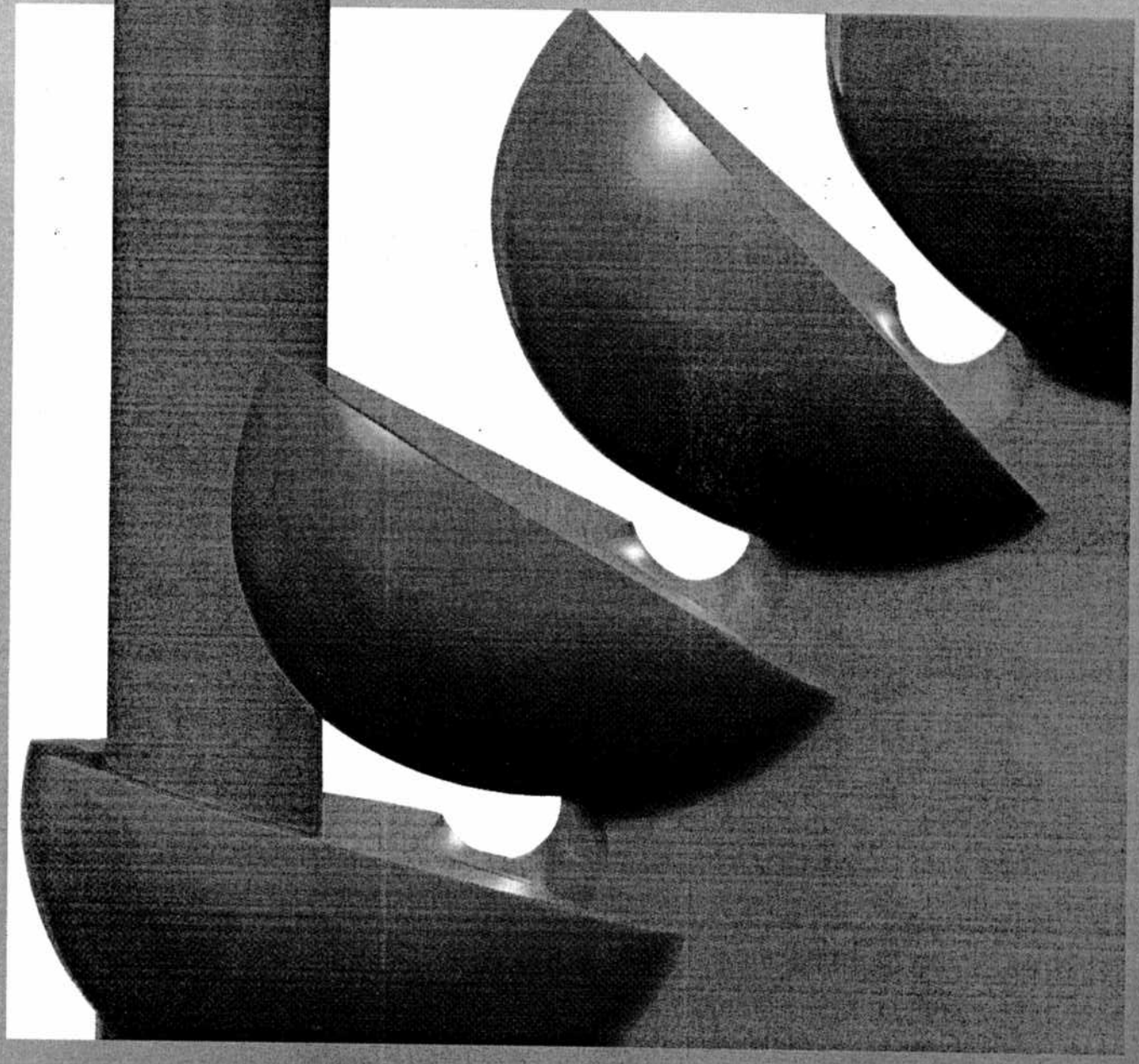
CALDER

PELTON WHEEL ENERGY RECOVERY TURBINES



CALDER ENERGY RECOVERY TURBINE

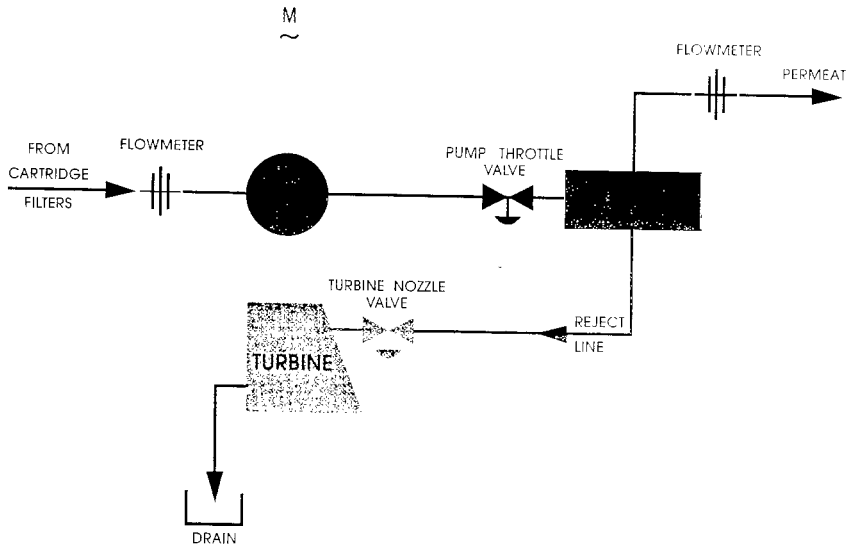


Diagram of a Centrifugal Pump with Pelton Wheel Energy Recovery Turbine

Today, over 600 turbines later, Calder is revolutionising the reverse osmosis industry again... With the introduction of a new range of energy recovery turbines that deliver higher power output at greater efficiency than ever before.

It is the energy recovery turbine that leads the industry in efficiency, dependability, durability and low maintenance cost. Our 3 year warranty demonstrates our confidence.

In keeping with the Calder tradition of leadership in energy recovery technology, the new series of turbines have been designed to maximise efficiency and reduce cost without compromising quality.

Building on over 20 years of experience supplying energy recovery turbines to the RO industry, we have achieved a radical improvement in turbine rotor design, enhanced accessibility for inspection and maintenance by building all turbines with a horizontally split housing, and reducing the weight and cost on machining up to 100 m^3/h with the introduction of non-metallic casings.

When you consider all of the factors, you'll find that no one has the combination of innovation and dependability that you will get with a Calder energy recovery turbine.

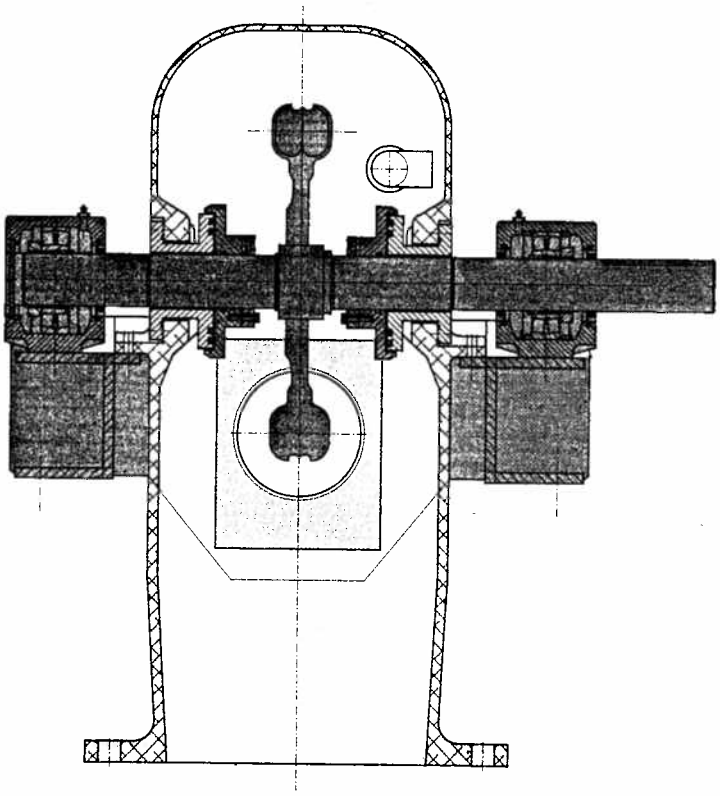
PRINCIPLE

The Calder system takes advantage of the high pressure energy which remains in the concentrate (brine) from the reverse osmosis process. The high pressure concentrate is fed into the Calder Pelton wheel hydraulic impulse turbine which then produces rotating power output used to assist the main electric motor in driving the high pressure pump. This concept allows a smaller, less costly motor to be utilised and saves a very considerable proportion of the power and, therefore, cost necessary to drive the pump.

The system is very easy to operate with only one control, comprising the adjustable input nozzle of the turbine, needed to set and maintain the required operating pressure. The plant is started up with the nozzle fully open and the pressure requirement of the system is achieved by gradually closing the nozzle using the hand-wheel or servo motor. The nozzle directs the jet of high pressure concentrate onto the bucket type blades of the Pelton wheel causing the wheel and shaft assembly to rotate. The design of the Pelton wheel and nozzle is optimised to ensure that almost all the kinetic energy of the jet is transferred into rotating mechanical energy enabling the turbine to operate at high efficiency with the liquid brine being discharged at atmospheric pressure. The Pelton wheel turbine can be direct coupled to motors or pumps at speeds up to 3600 R.P.M. For reciprocating plunger pump installations a V-Belt drive is often the most effective. Although larger turbines are available for higher duties and brackish water applications, six sizes of turbines cover the great majority of reverse osmosis applications where energy recovery is required. Turbines operate to following flows:

Model	Flow m^3/h (USGPM)	Max. Power Recovered (KW)
RO-290-40	30 (130)	55
RO-290-65	50 (220)	90
RO-310-65	100 (440)	180 direct drive, (130 V-Belts)
RO-350-65	100 (440)	180 direct drive, (130 V-Belts)
RO-350-80	180 (800)	380 direct drive, (250 V-Belts)
RO-350-80-2	320 (1400)	500 direct drive
RO-350-100-2	500 (2200)	1000 direct drive

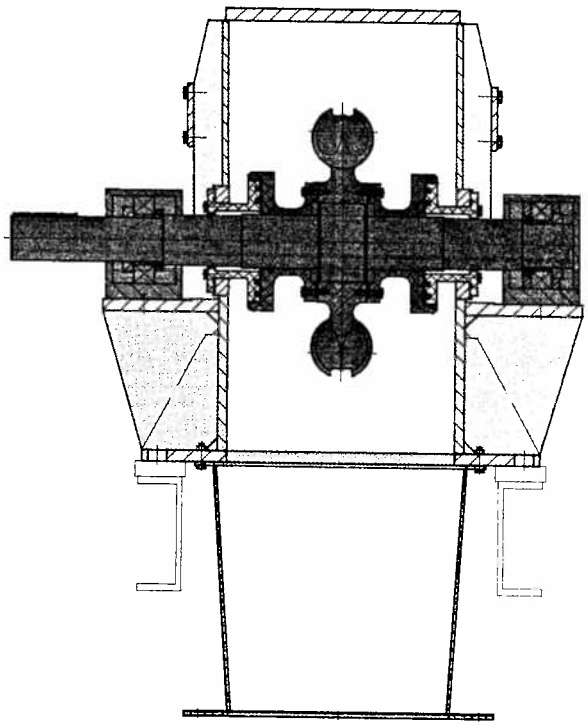
DESIGN FEATURES



Cross Section
RO-290-65/310-65/350-65

1. Totally Sealed, non-metallic Casing
2. Horizontal Split Case Design
3. External Taper Roller Bearing
4. Integrated Double Labyrinth Seals
5. Integrated Discharge Flange, ANSI and DIN
6. Victaulic Inlet connection
7. Precision cast Duplex Stainless Steel Pelton Wheel
8. New +High Efficiency + Calder Hydraulic Design

Cross Section
RO-350-80/350-100



1. Horizontal Split Case Design
2. Duplex Stainless Steel Casing
3. External Taper Roller Bearing
4. Integrated Double Labyrinth Seals
5. Integrated Discharge Flange, ANSI and DIN
6. Flanged Inlet connection
7. Precision cast Duplex Stainless Steel Pelton Wheel
8. New + High Efficiency + Calder Hydraulic Design

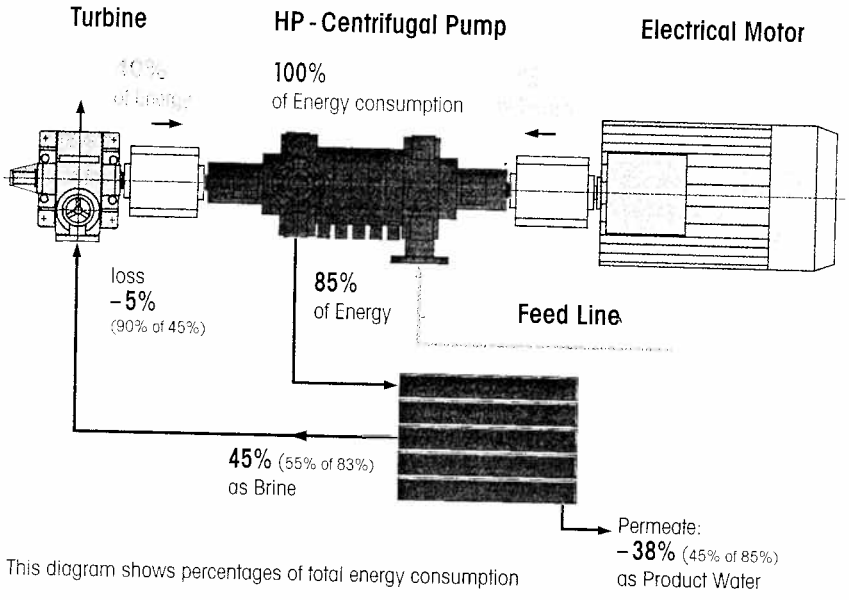
ENERGY SAVING

To illustrate the energy recovery and saving possible with the Calder system on a typical seawater desalination plant, the following example is taken:

Plant to give 3000 m^3/day of fresh water with 45 percent membrane conversion rate and operating pressure of 70 BARG.

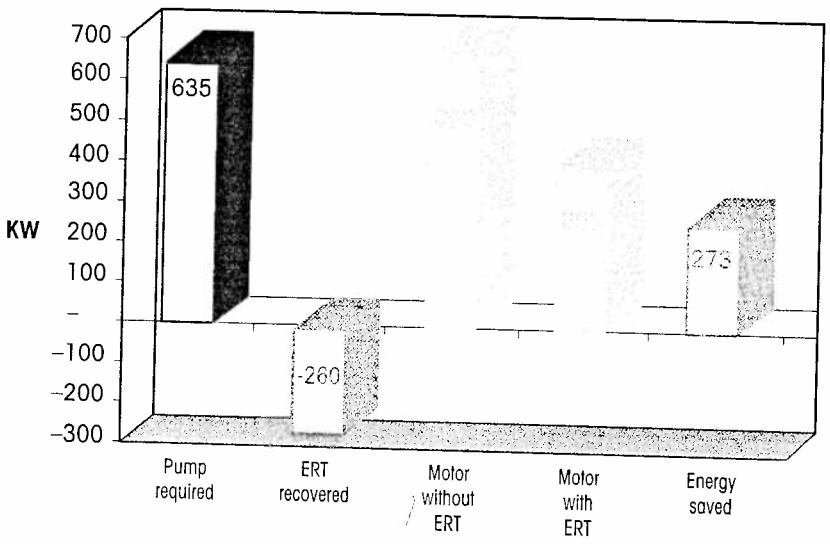
ENERGY BALANCE DIAGRAM:

Membrane conversion: 45%
HP-Pump efficiency: 85%
Recovery Turbine efficiency: 90%



This diagram shows percentages of total energy consumption

ENERGY BALANCE



Volume of seawater required from high pressure pump:

$$\frac{3000 \times 100 \times 1000}{45 \times 24 \times 60} = 4630 \text{ litres/min (1223 USGPM)}$$

Power required to drive the pump (assume 85 percent pump efficiency):

$$\frac{4630 \times 70}{600 \times 0{,}85} = 635 \text{ KW (847 HP)}$$

Volume of concentrate (brine) available for turbine:

$$\frac{4630 \times 55}{100} = 2546 \text{ litres/min (673 USGPM)}$$

Assuming pressure of concentrate (brine) at turbine nozzle is 68 BARG and turbine efficiency of 90%, the power output from the turbine is:

$$\frac{2546 \times 68 \times 0{,}90}{600} = 260 \text{ KW (346 HP)}$$

Therefore the power to be provided by the electric motor is:

635 – 260 = 375 KW (500 HP)

Proportion of total pump energy recovered by the turbine:

$$\frac{260 \times 100}{635} = 40{,}9\ \%$$

Assuming a cost of electricity at US$ 0,10 per unit (Kwh) and that the electric motor operates at an efficiency of 95 percent, the Calder energy recovery system in this particular example would show a direct saving on operating costs of:

$$\frac{260 \times 0{,}10}{0{,}95} = \text{US\$ } 27{,}37 \text{ per hours}$$

Assuming an operating factor of 95% the cost caving per year will be

27,37 x 24 x 365 x 0,95 =

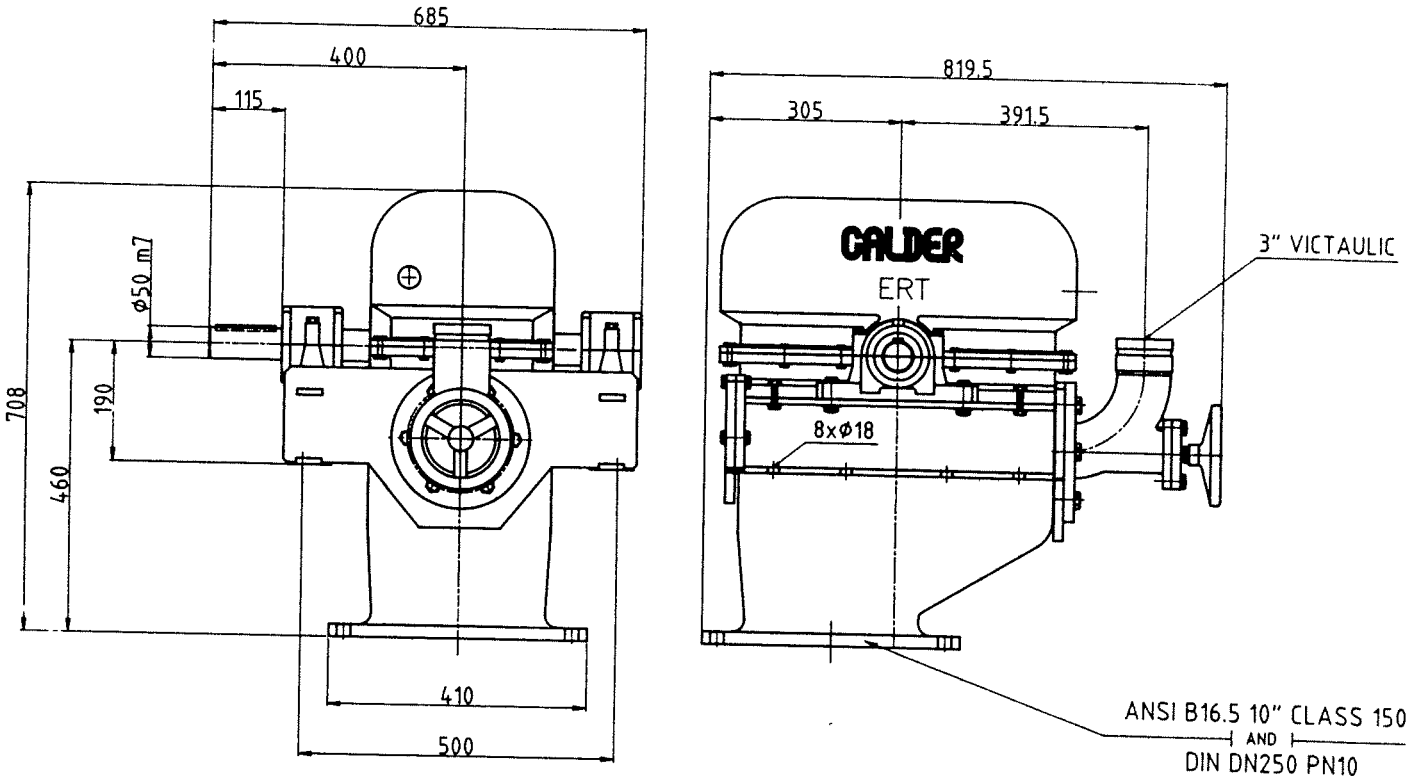
US$ 227,760.00

ENERGY RECOVERY TURBINE MODEL RO-290-65

Dimensions

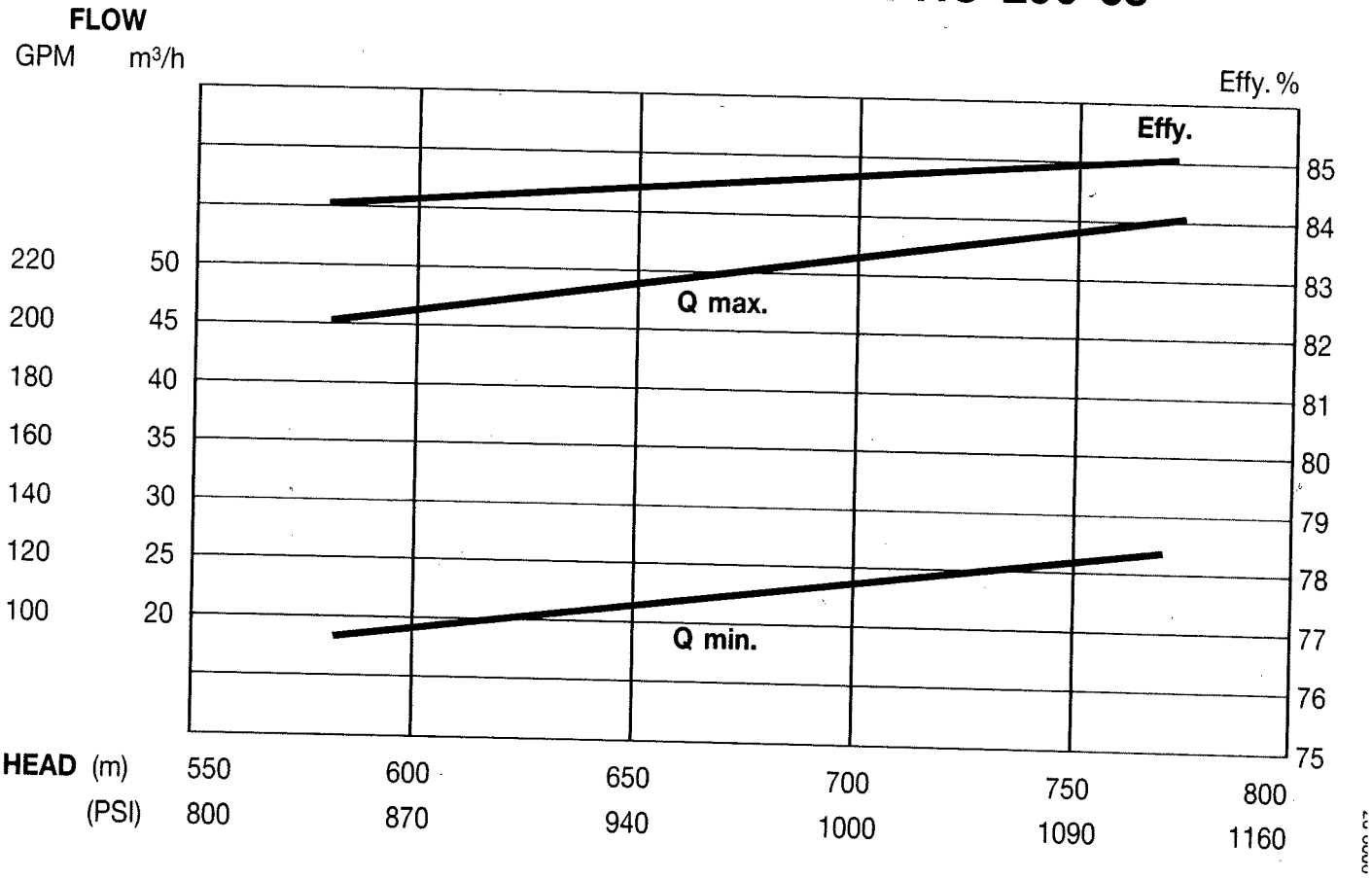
Data Sheet RO-290-65

DIMENSIONS IN (mm)

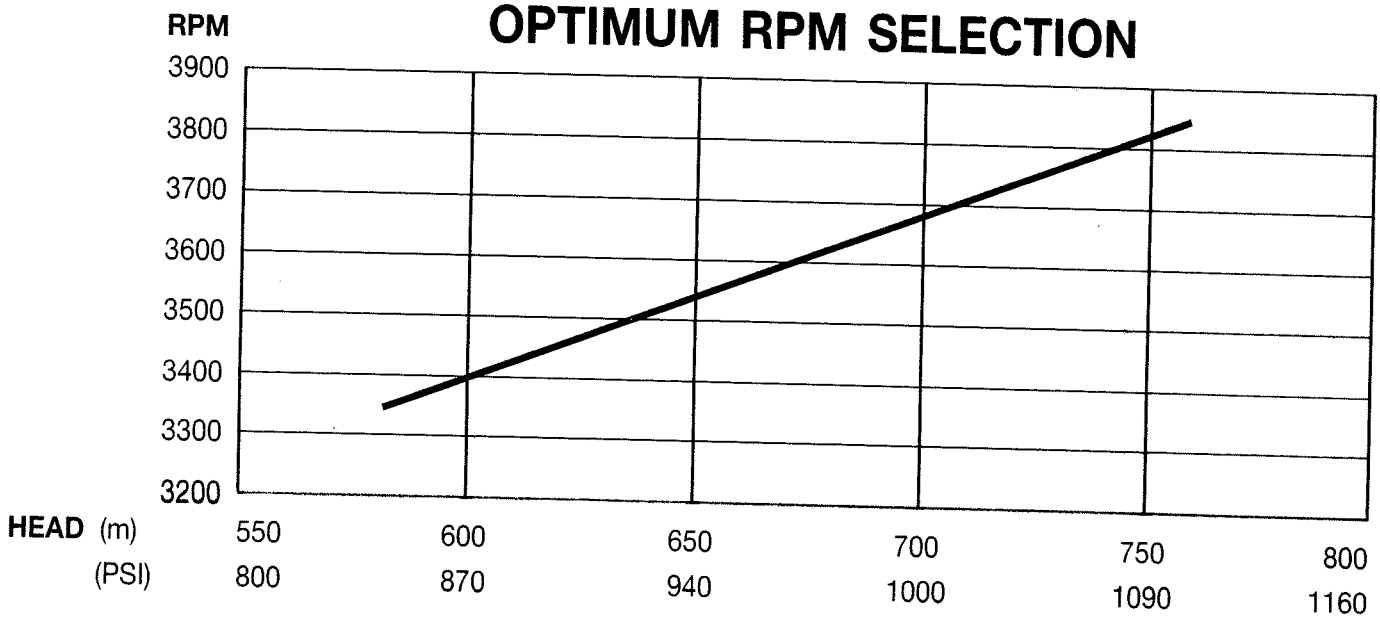


Inlet connection may be rotated in any 90 degree position.

PERFORMANCE CURVE RO-290-65



OPTIMUM RPM SELECTION



SELECTION EXAMPLE

Assuming a brine pressure of 650 m head. Follow vertical line to point where it intercepts efficiency line. Read value on right side i.e. 84,5% percent.
On RPM selection follow vertical line to point where it intercepts RPM line. Read value on left side, i.e. 3550 RPM.
Turbine discharge must be to atmosphere and unobstructed.

MATERIALS

HOUSING	GRP (Fibreglass)
SHAFT	Duplex
WHEEL	Duplex
LABYRINTH	EPDM (Non-metallic)
INLET NOZZLE VALVE	Duplex
NOZZLE	Stainless Steel
NEEDLE	Stainless Steel
NEEDLE SEAL	PTFE
NEEDLE GUIDE	Duplex
OUTLET FLANGE	Din DN 250 PN 10 AINSI B16.5 10" CLASS 150
INLET CONNECTION	3" Victaulic
BEARING GREASE	Shell Alvania R3 or equiv.
MAX. POWER OUTPUT, v-belt drive	90 KW
MAX. R.P.M.	4000
APPROXIMATE SHIPPING WEIGHT	120 KG (260 LBS.)

CALDER AG

ACC. NO. SCES 012

ISO 9001

CALDER AG
Industrie Nord
CH-5704 Egliswil
Switzerland
Tel. +41 62 769 60 60
Fax +41 62 769 60 70

CALDER LIMITED
Gregory's Bank
Worcester WR3 8AB
England
Tel. No. +44 1905 723255
Telefax +44 1905 723904