



# Customized Air Conditioning for Fresh Food Stores

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It is passe! The buzzword that inspires mega proportions is Retail - fuelled by the Indian passion for shopping, and our speculative mind set when it comes to property acquisition. Retail provides a mechanism to develop real estate, fuelling cost appreciation – the Indian developers dream-come-true!

New generation retail comes in many forms - malls (big and small), cash and carry supermarkets, stand alone stores, mini department stores, and now, vegetable & fruit stores!

This article is based on my experience with air conditioning equipment installed for cooling a fresh vegetable and fruit store, called by one of the promoters “Fresh” stores.

## The Merchandize

Mostly fruits and vegetables, and may be in future, dairy and meat or ready foods, seasonings, etc., etc.

Typically, low shelf life merchandize, heavily dependent on a "cold chain". A simple vegetable shop has complexities we are only now beginning to discover. I will touch on some aspects that are relevant to the selection of ACs for such stores.

The new generation "Fresh" stores work on a concept of "direct from producer to consumer", attempting to provide not only vegetables at a fair price but also to afford an air conditioned environment.

Yes – most such outlets are airconditioned! Typical stores sizes being 2000 sq ft to 4000 sq ft. Most stores currently use standard ducted splits /split AC units

I am however trying to work out the AC requirements of such an outlet, based on application and practical assessment of the following issues :

- Visual merchandizing
- Moisture loss
- Energy efficiency
- High footfalls
- Location /access
- Fit out time
- General arrangement
- Refrigeration equipment
- False ceiling
- Investment / ownership cost

## Visual Merchandizing

Surprised! If you thought visual merchandizing was only for jewellery stores, think again – would you buy a fruit or vegetable lacking in visual

## About the Author

Anil Dev is a mechanical engineer with 25 years of varied experience in the field of air conditioning. He has run independent businesses in service, contracting, dealership and finally in manufacturing. Now runs a 50:50 JV with Clivet, Italy and his previous company, Trac Fujico Air Systems. He is a member of ISHRAE.

appeal? Dust is a big enemy here, and a “Fresh” store needs to have "positive pressurization", to minimize ingress of air-borne dust.

**Moisture Loss**

If we have insufficient humidity, the product undergoes significant moisture loss, resulting in:

- Shrivelled appearance (loss of visual appeal)
- Loss of weight – reduction in sale value upto 10%

The AC system must hence be designed to work with higher air quantities (upto 550 cfm per ton) enabling the system to work at higher apparatus dew points, and higher relative humidity. 70% RH is recommended. Higher air quantity will provide the much needed air movement perception to compensate for the higher RH, in the area of comfort.

**Energy Efficiency**

This is of course a very important need to promote viability of the store. The system will of course be more energy efficient as a consequence of working at a higher ADP, and higher refrigerant temperature. Scroll compressors with optimized condensers are a must. As an option, in some cases, we could have the compressor in the indoor unit (read also the locational access limitations for a description) to help to reduce the length of suction line, and associated losses. 3-phase motors too further improve efficiency. Multiple compressor design is a must, and preferably with a *tandem* design or at least *interwoven* circuits, to enable the whole coil to become wet even with one compressor running, and a good compromise compared to high capital cost of VRV systems. This will help the system to adapt well to fluctuating loads (a reality in this case), while providing excellent part load efficiency.

**High Footfalls**

Typically for a small ticket, but a large footfall store, it is necessary to keep in mind the ingress of a large amount of dust. AC units must be designed with corrugated filters with high dust holding capacity and low pressure drop, that are capable of quick sliding/ easy cleaning. The store management must be appraised about the necessity to clean filters frequently.

**Location/Access**

Eventually, such stores will be penetrating not just large malls, but even small towns often lacking in infrastructure. The AC unit must be designed for the following:

- Very long refrigerant piping
- To be virtually "idiot-proof", and not dependent on high skill of installer.

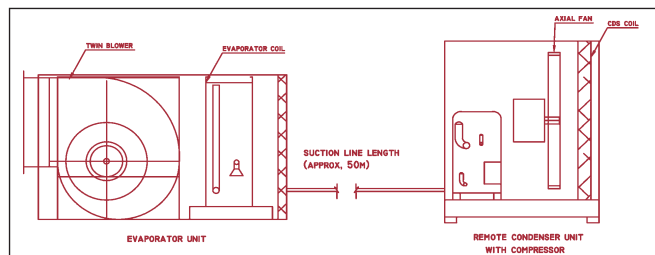


Figure 1 : Standard split AC

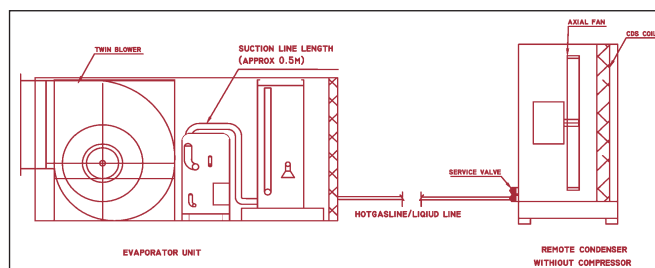


Figure 2 : Customized split AC

In this direction, it is my suggestion (for remote locations or stores needing very long length of piping), as an option, to have units with compressors that are within the indoor unit. This will help in allowing much longer refrigerant piping and also prevent inherent problems in piping design /oil return. A simple rule that "condensers must be located at a higher level than the indoor unit" will suffice.

**Fit Out Time**

Minimum time, completely modular approach, preferably duct-less units for a "quick-fix".

**General Arrangement**

In my opinion, a custom built unit would be the solution. A ceiling hung unit, with option of compressors (with acoustic enclosure) in the indoor unit, with 550 cfm per ton, in perhaps 5.0, 7.5 & 10.0 TR modules, with 2-compressor design, "interwoven" coil circuiting, corrugated filters, would fit the bill. The unit must have a plenum, with multiple deflection louvered registers, and a ductless approach (ductable options can also co-exist).

**Refrigeration Equipment**

This is to be considered for preparing a heat load, but

Option/Description	Capex (A/C)	Add. Capex (Elec/Dg) for addl. connected load	Connected Load kW	Electricity Consumed Based on 6% avg. load, 11 hrs. 365 days & 1 unit = Rs. 6/-	Value Erosion % due to moisture loss	Value Erosion based on Rs. 20000/day sales x 365 days
1 : 20 TR nominal standard unit	4.50 lakhs	0.90 lakhs	27 kW	4.23 lakhs	8%	5.84 lakhs
2 : 15 TR nominal customized unit	5.00 lakhs	Nil	21 kW	3.29 lakhs	3%	2.19 lakhs
<b>Differential</b>	0.50 lakhs	0.90 lakhs	6 kW	0.94 lakhs	5%	3.65 lakhs

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we can also take some precautions like keeping the condensers of refrigeration units outside the store.

**False Ceiling**

To be avoided as far as possible.

**Investment / Ownership Cost**

It is true that cost per ton for a unit customized as above could be 30-40% higher than off-the-shelf systems. But it is also true that a unit such as the one described can help lower installed capacity, to neutralize the higher cost per ton. The saving in electrical installation and DG capacity is a bonus, and the huge energy saving, thanks to capacity reduction, would be the icing on the cake!

**Comparison between Standard and Customized Solution**

Assumptions: (hypothetical case study)

Area : 2500 sq ft

Refrigeration load : 16 TR

Daily sale of fruits /vegetables : Rs. 20,000

Option 1 : 20 TR nominal capacity, standard split units, delivering 16 TR actual capacity due to low suction temperature and long refrigerant piping

Option 2 : 15 TR nominal capacity, high cfm and high suction temperature, customized unit, with short suction pipe, delivering 16 TR actual capacity.

Net saving per store : 0.40 lakh Capex, and 4.59 lakhs/annum in revenue.

Total revenue saving for 4000 stores : Rs. 18360 lakhs per annum.

To summarize, the benefits of such an approach would be:

- (1) Energy savings 20 to 25%
- (2) Savings in merchandize value erosion by checking weight-loss
- (3) Better dust control
- (4) Lower Capex (electricals /DG)
- (5) Reduced project time co-ordination - AC installation will need few days, with minimum co-ordination required with false ceiling / interior agencies.
- (6) Reduced limitation in distance between indoor and outdoor units, due to short suction line. Reduced de-rating in case of long piping.
- (7) Reduced failure risk due to oil return problems, due to potential limitations in obtaining expertise in remote areas
- (8) Proper humidity control even at partial loads
- (9) Excellent adaptability to load fluctuations
- (10) Possibility of 'zoning' to have zone wise temperature control.

This is in the true sense, application-based product engineering, and the benefits are pretty visible. ❖

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