

**PRESENTATION ON
ENERGY SAVING IN REFRIGERATION
PLANTS IN DAIRY**

**By
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General Manager- FRICK INDIA LTD**



-TOPIC COVERED –

- **Replacement of existing compressors with Energy Efficient Compressor.**
- **Use of Screw Compressors in large dairy plants .**
- **Advantages of Ammonia recirculation system.**
- **Features of PHE Chiller in a Dairy Plant.**
- **Advantages of Evaporative Condensers over Open type Condensers.**
- **Use of Variable Frequency drives in Dairy plants.**
- **Automation in Refrigeration Plant Operation.**

Replacement of existing compressors with Energy Efficient Compressor.



Replacement of existing compressors with latest Energy Efficient Compressor

We have developed latest energy efficient reciprocating compressor and furnish below the special features of this compressor.

❖ High grade cast iron body suitable for refrigeration application being thermally insensitive to expansions / contraction during operation. Better thermal insulation leading to low noise / sound.

❖ Taper roller bearings for better efficiency of crankshaft rotation. Less power losses, higher speed, lower maintenance, better overall efficiency, better equipped to deal with liquid slugs.



- ❖ Advanced piston type unloading system. Uses oil pressure very efficiently and causes unloading to be smooth and without a problem. Better unloading systems save the other maintenance costs while saving energy costs.
- ❖ Takes less space in the plant room due to its compact design.
- ❖ Has oil temperature gauge on crankcase to maintain oil temperature. Leads to long life of both the oil and machine.
- ❖ Has advanced micro oil foil filter with three way valve to monitor pressure drop.
Keeps the internals free of any of foreign particles.



❖ Oil cooler attached.

❖ Advanced connecting rod / bearing drilling design leading to high life and continuous supply of oil.

Comes with compact complete structure frame.



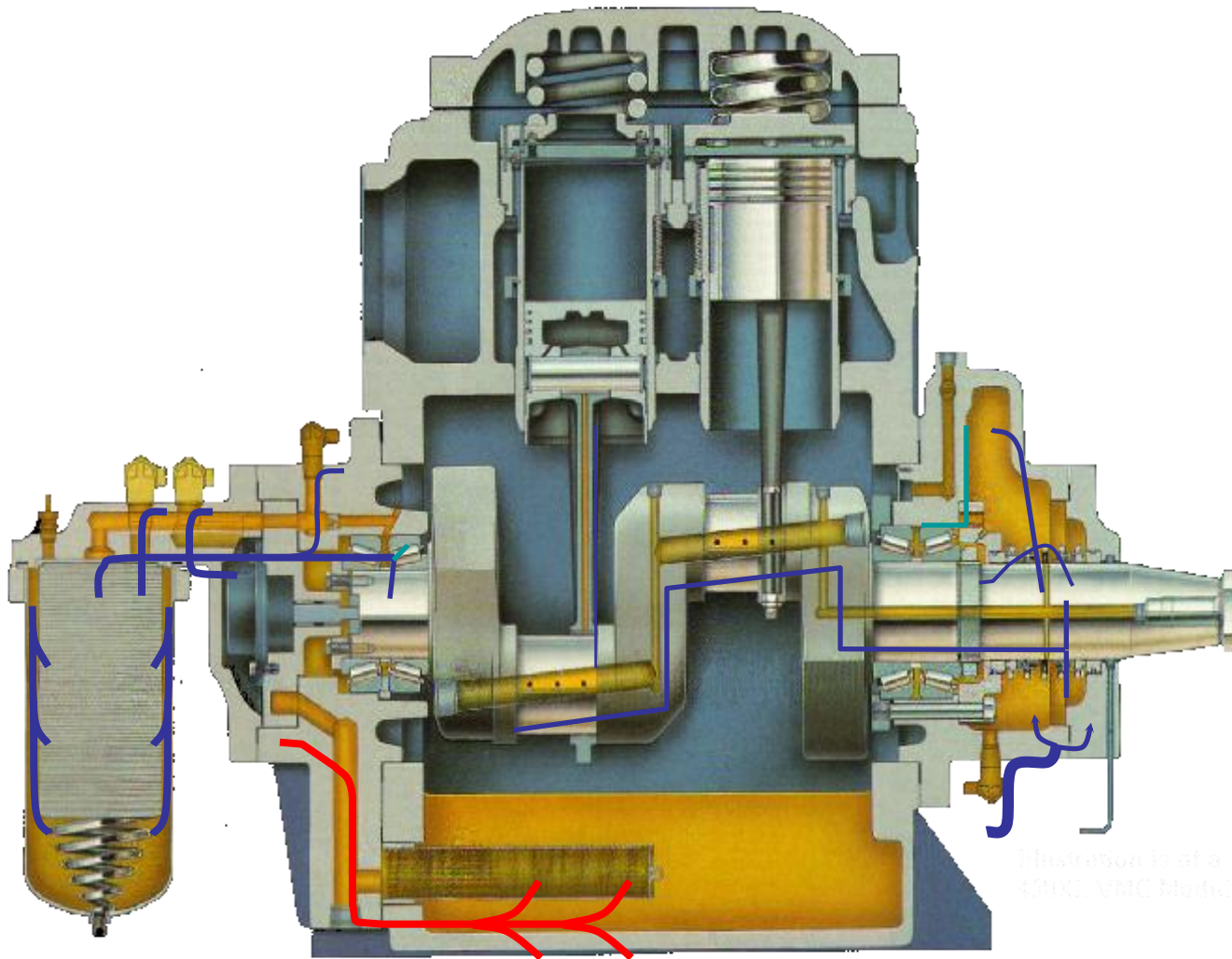
❖ Is a 1994 design made to compete against screw compressors in terms of power saving and long life.

❖ For example: the old reciprocating compressor will deliver 33.8 TR and consumes 46.3 BHP at $-10\text{ }^{\circ}\text{C}$ SST & $35\text{ }^{\circ}\text{C}$ SDT at 400 RPM.

Whereas our latest energy efficient compressor will deliver 36.32 TR and consumes 46.72 BHP at $-10\text{ }^{\circ}\text{C}$ SST & $35\text{ }^{\circ}\text{C}$ SDT at 800 RPM.

From the above, you will notice a power saving of approx. 6.4%.

450XL Cut Away - Oil Flow



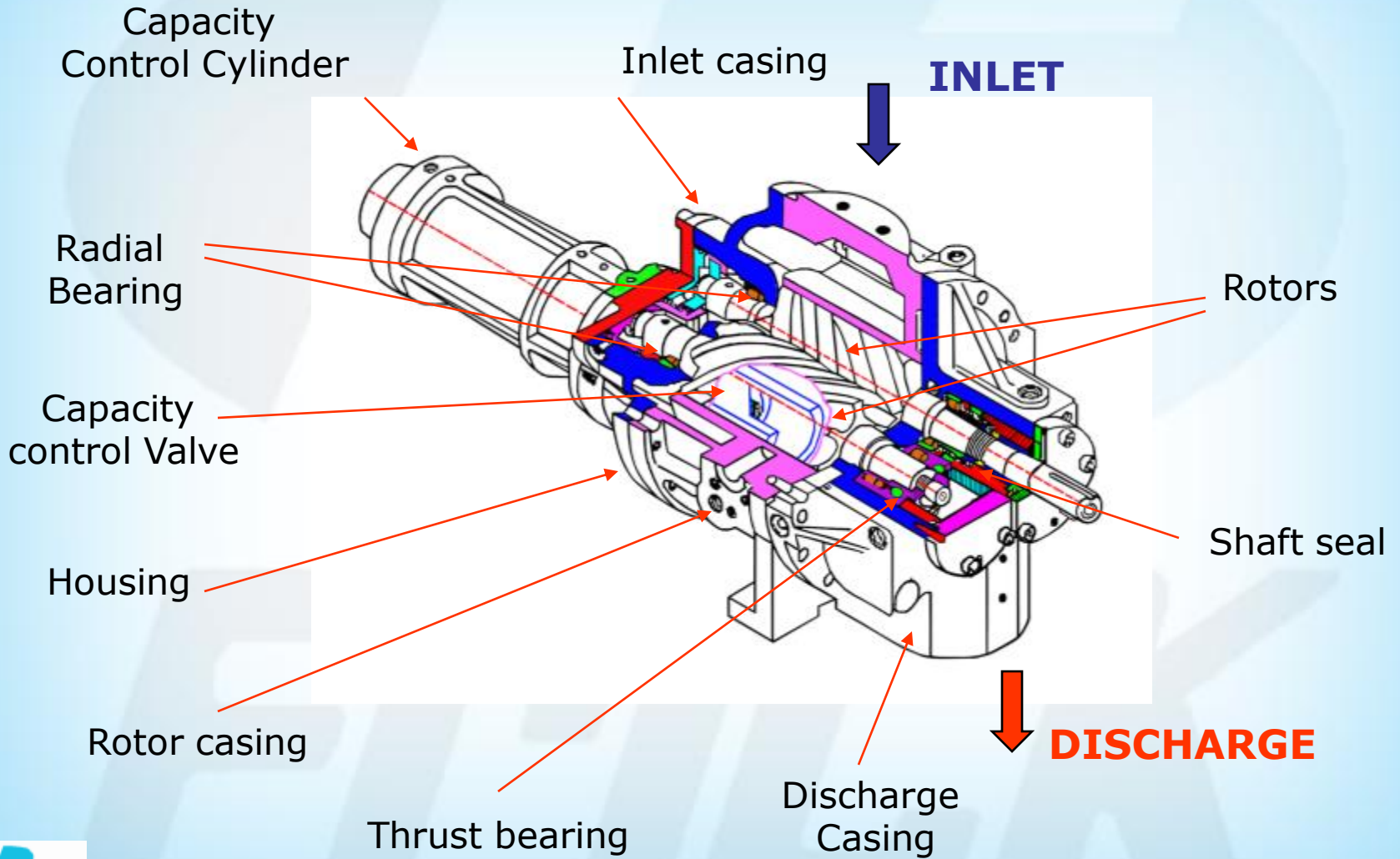
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Use of Screw Compressors in larger Dairy plants .

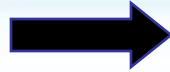
Now-a-days, all big dairy plants are replacing their existing (old) reciprocating compressors with screw compressor. We are recommending screw compressor for larger (refrigeration) capacity. Every one knows, screw compressor is best, less maintenance, mainly **POWER SAVING.** How the power is getting saved? Following are the reasons for power saving



Parts of Screw Compressor Block



Compression



Screw compressors are supplied with economizer, hence, sub cooled liquid (from outlet of economizer) shall be fed into evaporators (IBT, ACU, etc) instead of sending the warm liquid from receiver outlet. Hence, capacity of evaporator is economized (increased).

There are many moving parts, which require replacement due to wear and tear. The value mentioned in the capacity is for new compressor, over a period of (running) time the average power consumption would be higher compared to the table value.

As you know the reciprocating compressor can only be unloaded stepwise. I.e. in steps of 33%, 66% and 100%. In case of required capacity falling between steps, (for e.g. 70% approx) compressor would work at lower suction pressure (and temperature) and try to meet the required capacity.

At this condition, volumetric efficiency of the compressor is low and the power consumption is higher resulting in higher KW/TR. The effect of this phenomenon is that on a continuous utility plant such as yours, the compressor going to perform at other than design conditions for substantial duration resulting in higher KW / TR.

Reciprocating Compressors are belt driven and hence you should allow 3% for belt losses.

While comparing the same factors you would observe that screw compressor has no effect because of the following reasons:

No tolerance need to for Screw Compressor

There are no moving parts such as valves, piston, piston rings, etc in Screw Compressor

Screw Compressor can be unloaded or loaded from 10% to 100% (step-less). This means, if the capacity required by the plant is 69%, the compressor would operate precisely at this point and power consumption will be approx linear correspondingly.

Screw compressors are direct driven, hence not allowance need to be considered

Due to the above factors, minimum of 15-20% power penalty will be there for a reciprocating compressor over screw compressor

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For example, a reciprocating compressor will deliver 80.5 TR consumes 124.77bhp at -10 Deg C SST and 40 Deg C SDT at 930 RPM.

Whereas a screw compressor will deliver 80.5 TR and consumes 107.7 BHP at -10 Deg C SST and 40 Deg C SDT at 2950 RPM.

BHP/TR of reciprocating compressor	-	1.55
BHP/TR of screw compressor	-	1.33
Difference in KW/TR	-	0.16
Power saving $0.16 \times 80.5 \text{ TR} / 92\%$	-	14 KWH

So as per rating chart plus the other mentioned losses will atleast pessimestically add 15% totalling to 27kw

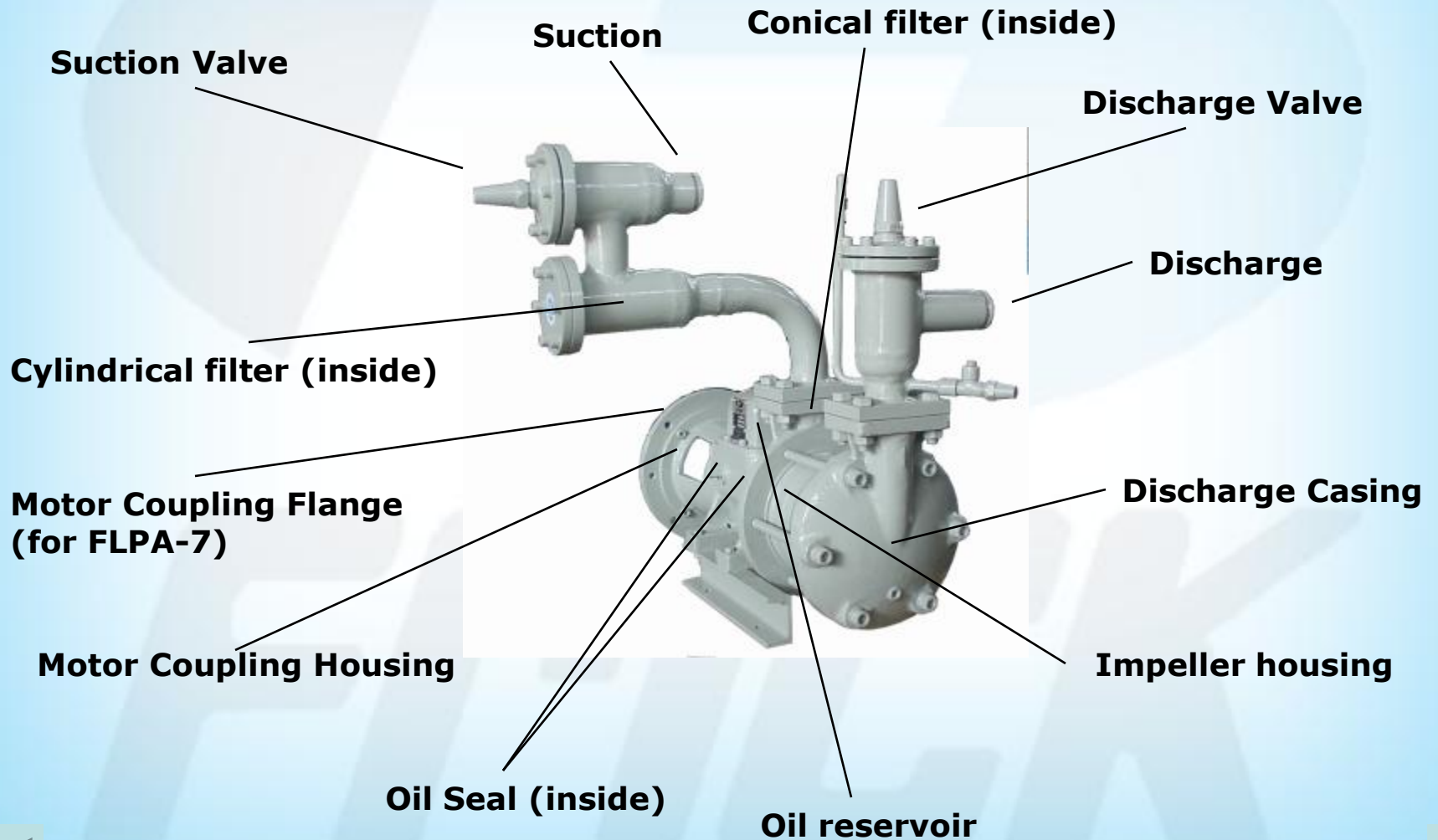
Power saving in a year- $27\text{KW} \times 20 \text{ Hrs} \times 350 \times 5 \text{rsdays}$ -RS9,45,000

Advantages of using Re-circulation System

- ❖ **Superb refrigerant distribution**
- ❖ **Lower inlet liquid temperature**
- ❖ **Cut down capital costs**
- ❖ **High system efficiency**
- ❖ **Reduced operating expenses**
- ❖ **Low maintenance**
- ❖ **Protection of compressors from liquid slugs**
- ❖ **Tremendous power saving in operation.**



Liquid Recirculation System



Features of PHE Chillers In Dairy Plant .

Now-a-days all the Dairies are incorporating the concept of Pre (PHE) Chiller and IBT combination i.e. return water from process will be pre chilled in the PHE chiller and fed into IBT for further chilling there by reducing the ice load In the above system, power saving will be enormous.

For milk chilling centers phe chillers without ibt system can be designed

PRE (Phe) Chiller

In a chilling centers , 20,000 liters of milk will be processed 4 Hours in the morning and 10,000 liters of milk will be processed in 2 Hours in the evening.

For a 5000 LPH milk process PHE chilled water flow of 12500 LPH shall be circulated with a temp range of 12 to 2 deg °C. 12 Deg C return water shall be chilled to 2 Deg C in a PHE chiller



For the above chilling, heat load works out to 50TR (approximately), a reciprocating compressor selected @ $-2\text{ }^{\circ}\text{C}$ SST & $40\text{ }^{\circ}\text{C}$ SDT delivers refrigeration capacity of 50 tr which consumes 53.5 BHP.

$$\text{BHP / TR} = 1.07$$

$$\text{Power consumption in 50TR x 1.07 BHP / TR x 6 Hours of Operation x .746} = 239 \text{ Units a day}$$

Equivalent IBT System

The BHP/TR of a reciprocating compressor for an IBT application at $-10\text{ }^{\circ}\text{C}$ SST & $40\text{ }^{\circ}\text{C}$ SDT will be 1.68.

$$\text{Total refrigeration capacity required per day} = 50 \text{ TR x 6. Hours} = 300 \text{ TR Per Day}$$

$$\text{Considering 20 Hours of operation} = 300\text{TR} / 20 \text{ hours} = 15 \text{ TR}$$

$$\text{BHP / TR @ } -10\text{ }^{\circ}\text{C} \text{ SST \& } 40\text{ }^{\circ}\text{C} \text{ SDT will be} = 1.55$$

$$\text{Power consumption} = 15 \text{ TR x 20 x 1.55 x .746} = 347 \text{ Units per day}$$

From saving of approx 45% with the above , you will notice a unit (power) Phe-Chiller system

Advantages of Evaporative Condensers over Open type Condensers

Evaporative condenser is a water conservation device and in effect, a condenser and a cooling tower combined into a single unit.

Most of the refrigeration plants in dairies are having open type atmospheric condensers, which mean indirectly getting affected by power penalty. Power penalty by way of running the make-up water pump continuously due to water wastage by splashing, high wind velocity etc.



Here we highlight the advantages of evaporative condensers

The space required will be very less. You can also place the condenser on terrace of plant room

Construction of sump tank for open type condensers will be costlier, whereas no sump is required for evaporative condenser.

Very often changing of valves are required in atmospheric condensers due to continuous drenching of vapour / liquid valves

For example for 80 TR refrigeration capacity atmospheric condenser will consume around 25% more power than evaporative condenser approximately.

80tr plant will require 16-20 stands consuming 10 hp

Equivalent evaporative condenser will need 6hp

Net savings of 2.98kw /75%- 3.97kwhx20hrs5rs x350days-rs1,38,950

Apart from water savings and your compressor savings

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Advantages of variable frequency drive

A **Variable Frequency Drive (VFD)** is a system for controlling the rotational speed of an alternating current (AC) electric motor by controlling the frequency of the electrical power supplied to the motor.

A Variable Frequency Drive is a specific type of adjustable-speed drive.

Operation of VFD Compared to Induction Motor:

The above device shall be provided for one pump, called as master pump. This pump will run continuously and the balance normal pumps shall be switched on/off automatically depending on the requirement of water flow. If the flow drops to minimal requirement then the above master pump changes its frequency automatically and meets the required flow. By running this system power is saved

Additional advantageous of VFD drive

When an induction motor is connected to a full voltage supply, it draws several times (up to about 6 times) its rated current. As the load accelerates, the available torque usually drops a little and then rises to a peak while the current remains very high until the motor approaches full speed.

By contrast, when a VFD starts a motor, it initially applies a low frequency and voltage to the motor. The starting frequency is typically 2 Hz or less.

Thus starting at such a low frequency avoids the high inrush current that occurs when a motor is started by simply applying the utility (mains) voltage by turning on a switch.

After the start of the VFD, the applied frequency and voltage are increased at a controlled rate or ramped up to accelerate the load without drawing excessive current. This starting method typically allows a motor to develop 150% of its rated torque while the VFD is drawing less than 50% of its rated current from the mains in the low speed range.










A VFD can be adjusted to produce a steady 150% starting torque from standstill right up to full speed.

Automation in Refrigeration Plant Operation.



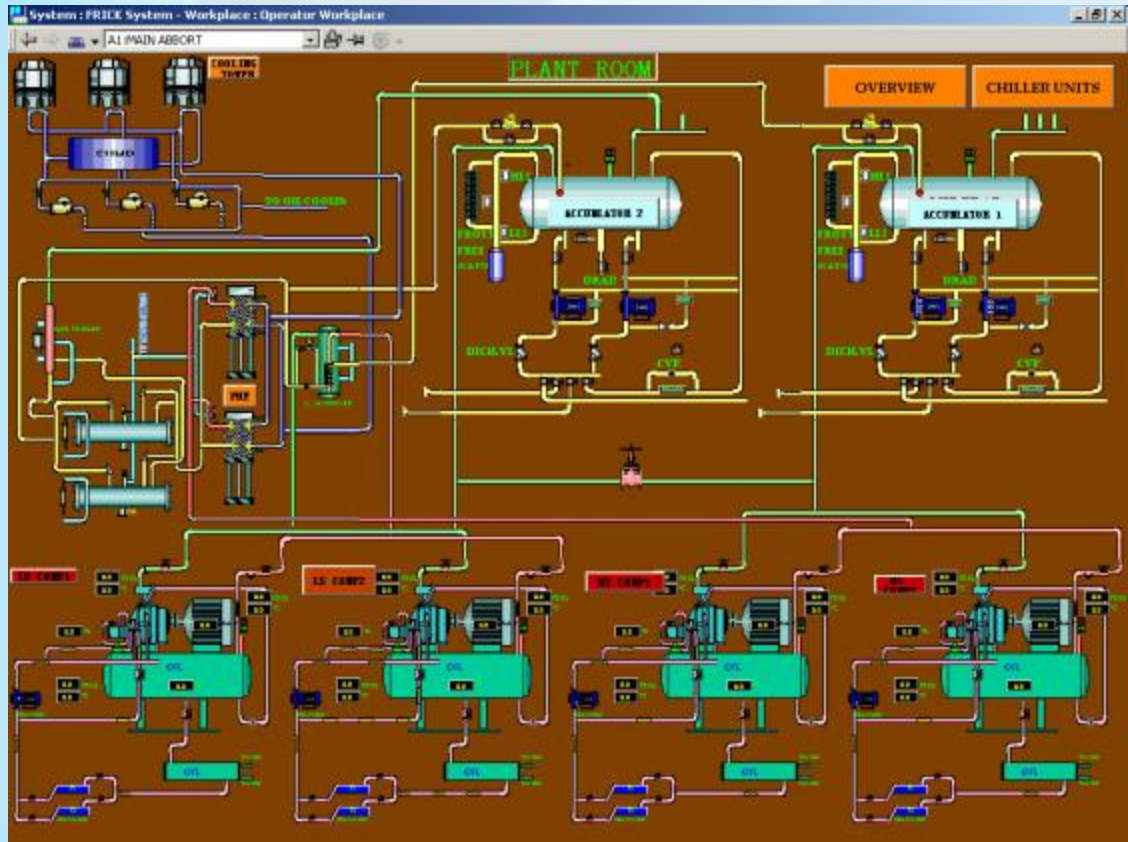
System: FRICK System - Workplace: Operator Workplace
Operator Workplace Plant Overview

PLANT MENU

 PLANT ROOM	 FAULT ANNUNCIATOR	 PLANT DATA SHEET
 MOTOR CONTROL	 TRIP ANNUNCIATOR	 COMP DATA SHEETS
 HOT GAS DEFROSTING	 TEMPERATURE TRENDS	 PRESSURE TRENDS

Frick India Ltd.
21.5 km, Main Mathura Road, Faridabad - 121 003

Total Plant Control. centralized temperature recorder and interlocking electric circuit for various process controls can be interlocked to your PC/PLC





***FRICK INDIA LTD.
OVERVIEW***

FRICK





Frick India Limited

- ❖ FRICK INDIA LIMITED was incorporated as a public limited company in 1962 in collaboration with Frick Company USA.
- ❖ Over the years Frick India has diversified and developed into one of the front ranking companies rated amongst the world's best.
- ❖ Frick India can provide you refrigeration equipment for almost all Industrial Refrigeration Applications.

Integrated production facility at Factory



New R&D Block



Compressor Assembly

- Administration
- In house R & D
- Engineering
- Pattern shop
- Foundry
- Machine shop
- Compressor Assembly
- Sheet metal fabrication
- Condensers & Coil Section
- Packaged air-conditioners wing
- Electrical control panels
- Plate freezer assembly
- Testing
- Stores and shipping wing.



Total Area of Factory :
Covered : 2,88,936 Sq. Ft.
Uncovered : 4,22,514 Sq. Ft.

In house staff : 488
Qualified Technical Personnel : 125
Technical Quality Control Personnel : 25
Skilled Technician : 338

CNC Machining



CNC Machining at Factory



In house Testing facility for Screw Compressors



Testing rig installed as per ISO 917:1989(E) standards.

Energy Efficient Equipments

**Two Stage Compressor Blocks
From MYCOM. Japan**



Evaporators for Cold rooms and Distribution Hall



Frigid Coil – FAFA Series



Frigid Coil – FATR Series

Condensers



Evaporative Condensers



Vertical Shell & Tube Condenser



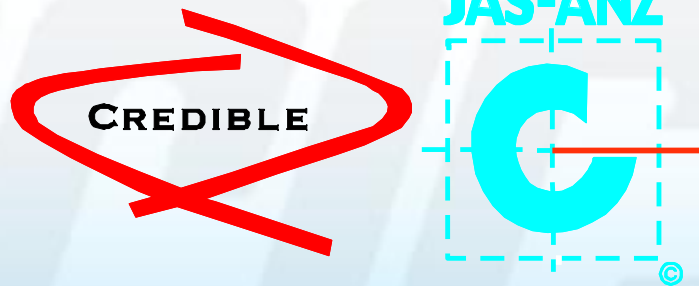
Horizontal Shell & Tube Condenser

Quality Certification

A pioneer in design, manufacture, installation and servicing of refrigeration and air-conditioning systems and equipment has achieved the certificate of assessment –

“Quality Management System ISO 9001:2000”

AN ISO 9001 : 2000

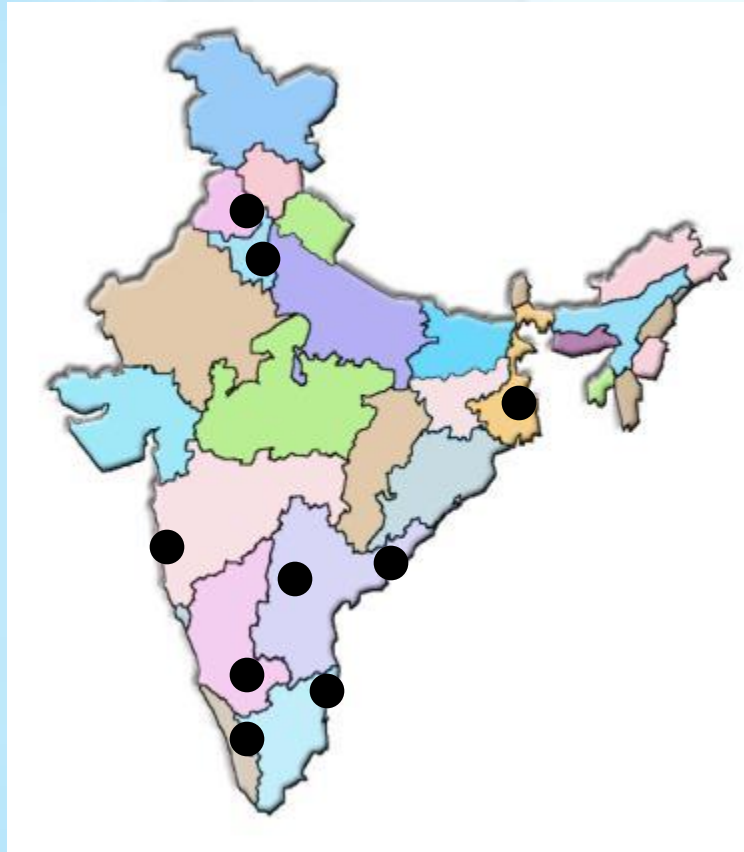


JAS-ANZ



CERTIFIED COMPANY

Frick India Service Network



- FARIDABAD-FACTORY
- DELHI (H.O.)
- MUMBAI
- CHANDIGARH
- CHENNAI
- SECUNDERABAD
- BANGALORE
- COCHIN
- KOLKATA
- VIZAG

All Branches are fully equipped to provide after sales services in their surrounding area within no time.



Prestigious jobs executed in Dairy & Ice Cream Industry with Overfeed system

- Baroda Dairy – Dairy – 360 TR
- Modern Dairies – Dairy – 250 TR
- Godhra Dairy – Dairy – 200 TR
- Devyani foods – Ice Cream – 180 TR



Devyani Foods



Godhra Dairy

Prestigious jobs executed

- Sumul Dairy, Surat – Dairy – 250TR
Expansion plant – 250TR
- Jalgaon Dairy – Dairy – 200TR
- Baroda Dairy, Sugam Unit – 200TR
- Mangalore Dairy – 150 TR
- Kwaliti Walls – Ice Cream – 50TR



Modern Dairy



Vadilal Industries



Prestigious jobs executed

- Macains Food – Food Processing – 363 TR
- Field Fresh – Multipurpose C/s – 260 TR
(BHARTI- WALLMART)
- Vadilal Industries Ltd. – 250 TR



Prestigious jobs executed

- Cadbury India Ltd – 300 TR * 6nos
- Barmalt India – Malt Processing – 500 TR
- Adani Wilmar Ltd – Vanaspati Cooling – 420TR
- Bhutan Breweries – Brewery – 200 TR
- Larsen & Tubro Ltd., Delhi – Concrete Cooling- 40 TR
- Devans Breweries Ltd, Rajasthan
- Som Breweries Ltd, Bhopal
- Empee Brewery, Chennai
- Privilege Industries Ltd, Pune



Barmalt India



J & K

Anantnag, Jammu, Leh, Srinagar.

Punjab

Amritsar, Bhatinda, Firozpur, Jalandhar, Khanna, Ludhiana, Mohali, Moga, Nangal, Pathankot, Patiala, Rajpura.

Chandigarh

Bassi, Chandigarh, Dera, Panchkula

Haryana

Gurgaon, Hissar, Kaithal, Kundli, Palwal, Panipat, Rohtak, Shahabad, Sirsa.

Gujarat

Ahmedabad, Anand, Barod, Deesa, Gandhinagar, Godhra, Himmatnagar, Jamnagar, Junagarh, Mehiana, Navapalli, Okha, Palanpur, Porbandar, Rajkot, Surat, Valsad.

Rajasthan

Ajmer, Alwar, Balotra, Banswara, Bharatpur, Bikaner, Bhilwara, Jaipur, Jaisalmer, Jodhpur, Kota, Sri Ganganagar, Udaipur.

Maharashtra

Akola, Aurangabad, Bhusawal, Jalgaon, Kolhapur, Mumbai, Nagpur, Nasik, Pune, Ratnagiri, Satara, Sholapur, Wardha.

Kerala

Alleppey, Alwaye, Calicut, Cannanore, **Cochin**, Ernakulam, Kollam, Kottayam, Kozhikode, Trichur, Trivandrum,



Uttar Pradesh

Agra, Allahabad, Aligarh, Amroha, Badaun, Ballia, Bareilly, Bulandshar, Etawah, Farukabad, Fatehpur, Ghaziabad, Gorakhpur, Hardoi, Haridwar, Jhansi, Kanpur, Khurja, Lucknow, Mathura, Meerut, Mirzapur, Noida, Obra, Rai-Bralley, Saharanpur, Shikohabad, Unchahar, Unnao, Varanasi.

Bihar

Patna, Darbhanga, Samastipur, Muzaffarpur, Arrah, Purnia, Gaya

Jharkhand

Bokaro, Dhanbad, Jamshedpur, Ranchi,

Orissa

Balasure, Bhubaneshwar, Bolanji, Cuttack, Jeypore, Puri, Rayagada, Rourkela, Sambalpur,

West Bengal

Burdwan, **Calcutta**, Durgapur, Farraka, Haldia, Purulia.

Chhattisgarh

Ambikapur, Bhilai, Bilaspur, Durg, Jagdalpur, Korba, Rajgarh

Karnataka

Bangalore, Bellary, Belgaum, Bijapur, Birur, Dharwar, Gulbarga, Karwar, Kolar, Kundapura, Mangalore, Mysore, Raichur, Shimoga, Shimoga, Udipi.

Tamilnadu

Chennai, Coimbatore, Cuddalore, Erode, Karur, Karaikol, Krishnagiri, Madurai, Neyreli, Pondicherry, Pudukottai, Rameshwaram, Salem, Tiruchirapalli, Tirunelveli, Tiruvannamalai, Tuticorin, Vellore, Villupuram.

Andhra Pradesh

Adilabad, Anantapur, Bhimavaram, Cuddapah, Eluru, Guntur, Guntakal, **Hyderabad**, Kakinada, Karimnagar, Kolhagudem, Kovur, Kurnool, Machillipatnam, Nandyal, Nellore, Rajamundri, Srikakulam, Vijayawada, **Vizag**, Vizianagram, Warangal,

Madhya Pradesh

Bhopal, Chhindwara, Guna, Gwalior, Indore, Itarsi, Jabalpur, Khandwa, Nagda, Panchmari, Satna, Singrauli, Ujjain, Vindhyanagar.

Thank you

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