as this manual is solely based on the InvictaNET controller.
Please contact Head Office for further information.

Trend Network Interface

When interfacing with the InvictaNET Echelon network via Trend BMS system, a combination of the EW Serial Interface Board and a Trend Interface Device is available. Custom designed software makes the InvictaNET network visible on the Trend Network as an IQ Device.
Further details and compatibility information is available from Head Office.

Heating Process

Electric Heating

Single or two-stage electrical heating can be provided as an option.
As described under Dehumidification on page 19, where air temperature and humidity are both critical, it is necessary to reheat the air after dehumidification. In this case, the correct amount of reheat capacity must be available.
Heaters can of course be used for heating-only (i.e. no dehumidification) cycles.
The design of the electric heating in IPAC units is flexible and comprises multiples of 2.5 kW, finned resistance elements, balanced, where possible, over the three electrical phases.
The standard heating option is a single bank of heaters in the first module of a twin unit. However, installed heating can be configured to match demand, with options for two-stage or four-stage heating.

- For details of capacity and heater bank arrangements, refer to Table 1-13 on page 27
- For heater control philosophy, refer to Section 4 - Electrical Heating of the full IOM

Where the electrical heat load is higher than standard for a particular unit, some of the heating elements may be fitted into the second module.
Each applicable module is fitted with two self-resetting, over-temperature thermostats, to ensure safety, should a fault condition arise.

Low Pressure Hot Water Heating System

Both upflow and downflow master units can be supplied with an LPHW (Low Pressure Hot Water) coil fitted to the air-off side of the cooling coil. Duties are shown on Table 1-12 on page 27. This heating option includes a 2-way or 3-way modulating valve, proportionally controlled to enable the LPHW coil to act as the primary heating source, as well as a re-heat coil during de-humidification duty.

The duty of the LPHW coil is rated to match the dehumidification available on the IPAC units. As a special, a larger coil and pipework arrangement could be installed if required; refer to Eaton-Williams for details.

Table 1-12 : LPHW duties

LPHW Duties Rated at design airflow, with air on at 20 °C and water temperatures on/off temperatures of 70/60 °C									
IPAC Model		**15-1**	**22-1**	**30-1**	**30-2**	**40-1**	**45-2**	**50-1**	**55-2**
Total Heating	kW	9	13	16	17	22	24	35	30
Water Flow Rate	l/s	0.21	0.33	0.38	0.42	0.53	0.59	0.86	1
	l/hr	760	1177	1364	1519	1908	2124	3096	2668
Hydraulic Pressure Drop	kPa	14	9	22	14	30	22	30	30
IPAC Model		**60-1**	**60-2**	**70-2**	**80-2**	**90-2**	**100-2**	**110-2**	**120-2**
Total Heating	kW	42	31	37	44	57	71	78	85
Water Flow Rate	l/s	1.03	0.76	0.91	1.06	1.39	1.72	1.89	2.06
	l/hr	3708	2729	3272	3816	5004	6192	6804	7416
Hydraulic Pressure Drop	kPa	40	14	30	30	30	30	40	40

Table 1-13 : Capacity and stages of electrical heating

Capacity and Stages of Electrical Heating All elements are 2.5 kW rating		
CAPACITY kW	**NUMBER OF ELEMENTS AND CONTROL BANKS**	
	SINGLE STAGE	**MULTI-STAGE**
5	2 elements in a single bank	1 element in the first bank, 1 element in the second bank
7.5	3 elements in a single bank	1 element in the first bank, 2 elements in the second bank
10	4 elements in a single bank	1 element in the first bank, 3 elements in the second bank
15	6 elements in a single bank (not applicable to IPAC 15-1 or IPAC 30-2)	3 elements in the first bank, 3 elements in the second bank (not applicable to IPAC 15-1)
22.5	-	1 element in the first bank, 6 elements in the second bank (not applicable to units <40 kW)
30	-	6 element in the first bank, 6 element in the second bank (not applicable to units <60 kW)

This system is illustrated in Fig. 1-6 - Chilled water cooling and LPHW heating diagram and comprises similar components, arrangement and flow control principles.

In response to the temperature of air entering the unit, the InvictaNET controller modulates a flow control valve to meter the flow of LPHW entering the heat exchange coil.

As the hot water passes through the heating coil, heat transfers from the hot water to the relatively low temperature supply air flowing on the other side of the coil's heat exchange surface.

Having passed through the heating coil, the water then returns to the water heating plant for reheating, before returning to the unit again.

LPHW Heating Coil

For LPHW heating, the standard heat exchange coil is manufactured from copper tubes with aluminium fins.

- As an option, the coil can be supplied as copper/copper, or copper/copper-electro-tinned.

Capacity Control Hot Gas Injection System

Either of two types of capacity control hot gas injection arrangements may be fitted as an option.
Only operative during cooling demand only, these arrangements are both illustrated in:

- Fig. 1-4 - Air-cooled DX refrigeration system basic circuit diagram, see page 15
- Fig. 1-5 - Water-cooled DX refrigeration system basic diagram, see page 16

Options are:

◆ **Fully automatic hot gas injection**

This system operates independently of the controller and modulates in response to sensed suction pressure, to meter the required volume of hot gas into the expansion line.

In this way a false evaporator load is created, which enables the compressor to continue operation at times of low load, when it would otherwise be stopped by the controller because of inadequate demand.

When correctly adjusted for optimum performance, this arrangement offers superior control of evaporator capacity and, in turn, closer control of air temperature.

◆ **Manually preset hot gas injection flow control, with operation determined by the unit controller**

This system provides master units with two stages of capacity control and master/slave units with four stages;
for further control details, refer to "Compressor Capacity Control" on page 4-16 of Section 4 of the full IOM.

The hot gas injection line is fitted with a solenoid valve and a flow control valve, which is set during commissioning to provide the appropriate injection flow, which is adjustable from 0 % (valve shut) to approximately 40 % (valve fully open) of discharge gas flow.

At a predetermined low load condition, the controller opens (energises) the solenoid valve to allow discharge gas to enter the expansion line.

2 Way or 3 Way Control Valve

The IPAC range offers a choice of either a two-way (standard) or three-way control valve. Two-way valves can be used on systems that have variable spped pumps to maintain constant pressure drop through the circuit.
For constant speed pump systems, the third outlet from the three-way valve is used to bypass the coil.
The bypass leg is designed to produce a balanced pressure drop through the system to match the coil, regardless of operating mode.

Liquid Receiver

A horizontal liquid receiver is recommended for each refrigeration circuit having a pipe run of greater than 30 metres.

- For further information, refer to: Air-cooled Direct Expansion (DX) System on page 15, Water-cooled DX System on page 16, and "Liquid Receiver" on page 6-6 of Section 6 of the full IOM.

The liquid receiver is a site-fit option, which should be installed at the liquid outlet from the condenser.

NOTE
It is recommended that a suitable pressure relief device is fitted with this option

Oil Separator

Although not normally required on IPAC units, compressor-matched oil separators for long pipe runs are available for site installation.
One oil separator would be required for each refrigeration circuit.

Compressor Acoustic Jacket

To minimise noise breakout, an acoustic jacket can be fitted to each compressors as an option.

NOTE
The fitting of an acoustic jacket is recommended for upflow front return units, where noise breakout may be an issue.

Compressor Discharge Non-return Valve

On installations where there is risk of liquid (resulting from condenser low temperature) migrating to the compressor during an off-cycle, the optional discharge non-return valve should be fitted.

Split Coil Rapid Dehumidification

Split coil rapid dehumidification is available. Please contact Eaton WIlliams for further information.

Pressure Relief

Eaton-Williams recommends that a pressure relief kit option is fitted to each refrigeration circuit.

⚠ WARNING

Depending on system design and/or total charge weight, pressure relief may be mandatory according to safety legislation.

Pressure relief devices must be sized, rated and installed according to industry safe practice and legislation.

The pressure relief kit comprises a pressure relief device, bursting disc and rupture indicator.
If system pressure rises to a predetermined value, the pressure relief device will open, exposing the bursting disc to system pressure.

If the bursting disc ruptures (at a predetermined pressure), excess pressure will be relieved to atmosphere until system pressure returns to a safe level. The pressure relief valve will then close so that further loss of refrigerant to atmosphere is avoided.
The rupture indicator provides a visual signal that pressure relieving has occurred and that a new kit is required to be fitted (after rectifying the cause of the excessively high pressure condition).

Water System Isolating Gate Valves

To enable the unit to be isolated from the water system, gate valves can be provided as an option; for water chilled or chilled water units only; refer to Fig. 1-5 and Fig. 1-6, as applicable.

Commissioning Set

This option can be used to set the design flow rate through the unit during commissioning of water chilled or chilled water units only; refer to Fig. 1-5 and Fig. 1-6, as applicable
Comprising water system isolating gate valves and a D931 flow-measuring double-regulating balancing valve, complete with fixed orifice flow measurement tappings on the return leg.

Flexible duct connectors (upflow units only)

For applications where an upflow unit is ducted straight from the fan outlet, optional flexible duct connectors are available, which reduce vibration transmission through the ductwork and also simplify installation.
The ductwork connection is a 30mm Doby 'slide-on' flange system, which conforms fully to HVCA specification DW142 for rectangular duct connections.

Table 1-14 : Flexible duct connection sizes

Flexible Duct Connection Sizes in mm

DUCT DIMENSION		IPAC MODEL							
		15-1	22-1	30-1	30-2	40-1	45-2	50-1	55-2
	Height	150							
Unit	Width	420	457	457	420	667	457	1335	667
Module	Depth	670	670	670	670	670	670	720	670
Unit	Width	-	-	-	420	-	420	-	420
Module	Depth	-	-	-	670	-	670	-	670

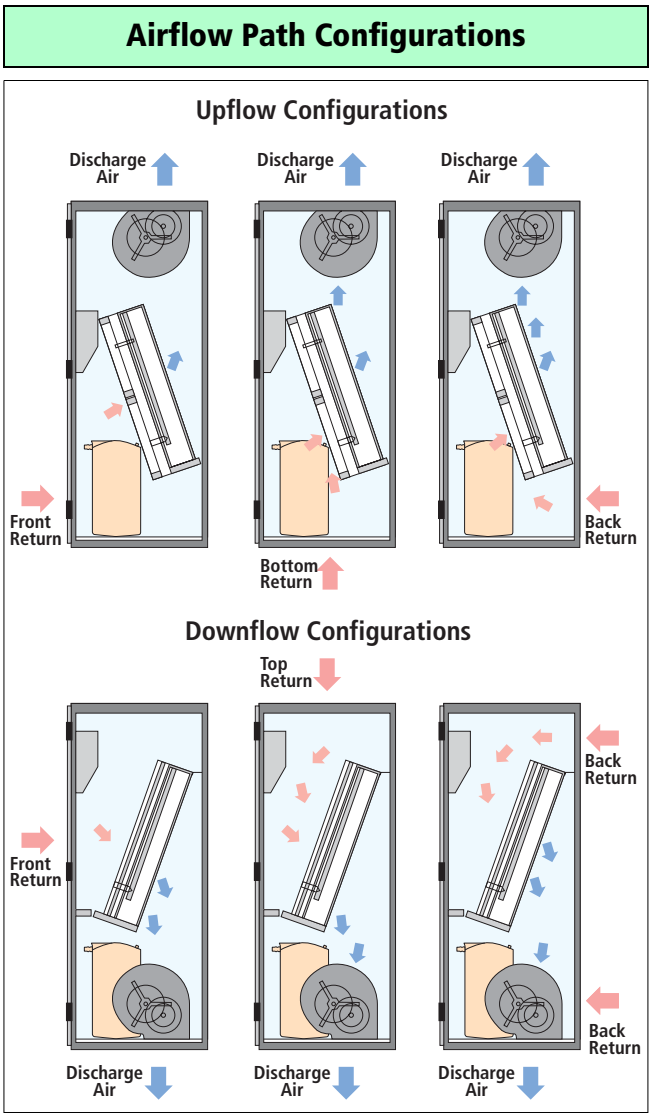
DUCT DIMENSION		IPAC MODEL							
		60-1	60-2	70-2	80-2	90-2	100-2	110-2	120-2
	Height	150							
Unit	Width	1335	457	667	667	1335	1335	1335	1335
Module	Depth	670	670	670	670	670	670	670	670
Unit	Width	-	457	457	667	667	1335	1335	1335
Module	Depth	-	670	670	670	670	670	670	670

Back-draught dampers (upflow units only)

For applications where units discharge into common ducting, if there is the possibility of air recirculation while any unit is in standby or shut-down mode, it is recommended that optional back-draught dampers are fitted at the fan discharge.

Airflow Options

Fig. 1-11 : Airflow path configurations



Humidifier

The optional Vapac® humidifier is a fully integrated system for maintaining and controlling air humidity.
The humidifier comprises a cylinder, in which electrodes are inserted. When electrical power is applied to the electrodes, energy passes between them, causing the water to boil and vaporise, producing steam.
The steam leaves the cylinder from the top and is released, via a manifold, into the air stream passing through the unit.

- For high humidification demand applications, the second module of a twin unit can also be fitted with a humidifier, as an option.

Table 1-15 : Humidification capacities

Humidification Capacities	
CAPACITY kg/hr	**NUMBER OF ELECTRODES**
< 5	3-electrode Vapac cylinder Can be fitted to all models
< 9	3-electrode Vapac cylinder Not applicable to single module units <30 kW Not applicable to dual module units <45 kW
< 15	3-electrode Vapac cylinder Not applicable to single module units <60 kW Not applicable to dual module units <100 kW

20% - 100% Proportional Output Humidifier

The InvictaNET Controller will attempt to balance the required humidification demand by varying the output of the steam humidifier from 20% to 100% of the available capacity.
This is achieved by varying the water quantity and quality within the cylinder.

Alarm Diagnostics Tools in Controller

By analysing feedback from the cylinder, the controller recognises various alarm states possible with the humidifier and displays them on the screen and extending remote alarms when necessary.

Different Bottle's for Varying Water Qualities

A medium conductivity cylinder is provided with the humidifier option as standard. To suit particular site water qualities, alternastive cylinders can be provided.
If the requirements are known prior to manaufacture, the unit can be supplied with the most appropriate cylinder at this stage. Using the correct cylinder will both extend the life of the cylinder and provide better control of the environment.
Please contact Head Office for further information.

Remote Vapac Options

Where the limited capacity of internal humidifier is insufficient for the system design, a range of options are available. A selection of Vapac standalone humidifiers can be networked to the InvictaNET Controller and can discharge steam either directly to the room (room distribution unit, RDU) or injected into the supply duct of a system.
Control and alarms from the remote humidifer are shared with the AHU display.

Second Unit OEM Option

In dual cabinet units a second OEM humidifier can be factory fitted into the second cabinet to increase the units output.

Rear Cosmetic Cover Panel

Where the units are to be installed in the centre of a room, cosmetic cover panels to match the overall unit finish can be factory fitted.

Multi-speed motors

Multi-speed motors are available. Please contact Eaton WIlliams for further information.

Side Gland Plates

As service connections may be required to pass through enclosed sections, each section can be supplied with a gland plate on either side, for ease of site service connection.
This design reduces the discharge pressure drop and under-floor noise levels. It can be used to discharge air to the rear of the units, as an alternative to the normal front-supply arrangement.
* Not available on water cooled condenser versions

Stainless Steel Drip Tray

As an option, the drip tray is available manufactured from stainless steel.

5 to 10 % fresh air intake, including volume damper control

An IPAC unit can have a 200 mm x 200 mm volume-controlled damper fitted to either the rear or the side of the unit. Once balanced, the unit will draw approximately 5 % fresh air to the unit, to help attain the recommended air changes per hour for a given room environment.
The fresh air inlet is supplied complete with a replaceable pre-filter; for details of the exact location of the fresh air entry points, contact Eaton Williams or their authorised agents.

Anti-vibration mountings

As an option, for applications where vibration transmission to surroundings must be kept to a minimum, anti-vibration mountings (AVMs) can be fitted to fan drive assemblies.

Dual Pulley Drives

For cabinets of duties less than 40kw, the fan drives are selected as single belts, these can be replaced by dual belt drives where specified.

Low Display Mounting

Where the units are positioned above floor level, the display can be lowered 600mm to compensate.

Lifting Channels

A set of galvanised steel lifting channels is available to lift the units off of their pallets without damaging the units. Please refer to the Installation Section for correct use.

Condensate Pump

Two types of optional condensate pump are available:

- Hot condensate pump
- Cold condensate pump

Application and suitability are dependent on whether drainage by gravity can be achieved and whether a humidifier is fitted.

Class 1, energy-efficient motors

As an option, supply fan drive motors are available to Class 1 Energy Efficiency.

Customised Colours

The standard pre-coated steel used in the cabinet construction can be oversprayed with any RAL or BS colour at additional cost.

Pipework

Pipework is manufactured from refrigeration quality copper tube. Connections are hermetically sealed by solder/brazed joints. After pipework assembly, the system is pressure tested. Suction lines are insulated with a closed-cell, synthetic rubber insulation material, which is jointed and vapour-sealed.

Auxiliary Humidification

On twin module units, if humidification demand is greater than the standard output, a second humidifier can be fitted to the secondary module. The secondary humidifier contains its own Echelon controller works in tandem with the InvictaNET controller to meet demand. The size of the secondary humidifier is limited by module cabinet size into which it is being installed. Where the installation would benefit from steam being injected directly into a duct, an additional (or alternative) humidifier, controlled by the InvictaNET controller, can be supplied; for details, refer to Eaton-Williams.

Hot condensate pump

For use in full air-conditioning units, where the internally trapped condensate pipe and Vapac humidifier outlet cannot be gravity fed to a suitable drain point.
Pump component materials are suitable for water high temperatures that can be produced by the humidifier.
Although this is a site-fit option, terminals are fitted to the IPAC unit for the power supply, and connection for the fault relay, into the water detection input of the controller
This pump is capable of holding 4 litres of water and can pump against a nominal head of 6 metres.

NOTE

Please note that a non-return valve may need to be fitted in the external pipework on site (by others) as this is not supplied with this pump.

Cold condensate pump

For use in non-humidifying units, where the internally trapped condensate pipe cannot be gravity fed to a suitable drain point a cold water condensate pump is supplied.

⚠CAUTION

A cold condensate pump is not suitable for use in units fitted with a humidifier, where water high temperatures can damage pump components.

Although this is a site-fit option, terminals are fitted to the IPAC unit for the power supply, and connection for the fault relay, into the water detection input of the controller.
This pump is capable of holding 2 litres of water and can pump against a nominal head of 4 metres.

Flood Detection

If required, an optional condensate flood detection device can be fitted. This could be from either an optional water detection tape (5 metres long - one per unit module, plus PCB for the master module), or, an alarm signal from a condensate pump (optional).

NOTE

If supplied by a third party, the device must provide a volt-free digital input, where:

- **Open circuit = healthy**
- **Closed circuit = fault**

If a flood is detected, the cooling process and humidifier (if fitted) stop, so that further flooding is avoided (configurable).

- For details on connection and operation, refer to Section 4 - INVICTANET CONTROLLER TECHNICAL MANUAL of the full IOM and the unit wiring diagram.

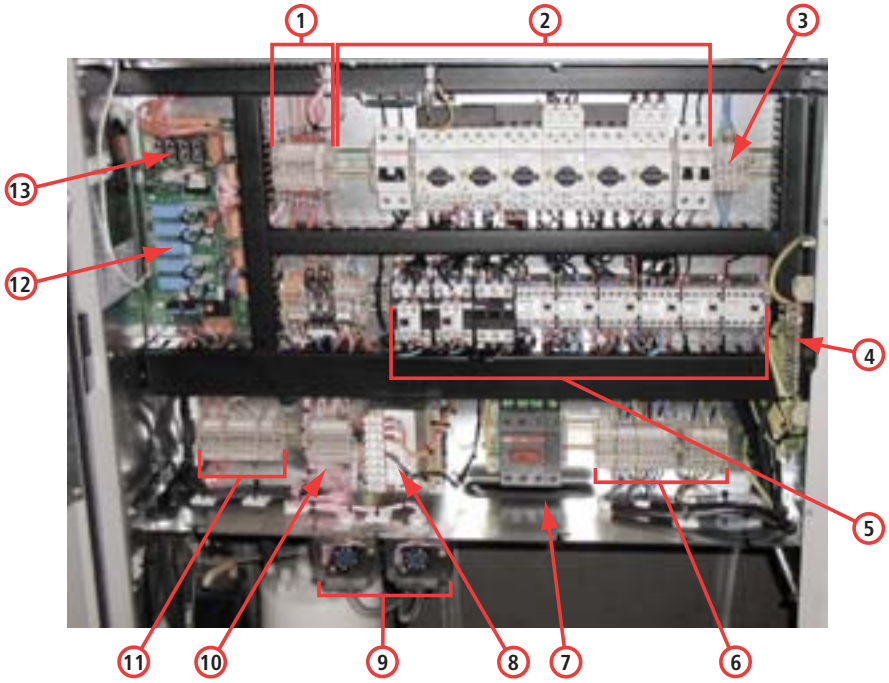
Electrical Equipment

Electrical equipment, specifications and options are as follows:
External electrical connections are:

- **380 to 415 volt, 5-wire, 3-phase, neutral and earth mains supply**
- **Remote alarm monitoring.**
- **Remote start/stop control functions.**
- **Emergency and fire shutdown functions.**

- IPAC units are all designed for minimum power input.
- The control panel is wired via clearly labelled terminal blocks, enabling easy modification / replacement of control system components.
- All components are internally wired to terminals. Any external interconnecting wiring must be made, by customer, to local regulations.
- In a twin module unit, interconnecting wiring is terminated, in both modules, to a numbered terminal rail, for customer interconnection at site.
- All controls are operated from a 24 V ac transformer supply.
- The equipment will, under all conditions, function within the limits required by Electromagnetic Compatibility Standards BSEH50081-1 and BSEH50081-2.
- Wiring cable is PVC insulated to BS 623 or BS 6004, as appropriate, and installed in accordance with BS 7671.
- Conductors for auxiliary purposes have a minimum cross section of 0.5 mm^2.
- Except for the 3-phase supply, conductors are identified by colour coded cables or by numbered ferrules, enabling easy identification and reference to the circuit diagram.

Fig. 1-12 : Electrical chassis general arrangement



1. **Internal wiring and fuses.**
2. **MPCB's for:**
   Fan 1 & 2
   Compressor 1 & 2
   Heater stages 1 & 2
   Humidifier
   Condenser
3. **Internal wiring terminals.**
4. **Earth Terminal Bar.**
5. **Contactors for:**
   Condensers 1 & 2
   Humidifier
   Heater stage 1 & 2
   Compressor 1 & 2
   Fans 1 & 2
6. **Power out for:**
   Sump pump
   Module 2 Fan 2 (if fitted)
   Module 2 Compressor 2 (if fitted)
   Module 2 CGH 2 (if fitted)
   Condensers
7. **Incoming power supply to Isolator.**
8. **Transformer 0 to 480/9/24 V ac.**
9. **Flow & Filter Air Differential Pressure switches.**
10. **Internal wiring for Module 2.**
11. **Wiring for Alarms, Shutdown and Water Detect.**
12. **InvictaNET controller daughter board.**
13. **InvictaNET controller mother board.**

- Where cables are grouped together in runs and subject to movement, they are suitably secured and protected from mechanical abrasion by a PVC sheath.
- Supply to the compressor(s), fans, heaters and Vapac unit is via approved protective devices.
- All terminal blocks are mounted on rails, clamped tightly together using intermediate end-brackets, where required.
- Terminals are designed to accommodate oversized cables, to ensure that voltage drops can be kept to a minimum.
- The standard service connections are through the base plinth. Where this is not convenient (i.e. an upflow front-return unit), as an option, side panels of the unit can have gland plates fitted for side service entry.

Air Movement Options

Front / Rear Return

For units with the front return option, rounded slots are punched into the front panels, to maximise return air area. Low PPI filter media is fitted behind these holes to enhance the appearance.
It is recommended that the Compressor Discharge Non-return Valve option (see page 28) is fitted to units having upflow front return, to minimise compressor breakout noise.
Rear return air entry is available on the majority of the range of IPAC units, however this option is not available on the following:

Units fitted with a water cooled condenser, IPAC 50-1, 60-1, 90-2, 100-2, 110-2 or 120-2 units.

For these, the turning section should be used instead.
On downflow units, the change from top to rear return is via a moveable plate. Configuration of upflow units must be specified at the time of ordering.
Typically front return units will have a greater noise level than figures generally given for the rear return units.

Table 1-16 : Front / rear return availability

Front / Rear Return Availability								
RETURN ARRANGEMENT	IPAC MODEL							
	15-1	22-1	30-1	30-2	40-1	45-2	50-1	55-2
Vertical	✓	✓	✓	✓	✓	✓	✓	✓
Front - Upflow	✓	✓	✓	✓	✓	✓	✓	✓
Front - Downflow	✓	✓	✓	✓	✓	✓	✓	✓
Rear - Upflow*	✓	✓	✓	✓	✓	✓	✓	✓
Rear - Downflow	✓	✓	✓	✓	✓	✓		✓
RETURN ARRANGEMENT	IPAC MODEL							
	60-1	60-2	70-2	80-2	90-2	100-2	110-2	120-2
Vertical	✓	✓	✓	✓	✓	✓	✓	✓
Front - Upflow	✓	✓	✓	✓	✓	✓	✓	✓
Front - Downflow	✓	✓	✓	✓	✓	✓	✓	✓
Rear - Upflow*	✓	✓	✓	✓	✓	✓	✓	✓
Rear - Downflow*		✓	✓	✓				

* Not available on water cooled condenser versions

Emergency Shutdown

In an emergency, the unit must be shutdown by using the quickest means possible.

⚠ WARNING

In an emergency, do NOT attempt to use controller functions to shutdown equipment, as this will initiate a controlled shutdown that is unlikely to be effective immediately.

It is recommended that an optional external Emergency Stop button is fitted, which when pressed will interrupt the power supply, shutting down the unit(s).

Fire Shutdown

An optional fire shut down facility may be fitted at the site and wired into unit terminals

If a fire is detected and triggers the system, it will interrupt the power supply to the controller, shutting down the unit and any network slaves.

- For details on connection and operation of both, refer to Section 4 of the full IOM and the unit wiring diagram.

Ancillary Options

A range of ancillaries is available for each of IPAC unit and the most suitable choice is dependent on the particular application and installation. Eaton-Williams Engineers will be pleased to offer advice as to the most suitable selections.

If a twin module unit is selected, the base is supplied in two sections, allowing for unit modules to be installed in separate positions.

All ancillaries are despatched with two locating pins, which fit into corresponding holes in the IPAC unit frame, to locate the extra sections.

NOTE

The supplied gasket seal must be used between any mating sections to eliminate air by-pass noise. As standard, unit module sections are not bolted together.

Table 1-17 : Available ancillaries and Section Heights

Standard available Ancillaries and Section Heights Dimensions in mm								
Dimension	Open Frame	Open Frame with Adj. Feet	Frame + Scoop	Frame + Scoop with Adj. Feet	Enclosed Sections	Turning Sections	Fresh Air Sections	High-Efficiency Filter Sections
Nominal Height	350	450	350	450	600	600	600	700
Minimum Height	350	450	350	450	500	500	600	700
Maximum Height	1000	1100	1000	1100	1100	1100	1100	800
In Increments of	50	50	50	50	100	100	100	100
Adjustable Feet		✓		✓				
Floor Support Angles	✓	✓	✓	✓	✓	✓	✓	✓
Side Gland Plates					✓	✓	✓	✓

Adjustable Feet

The adjustable feet option is recommended for all under-floor base plinth options. Providing 25 mm adjustability in corner jacking height, adjustable feet make levelling of base plinth sections quick and easy, before fitting a unit into position.

⚠ CAUTION

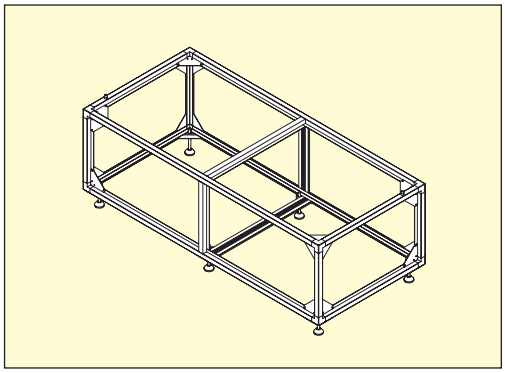
It is essential that units are level when installed, otherwise unit operation may be adversely affected and can result in damage to the unit.

Floor Support Angles

Where any of the above sections are used under a false floor, the plinth can be supplied with suitably sized angles, which can support the floor local to the plinth.

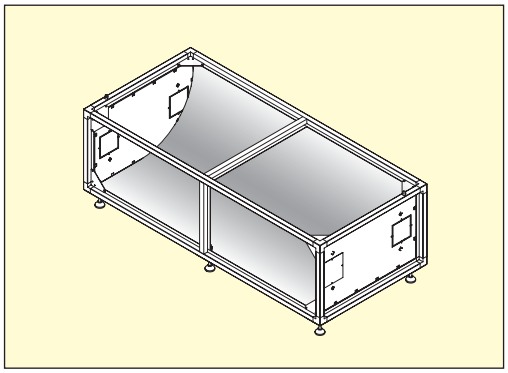
Open frame

The Open Frame illustrated (shown with adjustable feet), is recommended for floor return systems. This is the simplest base option and is designed to match each unit of the IPAC range.



Open Frame Base and Scoop

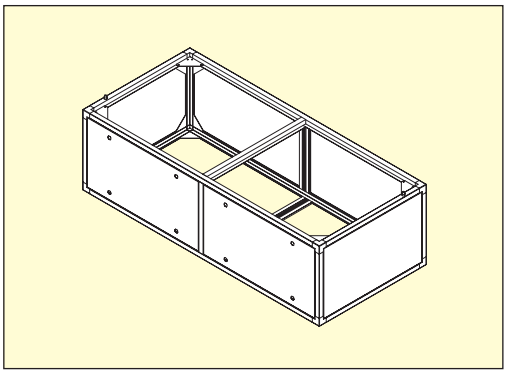
This base is of the same construction as the Open Frame, but with the addition of side enclosure panels and a discharge scoop, to guide the air into a floor void from downflow units.



This design reduces the discharge pressure drop and under-floor noise levels. It can be used to discharge air to the rear of the units, as an alternative to the normal front-supply arrangement.

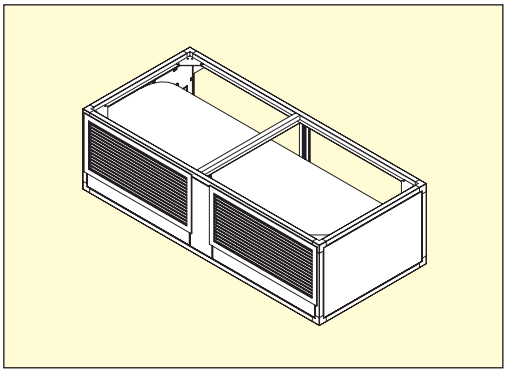
Enclosed Section (for ducting, etc.)

An enclosed section can be used on either the supply or return air path. A typical example of use would be to duct from an upflow unit into a vented ceiling.
Front panels are removable, should access be required.



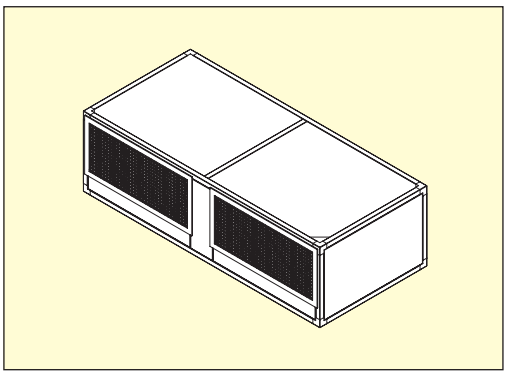
Turning Section (inc. double-deflection grilles)

Either used as a header or a base plinth, the turning section contains a scoop to aid airflow. This section is fully enclosed to match the unit design, with egg-crate return air grilles, or double-deflection supply grilles of satin anodised finish.



Fresh Air Modulating Section

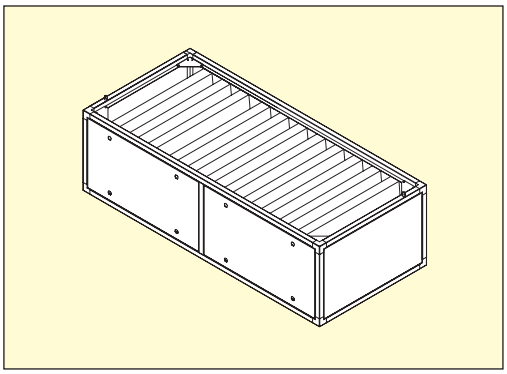
This is a 0 to 100% modulating fresh air mixing section.
Either as a header (downflow) or a base plinth (upflow), the section utilises outside air, where possible, to condition the room.
This optimises unit efficiency, reducing compressor loads by up to 60 % over a year.
The fresh-air control facility (refer to Economy Cooling Options on page 18 and "Economy Cooling Options" on page 4-19 of Section 4 of the full IOM) senses outside air temperature and internal temperature / humidity levels and responds by modulating the fresh air damper to keep the room air at the required condition.



When room air is evaluated as heading away from being at the required condition, the fresh air facility is inhibited by closure of the inlet damper. Each section is supplied complete with coarse grade, F2 pre-filters.

High-efficiency Filter Section

The high-efficiency filter section, which should be connected to the outlet section IPAC unit, contains standard size, 300 mm deep pleated front withdrawal panel filters to F5, F6, F7 or F8 specification. The high-efficiency filter section is made from a 450 mm filter section and a 250 mm spacer plenum section.



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- Air-cooled & Water-cooled Liquid Chillers
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- Package Telecommunications Units
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- OEM Process Cooling Control Units
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