

ALTERNATIVE REFRIGERANTS For REFRIGERATION INDUSTRY- HYDROCARBON (HC)

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Our Slogan: **Switch To Green, Save The Energy, Save The EARTH!**



WORKSHOP ON RECYCLE and RECLAIM of Refrigerants
and the Emerging Alternatives In the Market (Refrigeration
and Air Conditioning Sector)

The Saujana HOTEL, Kuala Lumpur, 25th September 2018



Topics to be explored

1. INTRODUCTORY OF A₃ CLASS FLAMMABLE REFRIGERANT
2. A₃ CLASS REFRIGERANTS CHALLENGE, OCCUPANCY & LOCATION CLASSIFICATION TABLE
3. CASE STUDY of HYDROCARBON REFRIGERATION SYSTEMS BASED OCCUPANCY AND LOCATION CLASSIFICATION
4. SITE INSTALLATION OF HYDROCARBON CHILLER
5. HYDROCARBON REFRIGERATION SYSTEM USERS IN MALAYSIA.
6. SUMMARY

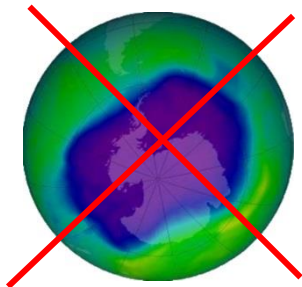


INTRODUCTORY OF A₃ CLASS FLAMMABLE REFRIGERANT

All Hydrocarbon refrigerant are highly flammable but non-toxic.

This gives them an “A₃” class in MS 2678:2017, flammable refrigerant system- code of practice.

Hydrocarbon refrigerants are natural organic compound with **zero Ozone Depleting Potential** and negligible **Global Warming Potential of 3** if compare to Carbon Dioxide = 1, per 100 years basic.



WHY SELECT HYDROCARBON REFRIGERANT? Hydrocarbon refrigerant is an environmental friendly refrigerant, and also an alternative refrigerant to replace existing ODP and GWP Refrigerant gas in the market.

Refrigerant	Molecular Weight (g/mol)	Initial Boiling Point (°C)	Latent Heat of Vaporization @ Boiling Point (kJ/kg)	Ozone Depleting Potential, ODP	Global Warming Potential GWP
R290 (A3)	41.1	-42.0	426	0	3
R600a / R436a (A3)	58.1/ 49.5	-12.0 / -26.2	363 / 404	0	3
R1270 (A3)	42.0	-47.7	440	0	3
R22	86.5	-40.8	233	0.04	1,800
R12	120.9	-29.8	165	0.9	10,600
R502	116.63	-45.4	172	0.5	1,600

Application range of A3 class refrigerant

A3 Class Refrigerant	Application Range	Alternative
R290	High/Medium Temperature; domestic appliances; commercial, industrial	R22, R407c R410a
R600a/ R436a	High/Medium Temperature; domestic appliances; commercial; Industrial; Automotive	R12 R134a
R1270	Medium/Low Temperature; commercial; Industrial; Industrial process refrigeration; chillers	R502 R404a R408a R507a

Compatibility

Hydrocarbon Refrigerants possess full chemical compatibility with nearly all lubricants, system components, all common elastomer and plastic refrigeration materials.

Description	Compatible	Not Compatible
Lubricant Oil	Mineral or Synthetic	Lubricant containing silicone or silicate (anti-foaming additive)
‘O’ Ring, Valve seats, seals and gaskets	All Common elastomer and plastic refrigeration material	EPDM, Natural rubbers and silicone rubber (unless for LPG)
Compressors	Reciprocating, Screw, Scroll	Centrifugal
Evaporators and condensers	Virtually same design and size, Heat transfer coefficients tend to be higher.	
Refrigerant Control Devices	Thermostatic Expansion Valve (TEV) & Electronic Expansion Valve (EEV)	EEV not comply to Safety Practice.



A3 Class Refrigerants Challenge , Occupancy & Location Classification Table

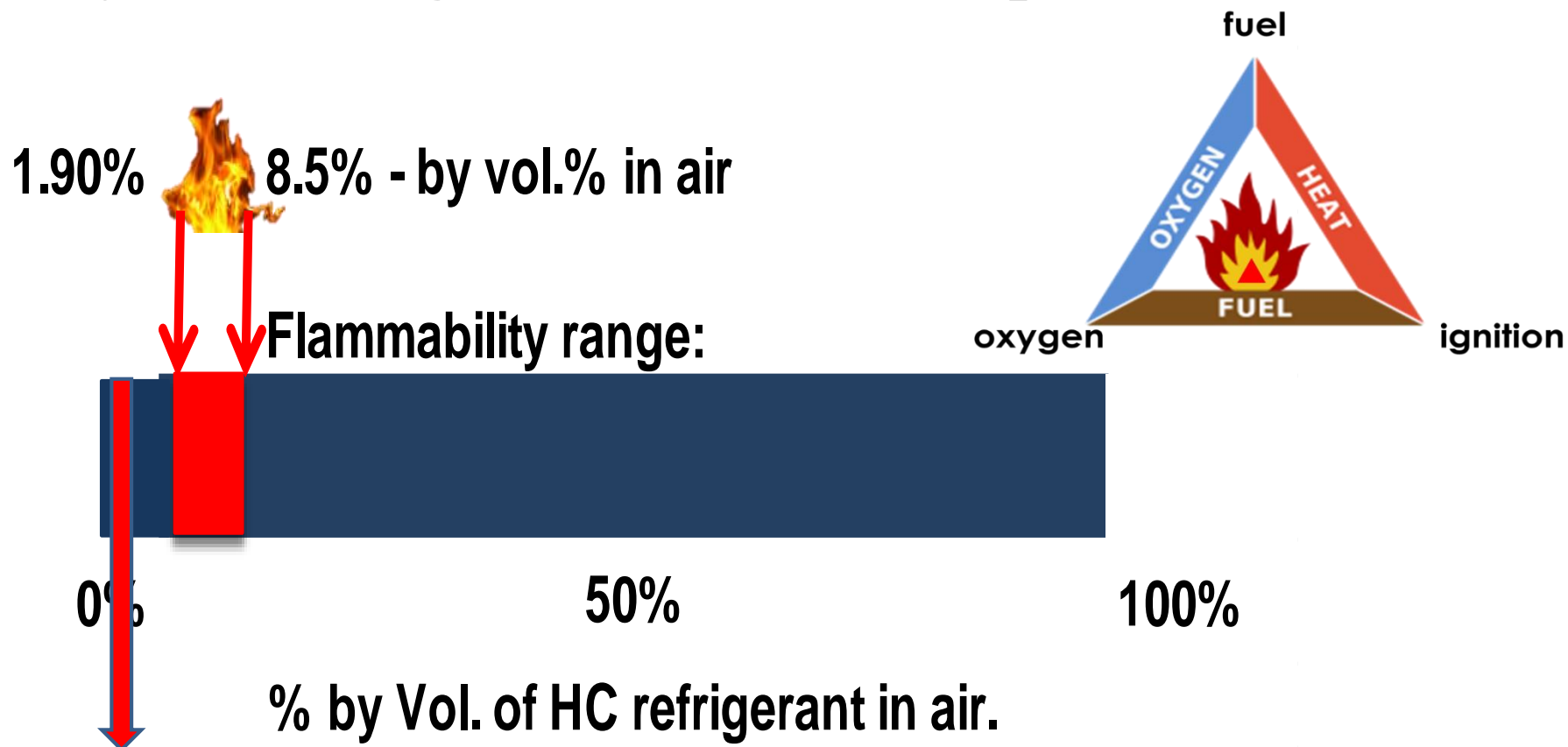
- The major consideration of utilizing Hydrocarbon refrigerant gas in refrigeration systems are safety matters.
- Either Propose to install Hydrocarbon in Existing Old Chiller
- Or Propose to install a NEW Hydrocarbon System.
- Kindly propose Hydrocarbon System located above ground level (preferably in ventilated area or roof top) in a special machinery room or in the open air, otherwise 1kg refrigerant charge is permitted below ground level; according MS 2678: 2017

Major Challenge is Flammable Properties

HC Refrigerant Type	Lower Flammability Limit (LFL)		Auto Ignition Temperature
	By Volume (%)	By Mass (kg/m ³)	
R600a	1.95	0.04	891 °C
R290	2.0	0.038	480 °C
R1270	2.2	0.038	472 °C

- The practical limit as defined by MS2678:2017 is 20% of LFL.
- These values are necessary when determining the maximum refrigerant charge, ventilation, flow rates and maximum allowable temperatures of components.
- Max. allowable refrigerant charge (kg) = $0.2 \times \text{LFL} \times \text{Volume of the room (m}^3\text{)}$

Major Challenge is Flammable Properties



- Practical Limit 20% of LFL, 0.008kg/m^3 as defined by MS2678:2017

Occupancy and Location Classification for Charge Limit above ground level (MS2678:2017)

Category	Examples	Volumes Calculated
A (Domestic/ Public)	Hospitals, Prisons, Theatres, Schools, Supermarkets, Malls, Hotels, Dwellings, Bungalow	~20% x LFL x Room Volume and not more than 1.5kg per sealed system or ~5kg per sealed system in special machinery room or in the open air
B (Commercial/ Private)	Business or Professional Offices, Places for General Manufacturing and where people work	~20% x LFL x Room Volume and not more than 2.5kg per sealed system or ~10kg per sealed system in special machinery room or in the open air
C (Industrial/ Restricted)	Cold Room, Meatpacking, refineries, non-public area of malls, plant rooms	~20% x LFL x Room Volume and not more than 10kg per sealed system in human occupied spaces ~20% x LFL x Room Volume and not more than 25kg per sealed system if High pressure side located in special machinery room or in the open air ~No charge restriction if all refrigerant containing parts located in a special machinery room and in the open air

Case Study of Hydrocarbon Refrigeration Systems Based on Occupancy and Location Classification

Refrigerator



Domestic Refrigerator- Panasonic Brand, Mitsubishi, Refrigerant Charge < 150 gram, may be installed in any size of room

COLD ROOM Freezer

~20% x LFL x Room Volume and not more than 25kg per sealed system if High pressure side located in special machinery room or in the open air

Category C	SYSTEM DESIGN Air Cooled Type	Refrigerant Mass Charge & Room Size
6 °C to 25 °C	5HP Scroll Compressor 10HP Scroll Compressor	R290, 1.8kg Charge, Cold Room Size > 237m ³ (10 x 6 x 4mH) R290, 4.2kg Charge, Cold Room Size > 592m ³
-24°C to 5°C	5HP Reciprocating Compressor 10HP Reciprocating Compressor 20hp Reciprocating Compressor	R290, 2.2kg Charge, Cold Room Size > 289m ³ R290, 4.5kg Charge, Cold Room Size > 592m ³ R290, 7.5kg Charge, Cold Room Size > 987m ³
-30°C	20HP Reciprocating Compressor	R1270, 7.5kg Charge, Cold Room Size > 987m ³

COLD ROOM

20% x LFL x Room Volume and not more than 25kg per sealed system if High pressure side located in special machinery room or in the open air

Case Study 1: PGEO Edible Oil, Pasir Gudang

1. Occupancy Classification: C (20°C Cold Room)
2. Location Classification: Compressor located in the open air, Indoor Direct Expansion, Room Size: 10m x 20m x 8mH = 1600m³



COLD ROOM

20% x LFL x Room Volume and not more than 25kg per sealed system if High pressure side located in special machinery room or in the open air

Case Study 1: PGEO Edible Oil, Pasir Gudang

3. Freezer Selection: Air Cooled Scroll Hydrocarbon Freezer, Single Compressor 10HP x 2 units,
4. Refrigerant Type/Refrigerant Charge per sealed system: R290 / 4.5 kg
5. Practical limit charge = 20% x LFL x Room Volume = $0.2 \times 0.038 \times 1600 = 12.16\text{kg}$

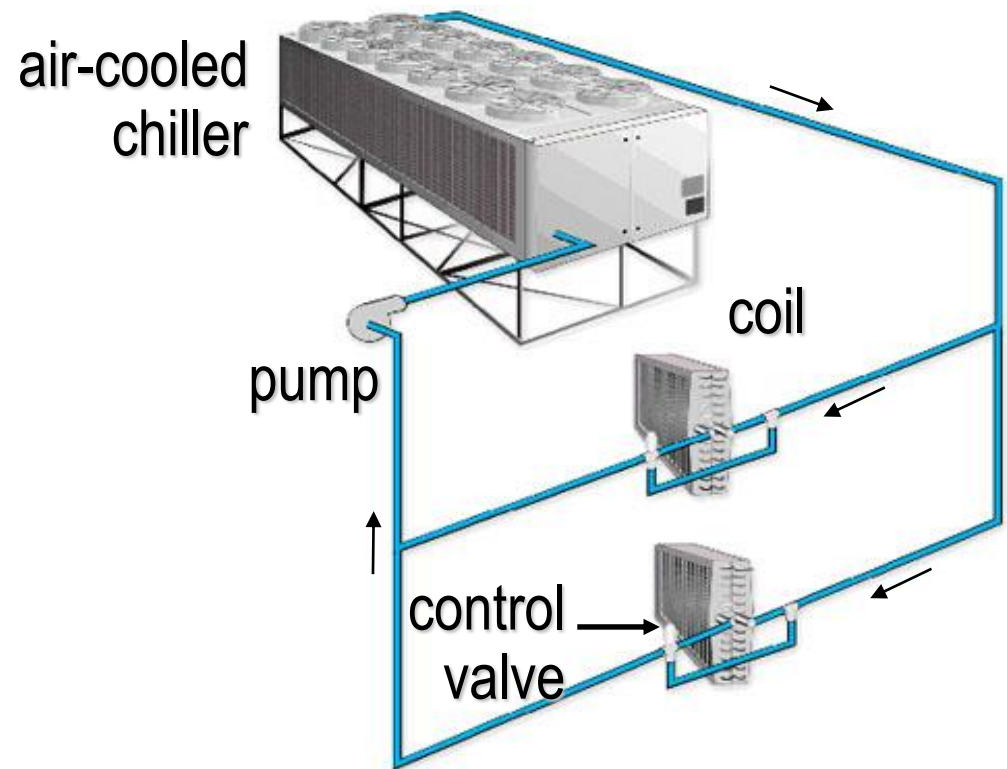


Category A Air Cooled Chiller– General Occupancy, Domestic/ Public

5kg per sealed system in special machinery room or in the open air

Suitable Capacity and Size of Chiller to be selected

1. Air Cooled Mini Chiller 5hp – 15hp **Scroll** compressor
(Charge limited to 5kg below)
 - School, budget hotel, bungalow house.
2. Air Cooled Multi-compressor Mini Chiller, up to 60hp (4 x 15hp **Scroll** compressor x 4.5kg HC refrigerant), non tandem type
 - Hospital, Theatres, Supermarket.

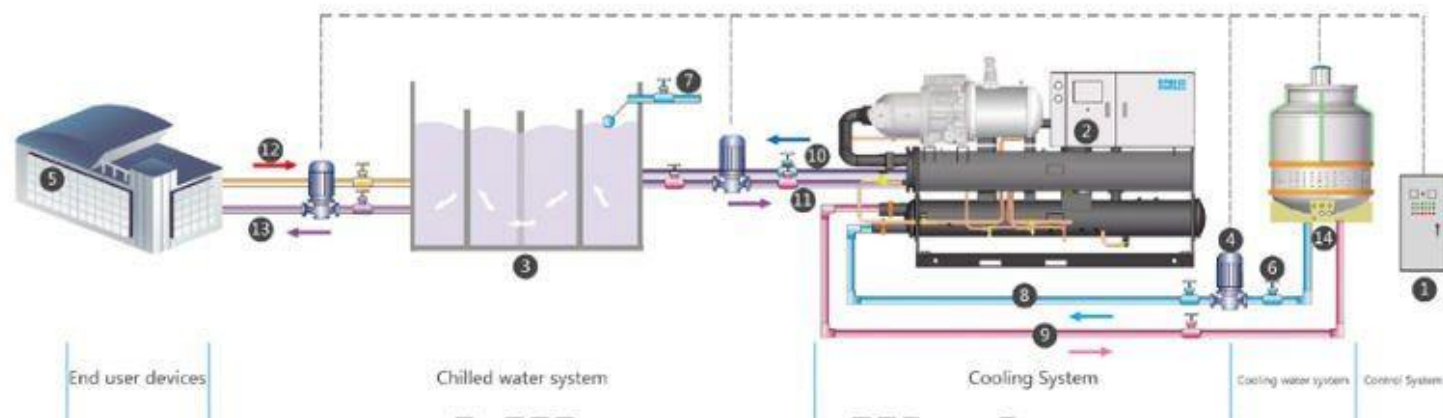


Category A Water Cooled Chiller– General Occupancy, Domestic/ Public

5kg per sealed system in special machinery room or in the open air

Bigger Capacity and Size of Chiller to be selected

1. Water Cooled **Scroll** Hydrocarbon Chiller up to 80HP- (4 x 20HP Scroll Compressor x 4.8kg HC refrigerant per system. Non-Tandem
 - Shopping Mall, Hospital, Prisons, School.



greenchiller.en.alibaba.com

- ① Control cabinet ② Refrigeration unit ③ Mixing tank ④ Pump ⑤ Production equipment
⑥ Valve ⑦ Supply water inlet ⑧ Cooling water ⑨ Cooling water inlet ⑩ Chilled water outlet
⑪ Chilled water inlet ⑫ Water equipment ⑬ Water equipment inlet ⑭ Cooling tower

Category A Air Cooled Chiller – General Occupancy, Domestic/ Public

5kg per sealed system in special machinery room or in the open air

Case Study 2: Institut Latihan Perindustrian Kepala Batas, Penang

1. Occupancy Classification: A (School)
2. Location Classification: in the open air, natural air ventilation



Category A Air Cooled Chiller– General Occupancy, Domestic/ Public

5kg per sealed system in special machinery room or in the open air

Case Study 2: Institut Latihan Perindustrian Kepala Batas, Penang

3. Chiller Selection: Air Cooled Scroll Hydrocarbon Mini Chiller, Single Compressor 6HP,
4. Refrigerant Type/Refrigerant Charge per sealed system: R290 / 3.0 kg



Category B Air Cooled Chiller– Supervised Occupancy, Commercial/ Private

10kg per sealed system in special machinery room or in the open air

Chiller Capacity and Size to be selected

1. Air Cooled Hydrocarbon Chiller, up to 120HP **Scroll** compressor (4 x 30HP Scroll Compressor x 9.2kg per system, non tandem type)
 - Offices, Small Shops, Restaurant, General Manufacturing Plant.

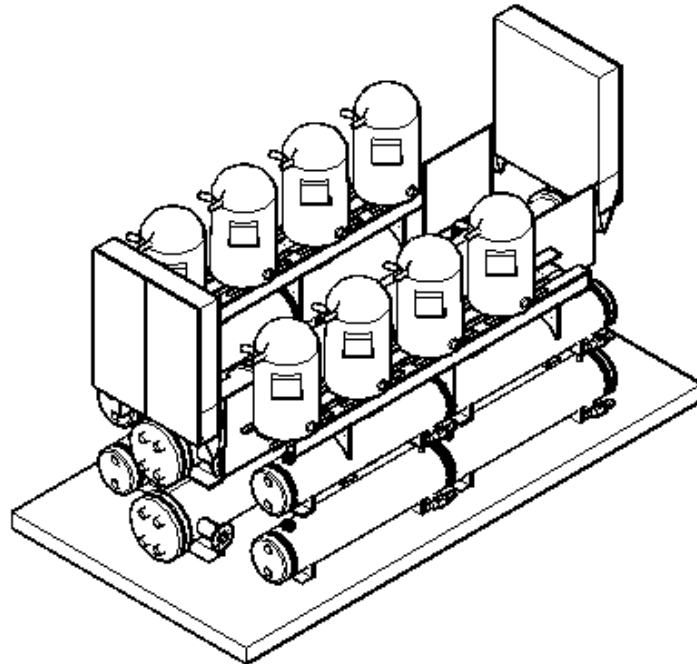


Category B Water Cooled Chiller– Supervised Occupancy, Commercial/ Private

10kg per sealed system in special machinery room or in the open air

Bigger Capacity and Size of Chiller to be selected

1. Water Cooled **Scroll** Hydrocarbon Chiller up to 240HP- (8 x 30HP Scroll Compressor x 6.5kg HC refrigerant per system. Non-Tandem
 - Commercial Offices, General Manufacturing Plant.



Category B Air Cooled Chiller– Supervised Occupancy, Commercial/ Private

10kg per sealed system in special machinery room or in the open air

Case Study 3: Mondelez Manufacturing Sdn Bhd, Johor Bahru

1. Occupancy Classification: C (Biscuit Manufacturing Plant)
2. Location Classification: in the open air, natural air ventilation



Category B Air Cooled Chiller– Supervised Occupancy, Commercial/ Private

10kg per sealed system in special machinery room or in the open air

Case Study3: Mondelez Manufacturing Sdn Bhd, Johor Bahru

3. Chiller Selection: Air Cooled Scroll Hydrocarbon Chiller, Single Compressor 15HP
4. Refrigerant Type/Refrigerant Charge per sealed system: R290 / 4.50 kg



Category B Water Cooled Chiller– Supervised Occupancy, Commercial/ Private

10kg per sealed system in special machinery room or in the open air

Case Study 4: Teleflex Medical Sdn Bhd, Taiping

1. Occupancy Classification: C (Medical Tube Manufacturing Plant)
2. Location Classification: in the Special Machinery Room, with forced ventilation system



Category B Water Cooled Chiller – Supervised Occupancy, Commercial/ Private

10kg per sealed system in special machinery room or in the open air

Case Study 4: Teleflex Medical Sdn Bhd, Taiping

3. Chiller Selection: 90HP Water Cooled Hydrocarbon Chiller, 3 x 30HP Compressors
4. Refrigerant Type/Refrigerant Charge per sealed system: R290 / 6.20 kg



Category C Air Cooled Chiller– Authorised Access, Industrial / Restricted

No charge restriction if all refrigerant containing parts located in a special machinery room and in the open air

Chiller Capacity and Size to be selected

1. Air Cooled Hydrocarbon Chiller, up to 250HP **Screw** compressor (2 x 125HP Screw Compressor x 32kg per system, non tandem type)
 - Cold Stores, Dairies, Non-public areas of supermarket, plant rooms



Category C Water Cooled Chiller– Authorised Access, Industrial / Restricted

No charge restriction if all refrigerant containing parts located in a special machinery room and in the open air

Bigger Capacity and Size of Chiller to be selected

1. Water Cooled **Screw** Hydrocarbon Chiller up to 420HP- (2 x 210HP Screw Compressor x 45kg HC refrigerant per system.
 - Cold Stores, Dairies, Non-public areas of supermarket, plant rooms



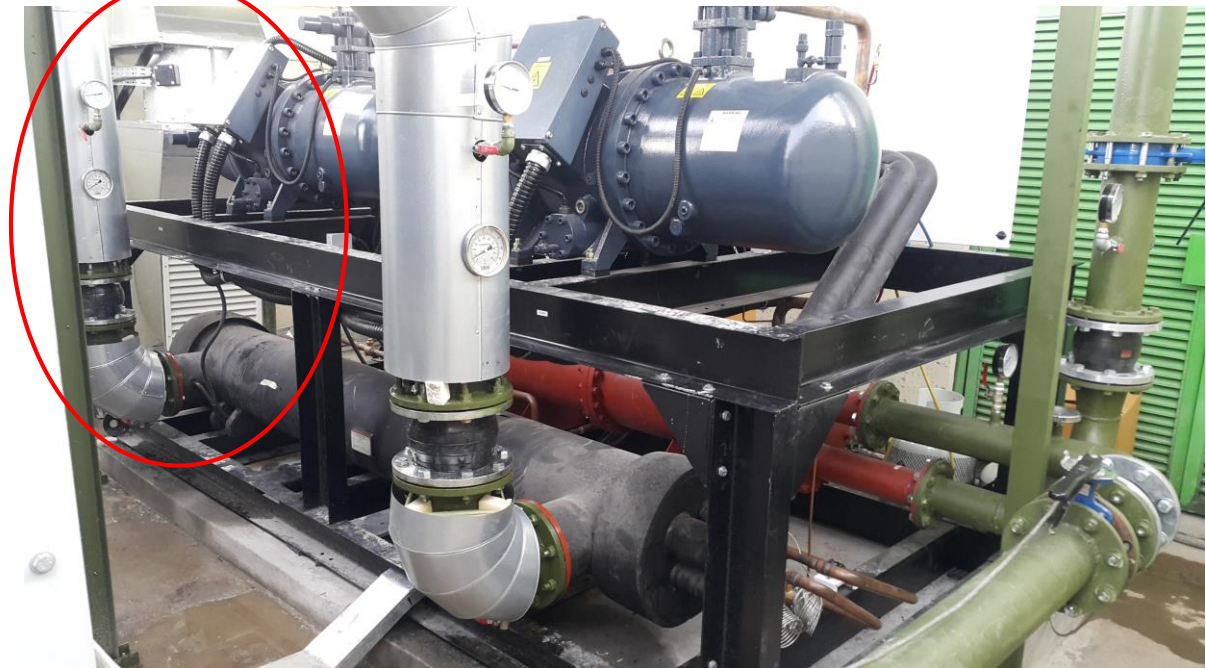
Category C Water Cooled Chiller– Authorised Access, Industrial / Restricted

No charge restriction if all refrigerant containing parts located in a special machinery room and in the open air

Case Study 5: Syarikat Wen Ken Drugs Sdn Bhd, Johor

1. Occupancy Classification: C (Cap Tiga Kaki Medicine Manufacturing Plant)
2. Location Classification: on Rooftop, with forced ventilation system and only authorised personnel is allowed to access.

Mechanical Ventilation system installed to prevent trapped of refrigerant gas even though on rooftop



Category C Water Cooled Chiller– Authorised Access, Industrial / Restricted

No charge restriction if all refrigerant containing parts located in a special machinery room and in the open air

Case Study 5: Syarikat Wen Ken Drugs Sdn Bhd, Johor

3. Chiller Selection: 140HP Water Cooled Screw Chiller, 2 x 70HP Compressor
4. Refrigerant Type/Refrigerant Charge per sealed system: R290 / 14.5 kg



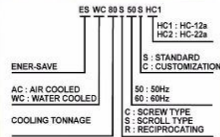
Hydrocarbon Chiller Design, Using **Scroll Compressor**, Wide range, can design for Category A, Category B & Category C but Capacity smaller up to 240HP, multi-compressor type

ENER-SAVE HYDROCARBON Water Cooled Scroll Chiller



*Applicable to Residential, Commercial, Industrial, Institution
and Government Building Category A, B & C- chiller
located at special machinery room or in the open air .*

Model Description



Superior Feature:

ESWC Hydrocarbon series designed using scroll hermetic compressor. System designs consist of several systems and every system operated by single scroll compressor. It further reduces the refrigerant gas charge amount and increases the feasibility of easy maintenance and servicing.

Scroll compressor – ZR380 deploy to serve the main compression drive to ESWC Hydrocarbon Chiller, low noise level, high EER and high reliability and tested in many application. The electrical termination point is sealed by fire rating insulation. Series HC1 which is utilizing the HC-12a as refrigerant further reduce extremely high pressure hazard if compares to system using HC-22a and HFC R410a



Scroll Compressor Operation flow of scroll compressor Isolobene/ Propane refrigerant gas sensor

Chiller capacity control design is based on number of compressor and the control step from thermostat controller. Other safety gadget to protect the chiller system is flow rate sensor, pressure switch, anti-freeze sensor and HC leak detector. HC leak detector can be linked to exhaust fan or other control circuit for refrigerant gas evacuation and indication.

Control Panel

- Interactive screen.
- User friendly interface.
- Simple operation.
- Graph and digital numerical display for chilled water temperature.
- Display for Cut-OFF and Cut-IN temperature set-points.
- Temperature in Centigrade unit.
- System run time display in Days, Hours, and Minutes
- Indicator lights to show the number of running compressors, compressor's status, running status, system error, and compressor's maintenance indicator.
- Active Alarm and History Alarm display to show the current and previous error.
- Parameters is set to factory default if the PLC is out of battery for 10 days.
- Easy set point setting for Cut-Off / Cut-IN temperatures and Cut-IN Timers.
- Password features to provide safety for the system parameters from being adjusted by unauthorized person.
- PLC I/O indicators to show the current PLC I/O status.



Technical Specification:

Model (40RT to 120RT)	ESWC400S 50HCx	ESWC600S 50HCx	ESWC600S 60HCx	ESWC100S 50HCx	ESWC120S 50HCx
General					
Capacity, RT +/-5%	40	50	60	100	120
Rated Power, kW	35	43	52	85	100
Operating Power, kW	32	39	45	78	90
Number of Compressor	2	2	2	4	4
Capacity Steps of Compressor	100 – 50 – 0	100 – 50 – 0	100 – 50 – 0	100 – 75 – 50 – 25 – 0	100 – 75 – 50 – 25 – 0
Compressor					
Type	Scroll	Scroll	Scroll	Scroll	Scroll
Compressor Model	ZR240	ZR310	ZR380	ZR310	ZR380
Connection	DOL	DOL	DOL	DOL	DOL
Power Supply	380V/415V/3-Ph/50Hz				
Condenser Shell & Tube					
Water Connection	100	100	100	125	150
Size, mm dia, each	29	35	43	58	86
Water Flow Rate, m3/h	7.1				
Cooling Shell & Tube					
Chilled Water, LCWT	7.1				
Degree Celsius	22.5	27.5	28	45	58
Water Flow Rate, m3/h	1	1	1	2	2
Number of Cooling shell and tube	75	75	100	125	125
Water Connection	100				
Size, mm dia, each	125				
Refrigerant					
HC-12a, Weight, kg per system	4.5	5	5.3	5	5.3
HC-22a, Weight, kg per system	4.8	5.9	6	5.9	6
Category	A, B & C	AHC-12a, B & C	B & C	AHC-12a, B & C	B & C
Dimension					
Height, mm	1530	1560	1600	1560	1600
Width, mm	600	650	1350	1300	2700
Length, mm	2235	2235	2100	2400	2400
Weight, kg	690	1220	1395	2440	2650

Model (63RT to 97RT)	ESWC63S 50SHCx	ESWC78S 50SHCx	ESWC97S 50SHCx
General			
Capacity, RT +/-5%	63.2	78.9	97.4
Operating Power, kW	50.0	61.3	75.6
No. Of refrigerant circuits	4	4	4
Capacity Steps of Compressor	100 – 75 – 50 – 25 – 0	100 – 75 – 50 – 25 – 0	100 – 75 – 50 – 25 – 0
Compressor			
Type	Scroll	Scroll	Scroll
Compressor Model	ZR250	ZR310	ZR380
Condenser Shell & Tube Cooling Shell & Tube			
Refrigerant			
R290, Weight, kg per system	4.8	5.9	6
Category	A, B & C	B & C	B & C
Dimension			
Height, mm	1530	1560	1600
Width, mm	1300	1700	2700
Length, mm	2235	2400	2400
Weight, kg	2200	2440	2650

Collaboration Program With:

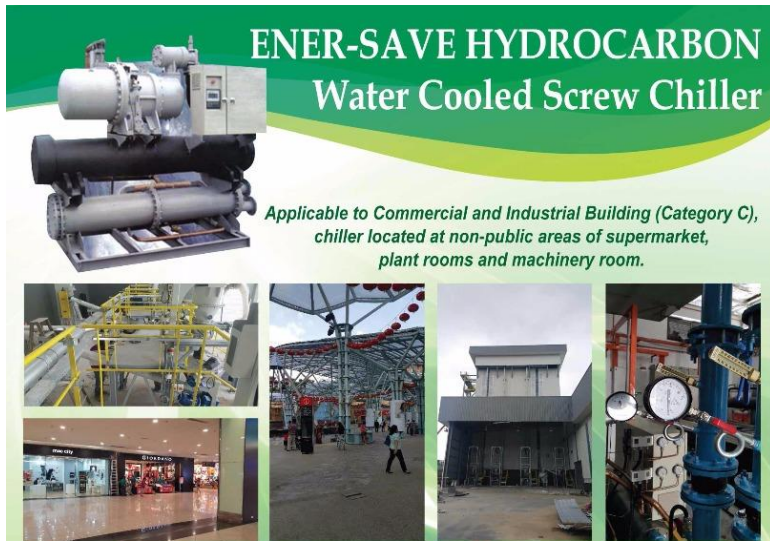


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Hydrocarbon Chiller Design, Using **Screw Compressor**, Benefit is larger capacity up to 420HP Single Compressor or multi-compressor but limited to Category C, industrial use.



ENER-SAVE HYDROCARBON Water Cooled Screw Chiller

Applicable to Commercial and Industrial Building (Category C),
chiller located at non-public areas of supermarket,
plant rooms and machinery room.

Technical Specification:						Technical Specification:						Technical Specification:					
Model (99RT to 156RT)	ESWC 99C50 SHCx	ESWC 107C5 0SHCx	ESWC 125C5 0SHCx	ESWC 135C5 0SHCx	ESWC 156C5 0SHCx	Model (99RT to 156RT)	ESWC 99C50 SHCx	ESWC 107C5 0SHCx	ESWC 125C5 0SHCx	ESWC 135C5 0SHCx	ESWC 156C5 0SHCx	Model (200B to 300B)	RC2-200B	RC2-410B	RC2-230B	RC2-510B	RC2-300B
Capacity, RT	99.3	107.8	125.9	135.5	156.5	Capacity, RT	99.3	107.8	125.9	135.5	156.5	Capacity, RT	200	410	230	510	300
Rated Power, kW	78.8	82.7	98.9	101.4	117.7	Rated Power, kW	78.8	82.7	98.9	101.4	117.7	Rated Power, kW	150	300	150	300	150
Operating Power, kW	78.8	82.7	98.9	101.4	117.7	Operating Power, kW	78.8	82.7	98.9	101.4	117.7	Operating Power, kW	150	300	150	300	150
No. Of refrigerant circuits	2	1	2	1	2	No. Of refrigerant circuits	2	1	2	1	2	No. Of refrigerant circuits	2	1	2	1	2
Capacity Steps of Compressor	100 – 75-50 – 25 – 0	100 – 50 – 0	100 – 75-50 – 25 – 0	100 – 50 – 0	100 – 75-50 – 25 – 0	Capacity Steps of Compressor	100 – 75-50 – 25 – 0	100 – 50 – 0	100 – 75-50 – 25 – 0	100 – 50 – 0	100 – 75-50 – 25 – 0	Capacity Steps of Compressor	100 – 75-50 – 25 – 0	100 – 50 – 0	100 – 75-50 – 25 – 0	100 – 50 – 0	100 – 75-50 – 25 – 0

Model (99RT to 156RT)	ESWC 99C50 SHCx	ESWC 107C5 0SHCx	ESWC 125C5 0SHCx	ESWC 135C5 0SHCx	ESWC 156C5 0SHCx
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General					
Capacity, RT +/-5%	99.3	107.8	125.9	135.5	156.5
Operating Power, kW	78.8	82.7	98.9	101.4	117.7
No. Of refrigerant circuits	2	1	2	1	2
Capacity Steps of Compressor	100 – 75-50 – 25 – 0	100 – 50 – 0	100 – 75-50 – 25 – 0	100 – 50 – 0	100 – 75-50 – 25 – 0

Compressor					
Compressor Model	RC2-200B	RC2-410B	RC2-230B	RC2-510B	RC2-300B

Condenser Shell & Tube					
Cooling Shell & Tube					
Refrigerant					

R290, Weight, kg per system	21 x 2	42.0	25.2 x 2	52.5	29.4 x 2
30 & Category	C	C	C	C	C

Dimension					
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Collaboration Program With:



30 & 30A, Jalan Peraluan Besi 3, Taman Sri Putri,
81300 Skudai, Johor, Malaysia.
Email: project@ener-save.biz
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Tel: +607-557 2669 Fax: +607-558 2669

Pertaining to Site Installation, Mechanical Ventilation- Risk Control at 25% LFL Control (MS)



 **ENER-SAVE**



Specifications	
Models(x)	Low(L), Medium(M), High(H) Moisture
Range	5-85% LEL
Operating Voltage	12-28V d.c.
Maximum Power Consumption	2.5W
Operating Temperature Range	0-50°C
Operating Humidity Range	0-30%(L), 31-70%(M), 71-95%(H)
Pre-Heat Time	24 Hours, (Immediate use is allowed)
Relay Rated Load	10A, 250V a.c. / 24V d.c.
Dimension	67 x 70 x 36mm
Cable Input & Output	(7 x 0.5mm) 4 Cores-2 In 2 Out

EP01-x | Propane Gas Detector

Humidity
→ L - Low Moisture
→ M - Medium Moisture
→ H - High Moisture



Hydrocarbon equipment located in the open air or in machinery room, in the event of leak, the refrigerant shall be drawn-out by natural or forced ventilation. Thus, It is safe to propose and install an emergency mechanical ventilation in machinery room forced ventilation,


the air flow for emergency mechanical ventilation shall be ten (10) air charges per hour or the air flowrate obtained by formula 2 in MS2678:2017, if there are source of ignition

$$v = 0.004 \times m / \text{LFL} \quad \text{[Formula 2]}$$

where

- v = air flow rate in m^3/s ;
- m = mass of refrigerant charge in the refrigerating system with the largest charge, any part of which is located in the machinery room.
- LFL = lower flammability limit of the refrigerant

Labelling on System using Flammable Refrigerant such as Hydrocarbon, must be clear and informative

 WARNING	
 Propane (R-290)	Risk of fire or explosion! Flammable refrigerant used. <ul style="list-style-type: none">▪ Place in well ventilated area to prevent accumulation of refrigerant.▪ Repair and disposal must be carried out by trained service personnel.▪ No naked flame during servicing or repair.
ENER-SAVE R-290 <p>RISK PHRASES : Liquefied flammable gas. Flammable air-vapour mixtures may form if allowed to leak into atmosphere.</p> <p>PRECAUTIONS : Keep away from heat, sparks and flames. Container temperature should not exceed 49°C. Store and use with adequate ventilation. Wear protective equipment during handling. Avoid skin or eye contact. Contact with liquid may cause frostbite.</p> <p>FIRST AID : If inhaled, remove victim to fresh air. If not breathing, give artificial respiration. For skin or eye contact with liquid, flush with lukewarm water for at least 15 minutes. Seek medical attention if irritation persists. For use by qualified personnel only. SEE MATERIAL SAFETY DATA SHEET.</p> <p style="text-align: center;">ENER-SAVE SDN BHD Lot 36 Jalan Perigi Nenas 8/7 Kawasan Perindustrian Pulau Indah 42920 West Port Selangor D E Tel: 07-557 2669 Fax: 07-558 2669</p>	

Proper Labelling on Machinery Room



**Required
Signboard**



Highly Flammable
Refrigerant Gas HC-22a

During Maintenance

Advice the maintenance personnel is trained and competent person.

- No handphone
- No cigarette or no smoking
- Prepare Fire Extinguisher
- Surrounding ventilated
- No others ignition source within 3m range



A3 Class refrigerant gas Users in Malaysia

1. JB Cocoa Sdn Bhd- Since year 2009
2. Kualiti Alam Sdn Bhd- since year 2009
3. SDP Manufacturing Sdn Bhd- since year 2009
4. YKK (M) Sdn Bhd- since year 2009
5. Kraft Foods Manufacturing Sdn Bhd- since year 2010
6. Rikevita (M) Sdn Bhd- since year 2010
7. Siegwerk Malaysia Sdn Bhd- since year 2010
8. EE Guan Construction Sdn Bhd- Since 2009
9. Joncan Composite Sdn Bhd- Since 2009
10. Sinar TM Sdn Bhd- Since 2009
11. DGR Packing & Supply Sdn Bhd- Since 2009
12. Pusat Latihan Komputer Era Informasi- Since 2008
14. JCY HDD Technology Sdn Bhd- Since 2008 (Chiller 200tons)
15. Suntec Alarm System & Automation- Since 2009
16. Network Food Industries Sdn Bhd- Since 2011
17. RadaTech Corporation Sdn Bhd- Since 2010
18. PGEO Edible Oils Sdn Bhd- Since 2011
19. Thong Guan Plastic & Paper Industries Sdn Bhd- Since 2012 (300 tons)
20. Calsonic Kansei Malaysia Sdn Bhd- Since 2012



SUMMARY

1. A3 Class Flammable Refrigerant is an environmental –friendly refrigerant, non ozone depleting and negligible global warming substance
2. Design or manufacture A3 class flammable refrigerant chiller based on Malaysian Standard MS 2678: 2017
3. Propose to install A3 class flammable refrigerant chiller in the open air or machinery room above ground level, always refer to Occupancy and location classification table
4. Choose the right mass charge of A3 class flammable refrigerant chiller for the right occupancy classification.

Switch to Green, Save the Environment, Save the Earth!



Q & A



THANK YOU!

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