

INTRODUCTION TO PRISM MEMBRANE N₂ SYSTEMS

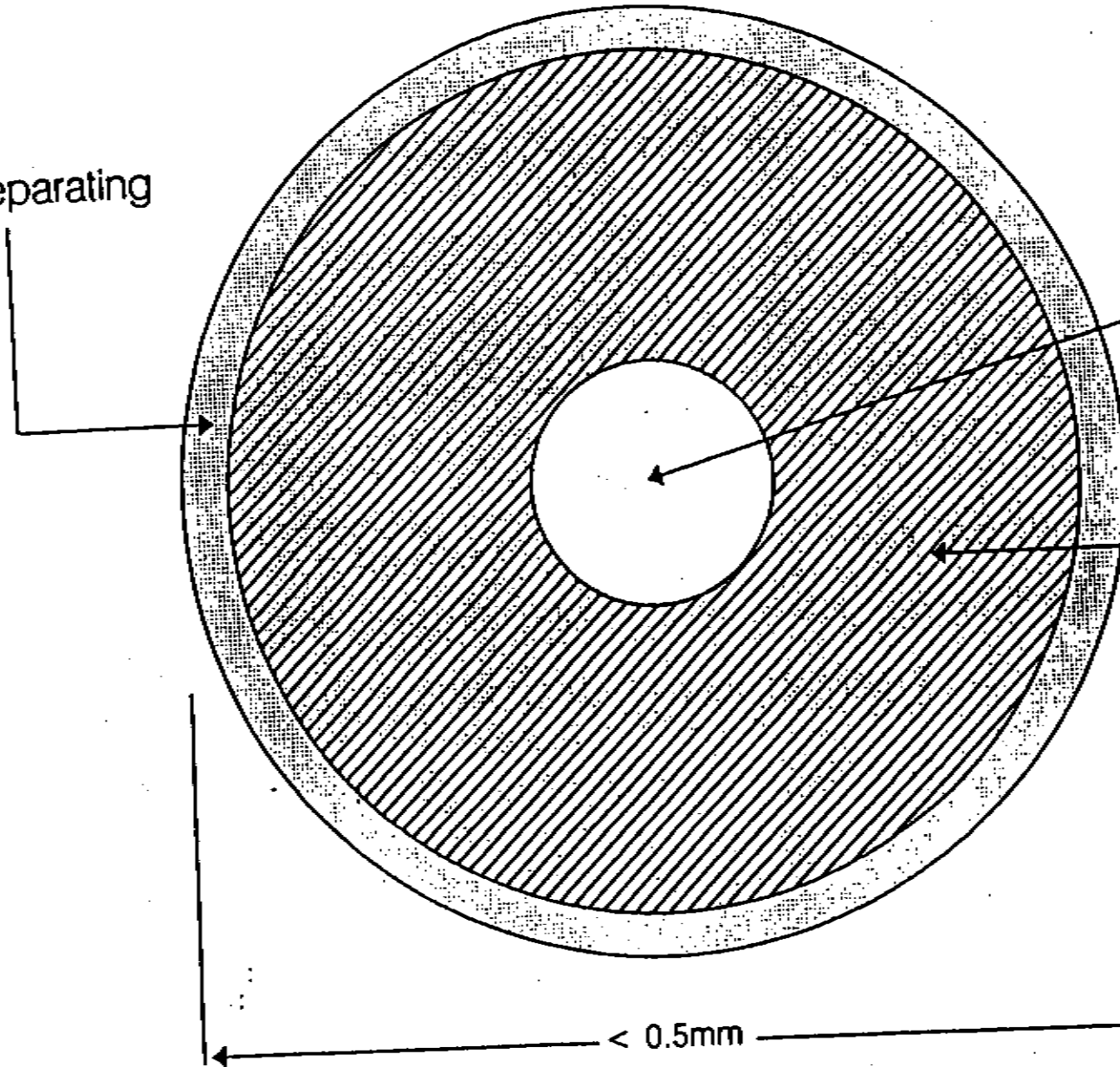
- FIBER
- SEPARATORS
- SYSTEMS

FIBER

- PROPERTY - PERMEATION
- MATERIAL - POLYSULFONE
- CONFIGURATION - HOLLOW FIBER

Cross Section of Hollow Membrane Fiber

Outer Wall
- does all separating



Hollow Bore

Polysulfone Support
Structure

< 0.5mm

Permeability Discussion

D_i - diffusion coefficient - measures how rapidly the gas, i , can travel through the membrane polymer

S_i - solubility constant - measures ability of gas, i , to "dissolve" in membrane polymer

P_i - permeability coefficient - relative measure of how fast the gas, i , permeates the membrane fiber

$$P_i = S_i \times D_i$$

As D_i or S_i increases, P_i increases

Permeability Discussion (contd.)

Q_i - flux - flowrate of gas i that permeates membrane wall

$$Q_i = \frac{P_i}{L} (\text{PRESS}_{i,\text{inside}} - \text{PRESS}_{i,\text{outside}}) A$$

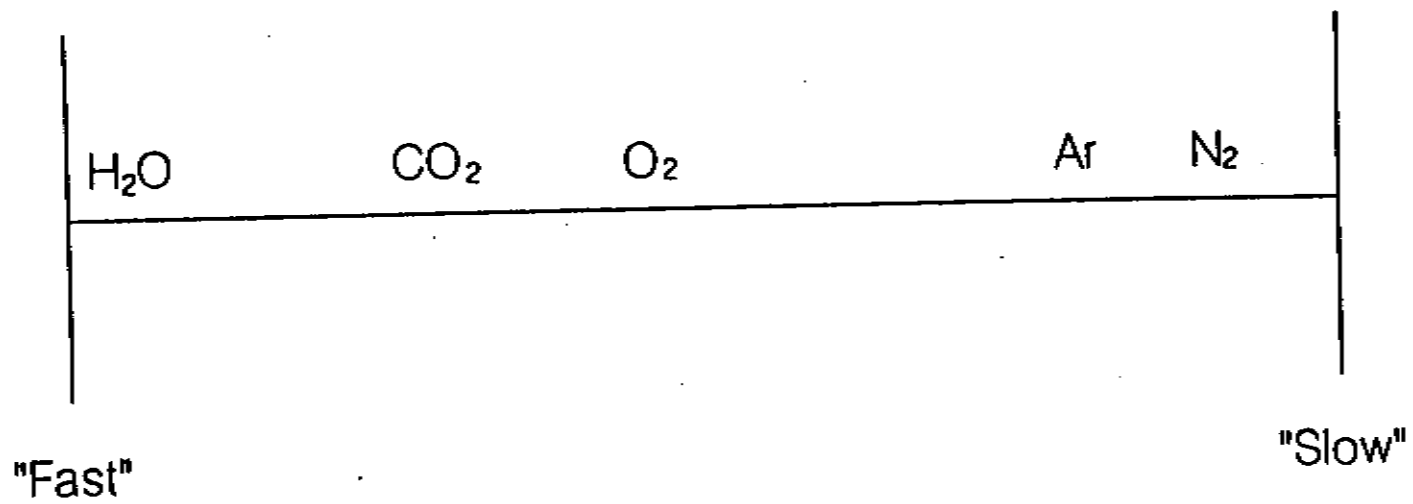
L - outer wall thickness of membrane fiber

$\text{PRESS}_{i,\text{inside}}$ - partial pressure of gas inside fiber bore

$\text{PRESS}_{i,\text{outside}}$ - partial pressure of gas outside fiber

A - fiber surface area

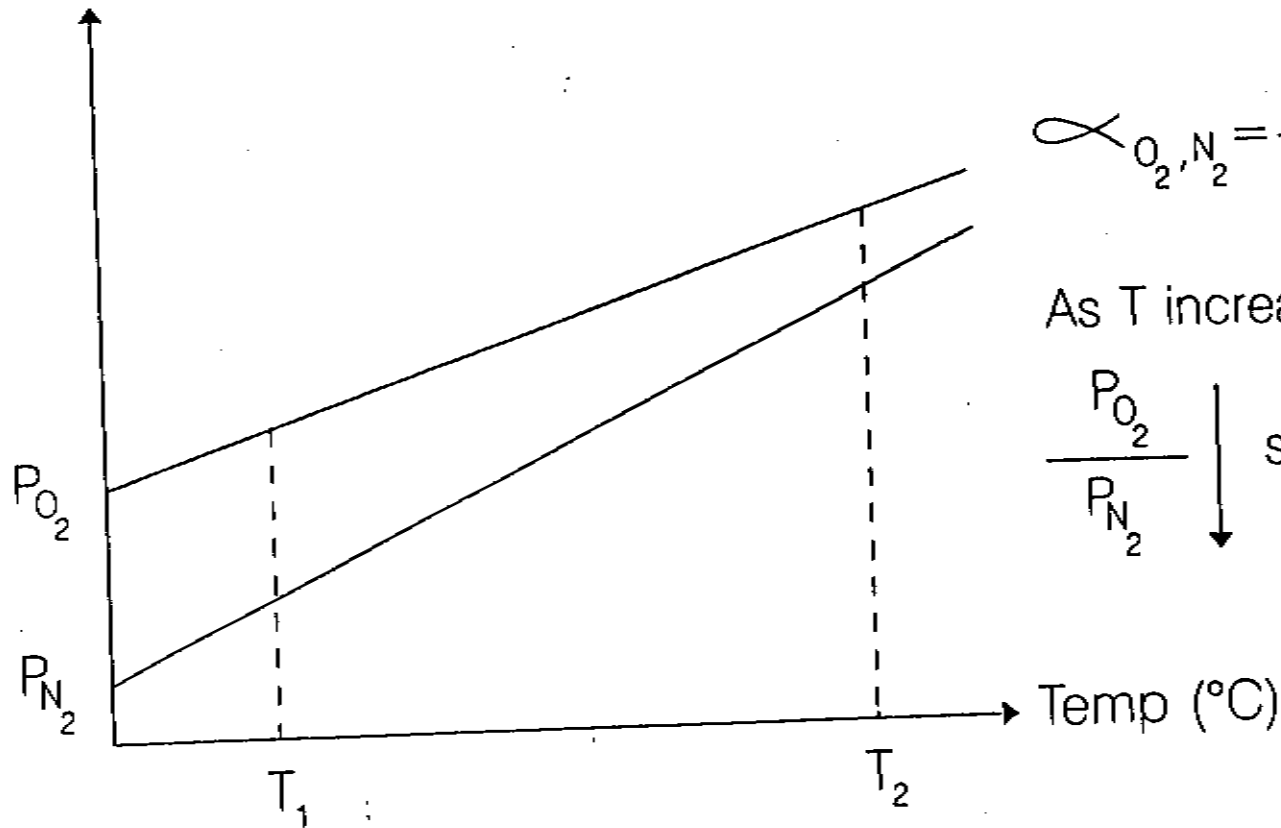
Relative Permeability Rates



SEPARATION FACTOR

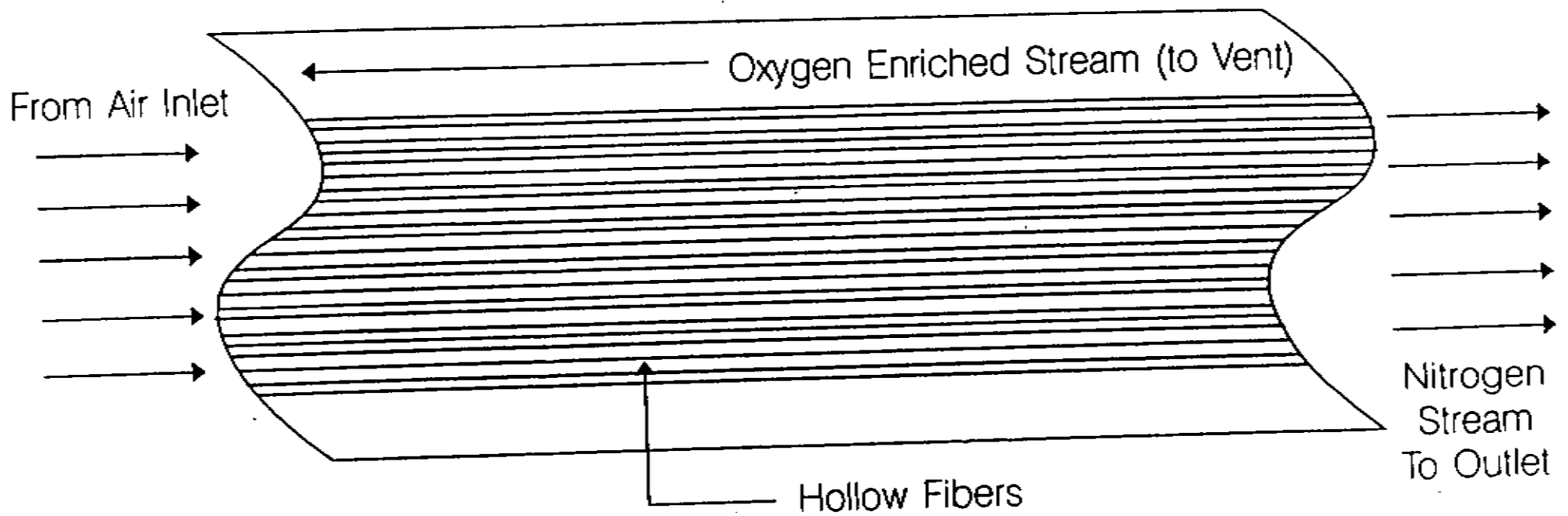
- INDICATION OF SEPARABILITY OF TWO COMPONENTS
- COMMONLY REPRESENTED BY " α " (ALPHA)
- $\alpha = \frac{P_{O_2}}{P_{N_2}}$

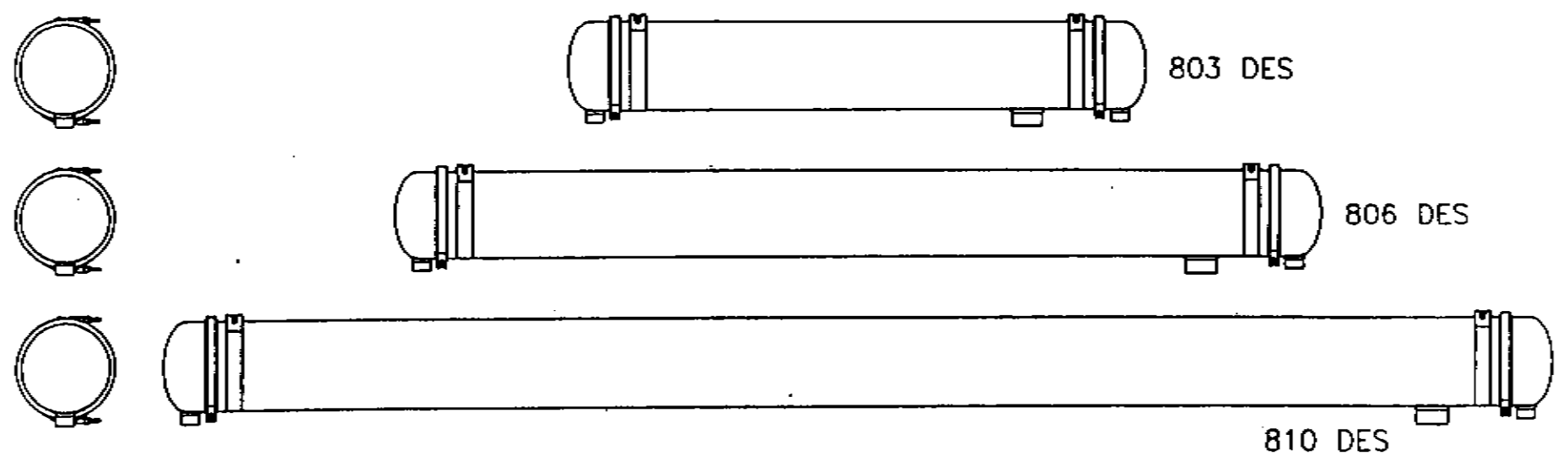
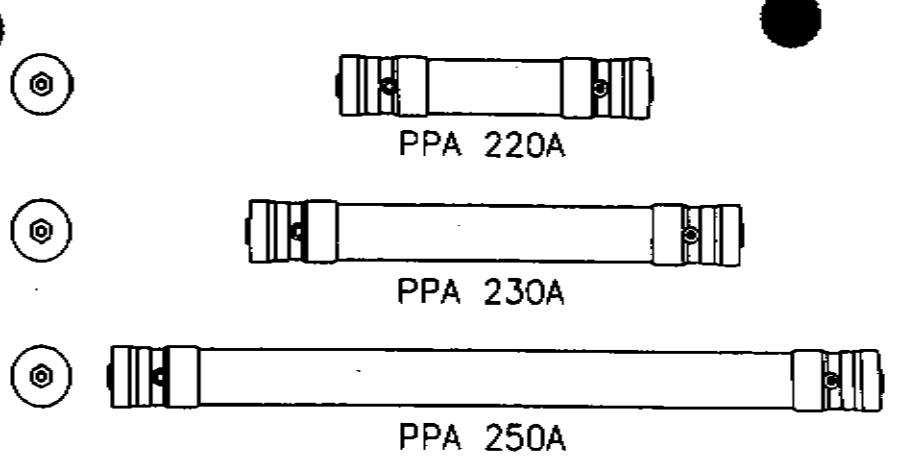
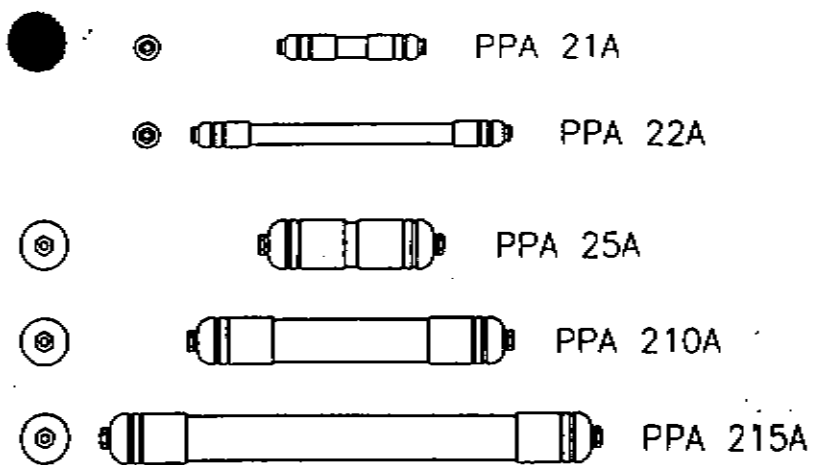
Permeability Coefficients vs. Temperature



As the operating temperature increases, the membrane becomes less "selective" between oxygen and nitrogen. The rates at which both gases permeate the membrane increase, but more so for nitrogen.

Air Flow Through Membrane Separator





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DRAWN: KMJ	6/16/94	APPROVE: WAU	6/16/94
UNLESS OTHERWISE NOTED: ALL DIMENSIONS IN INCHES. ALL MACHINED SURFACES TO BE: ϕ ✓ TOLERANCES: X.XX ± 0.010 X.XXX ± 0.005 ANGLES: ± 0.5° BREAK SHARP EDGES.		THIRD ANGLE PROJECTION	

PERMEA

PROJECT PPA
TITLE SEPARATOR SIZE COMPARISON CHART

MATERIAL: N/A
NO. REQ'D: 1 | SCALE: 1:16 | SHEET 1 OF 1

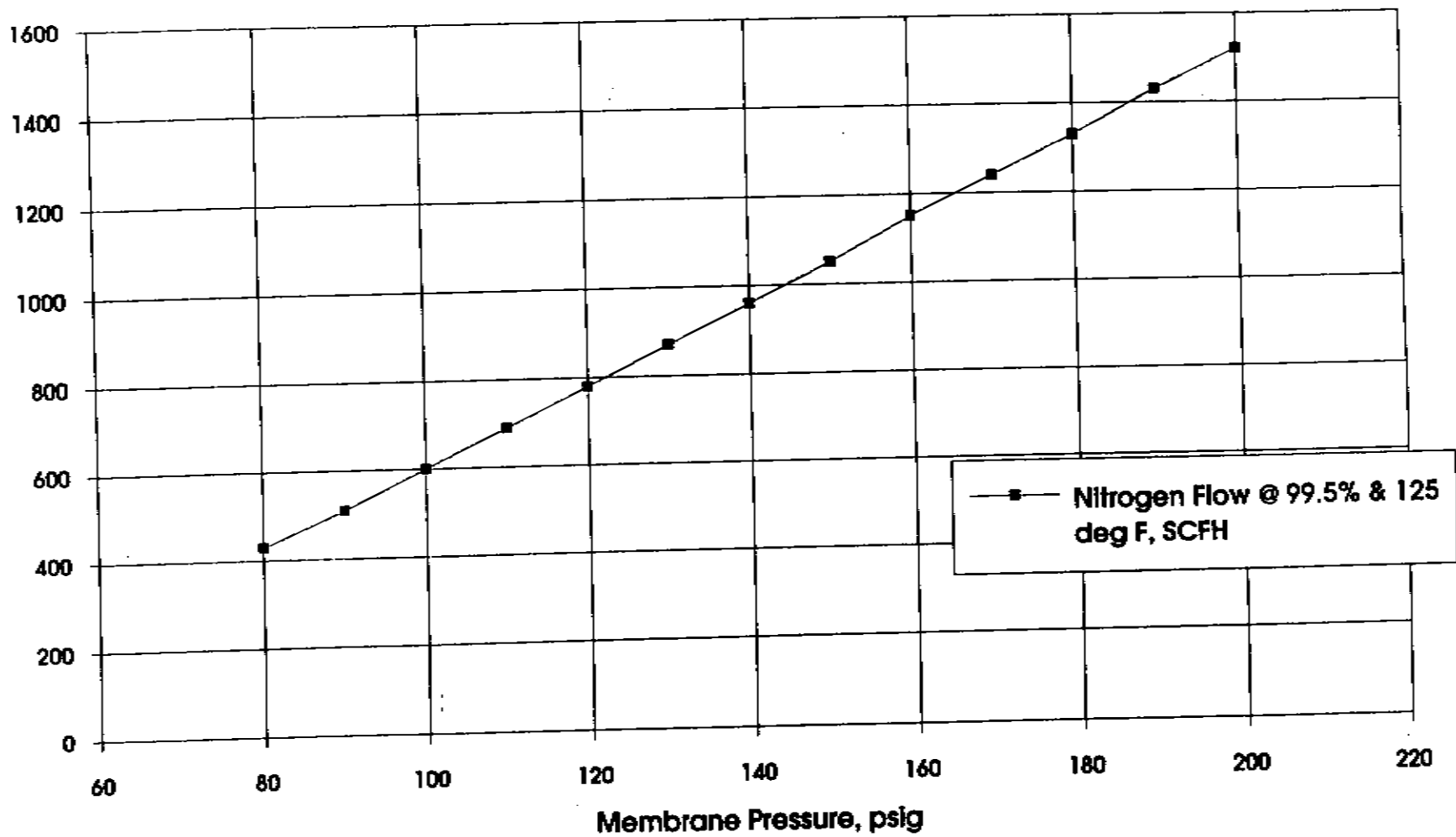
DWG SIZE A | DRAWING / PART NO. 2965-00-01 | REVISION 3

REV	DESCRIPTION OF CHANGE	BY	DATE	APP
3	NONE	KMJ	3/3/95	LA
	REVISE TITLEBLOCK			

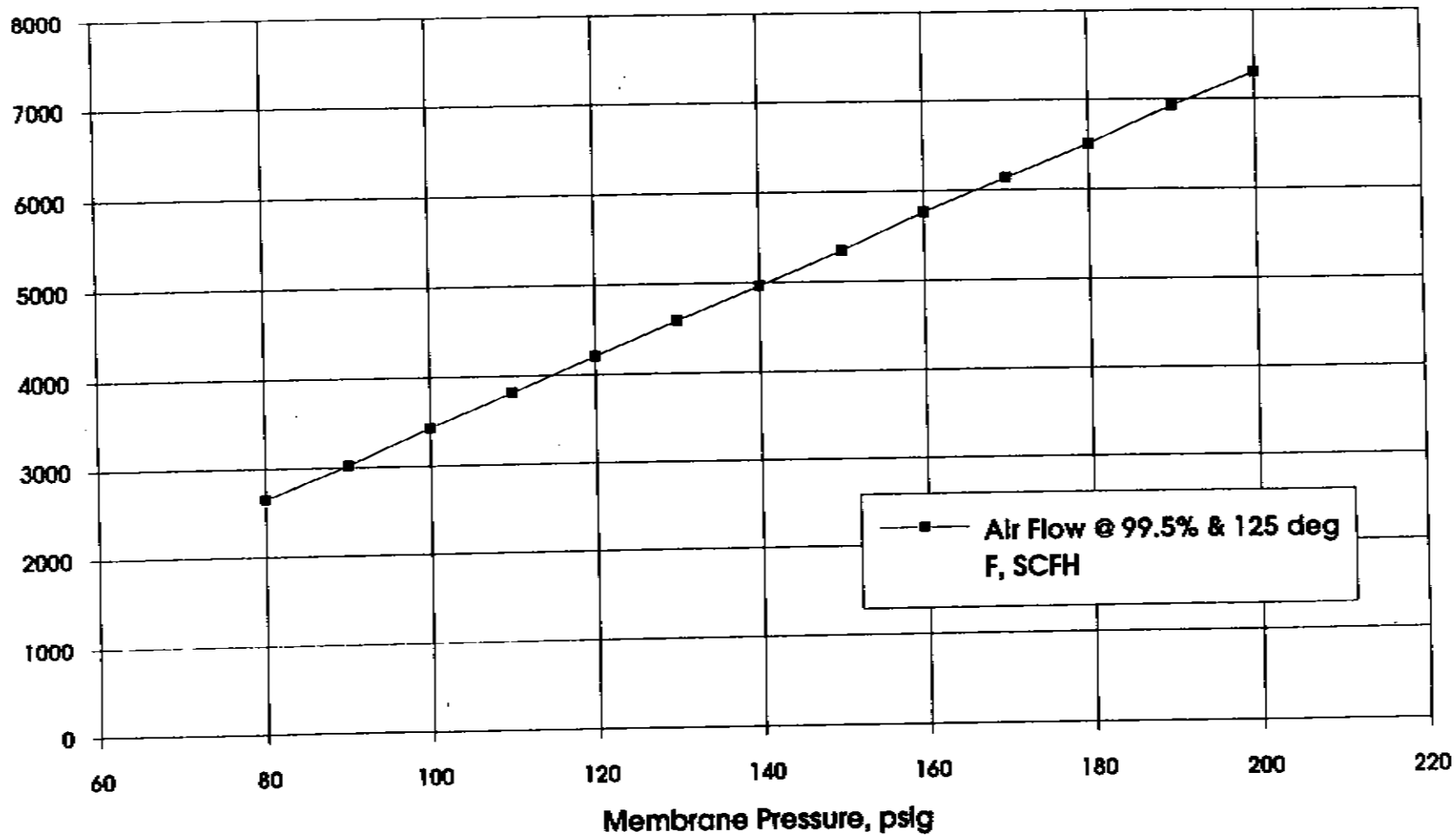
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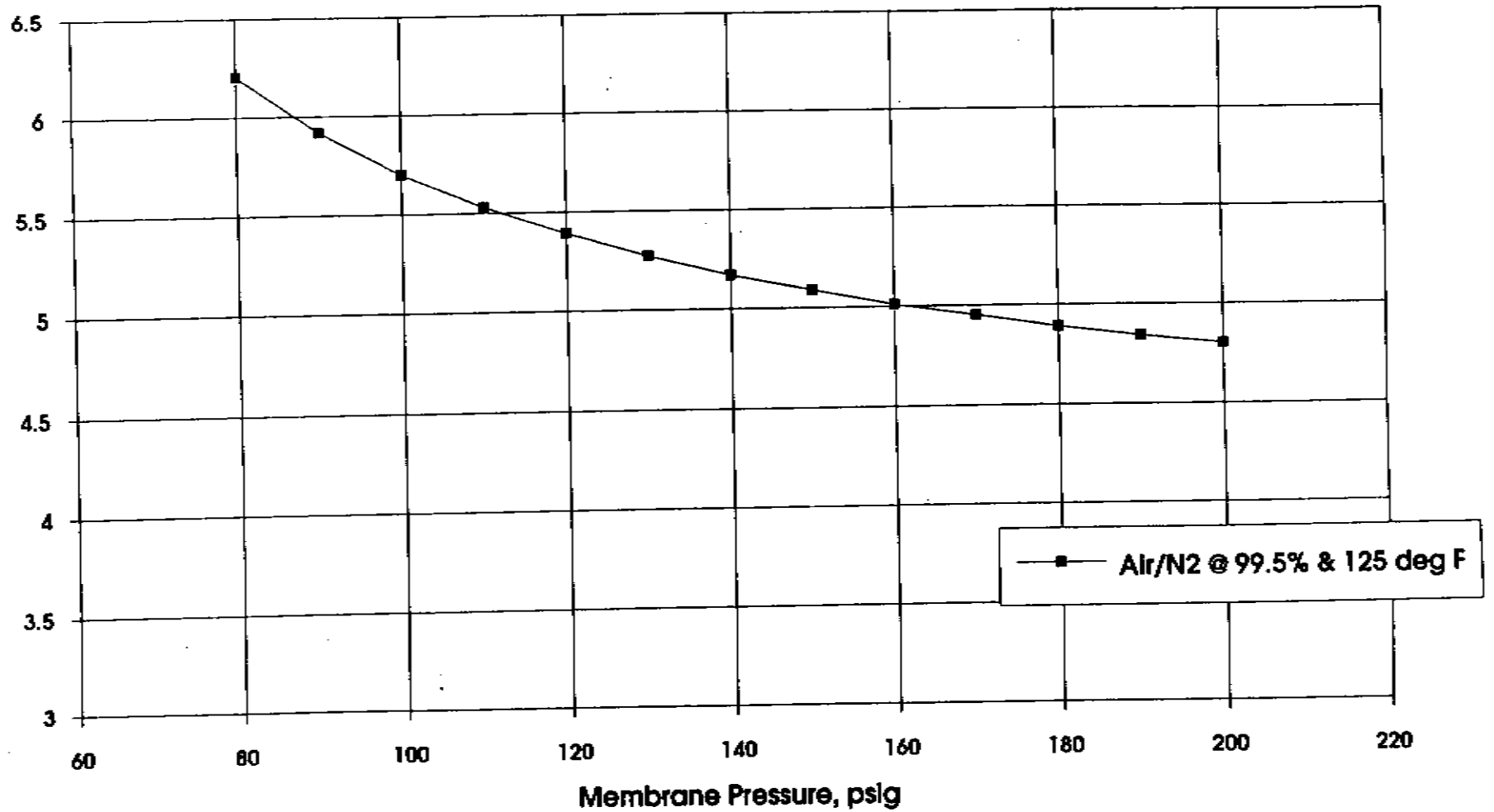
Pressure Sensitivity of PRISM Membrane Systems



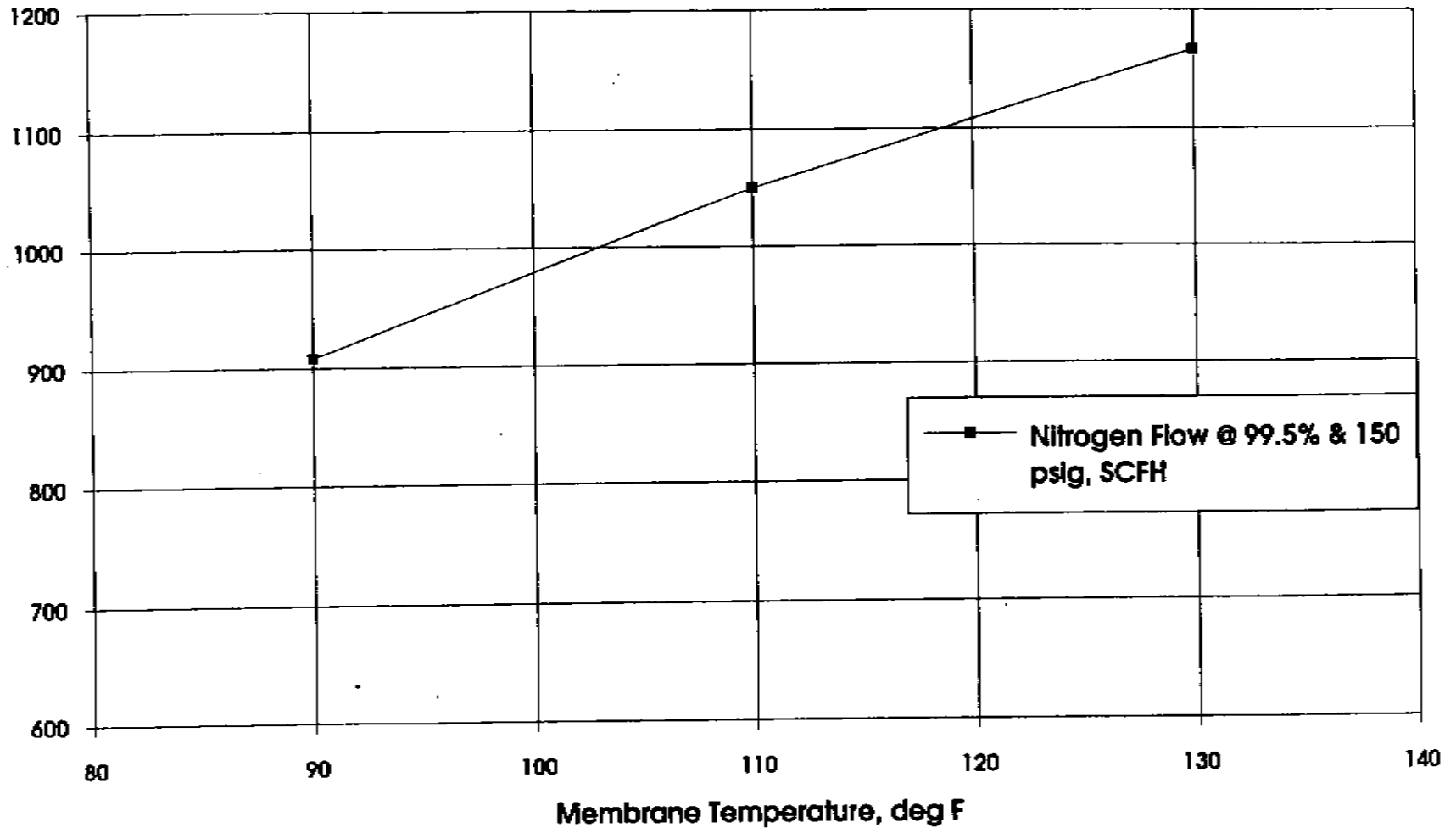
Pressure Sensitivity of PRISM Membrane Systems



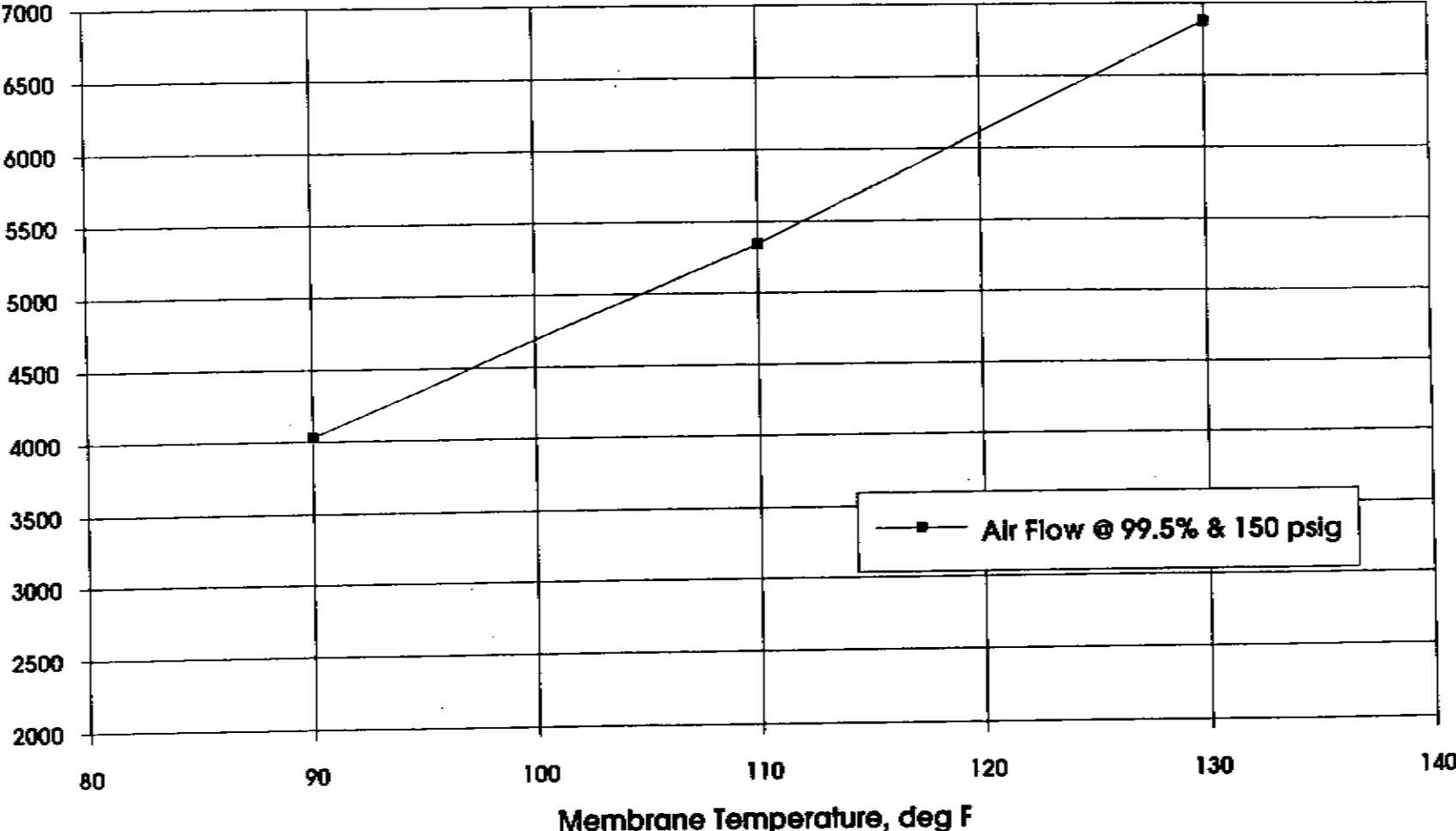
Pressure Sensitivity of PRISM Membrane Systems



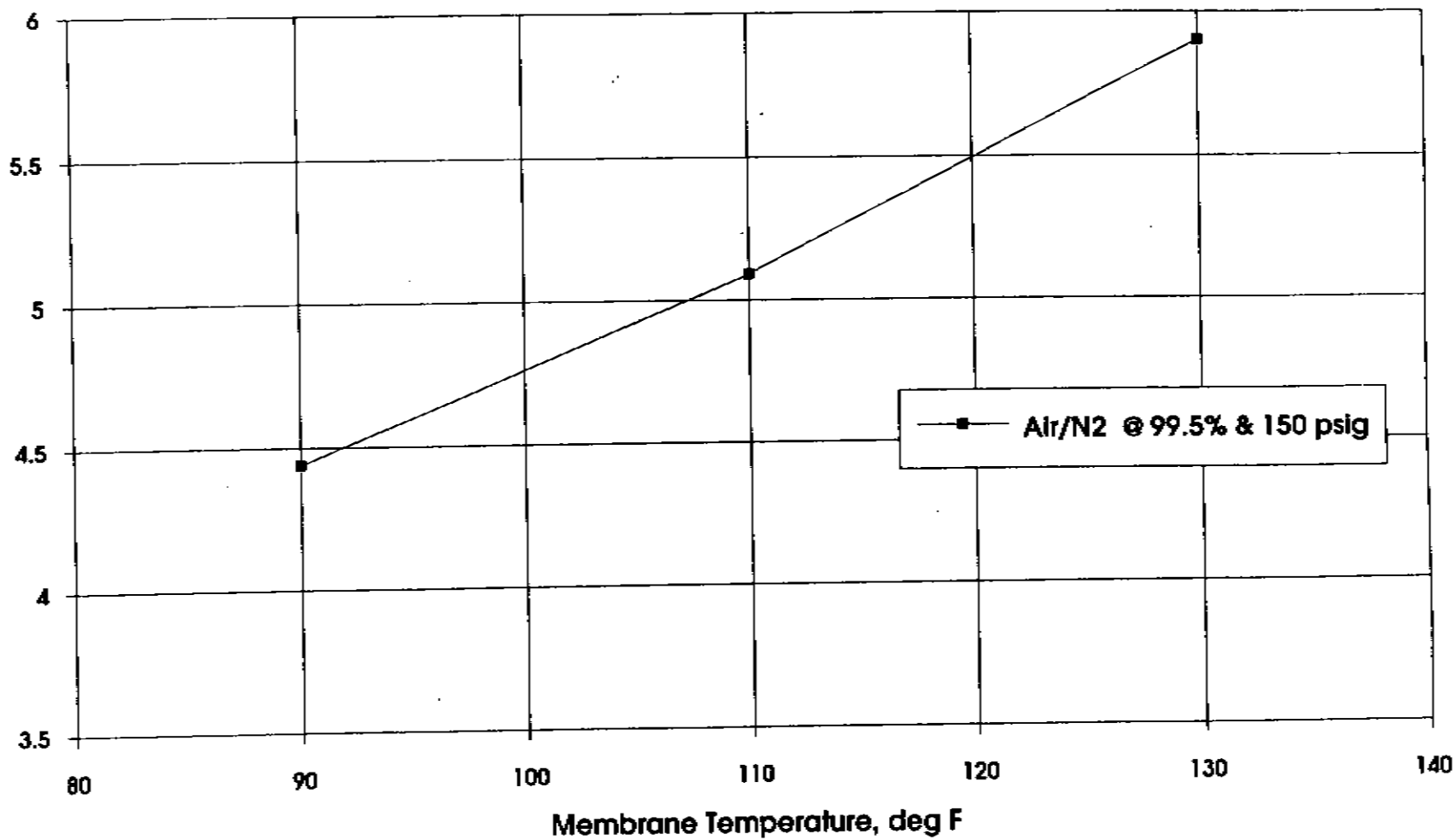
Temperature Sensitivity of PRISM Membrane Systems



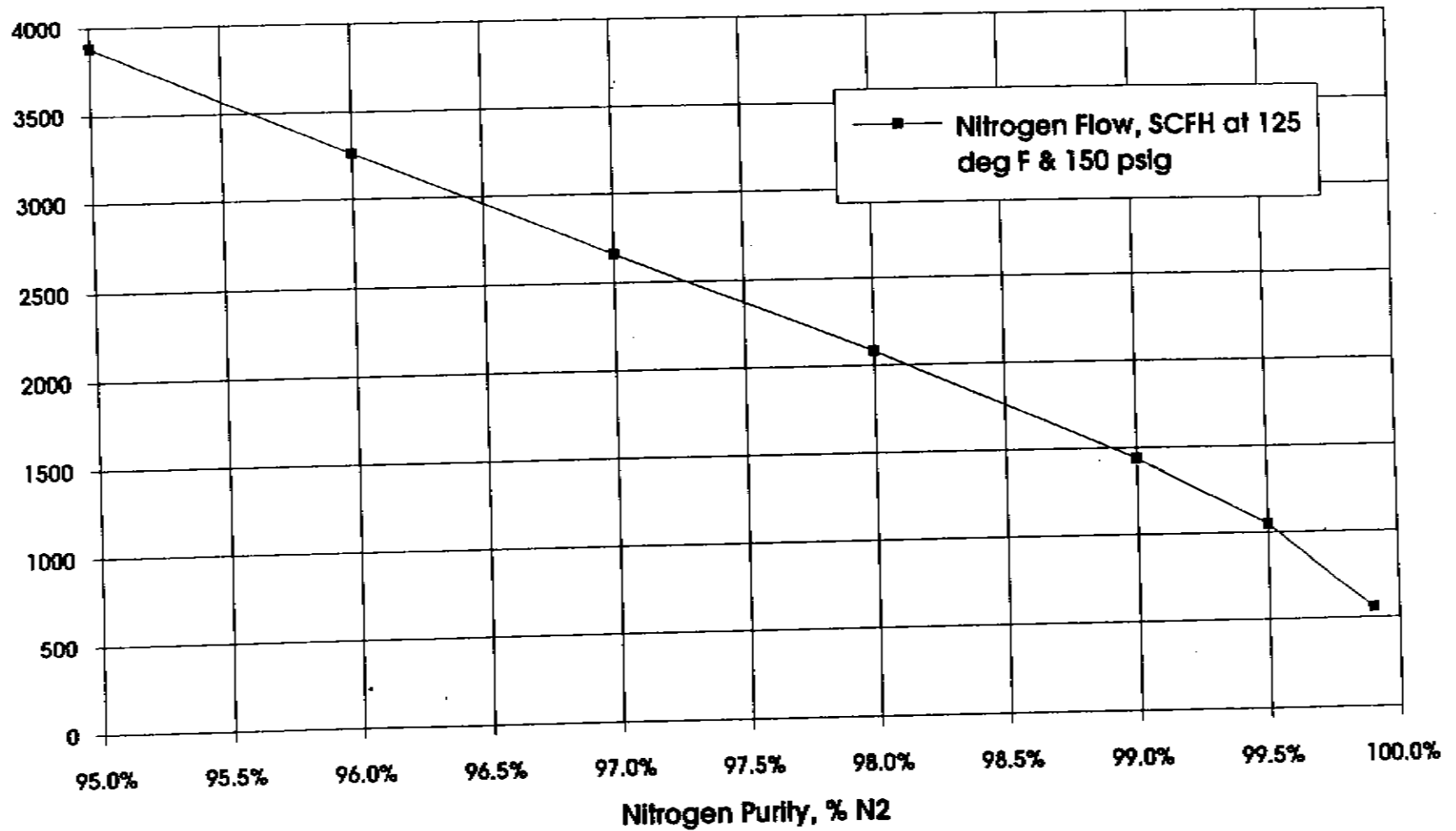
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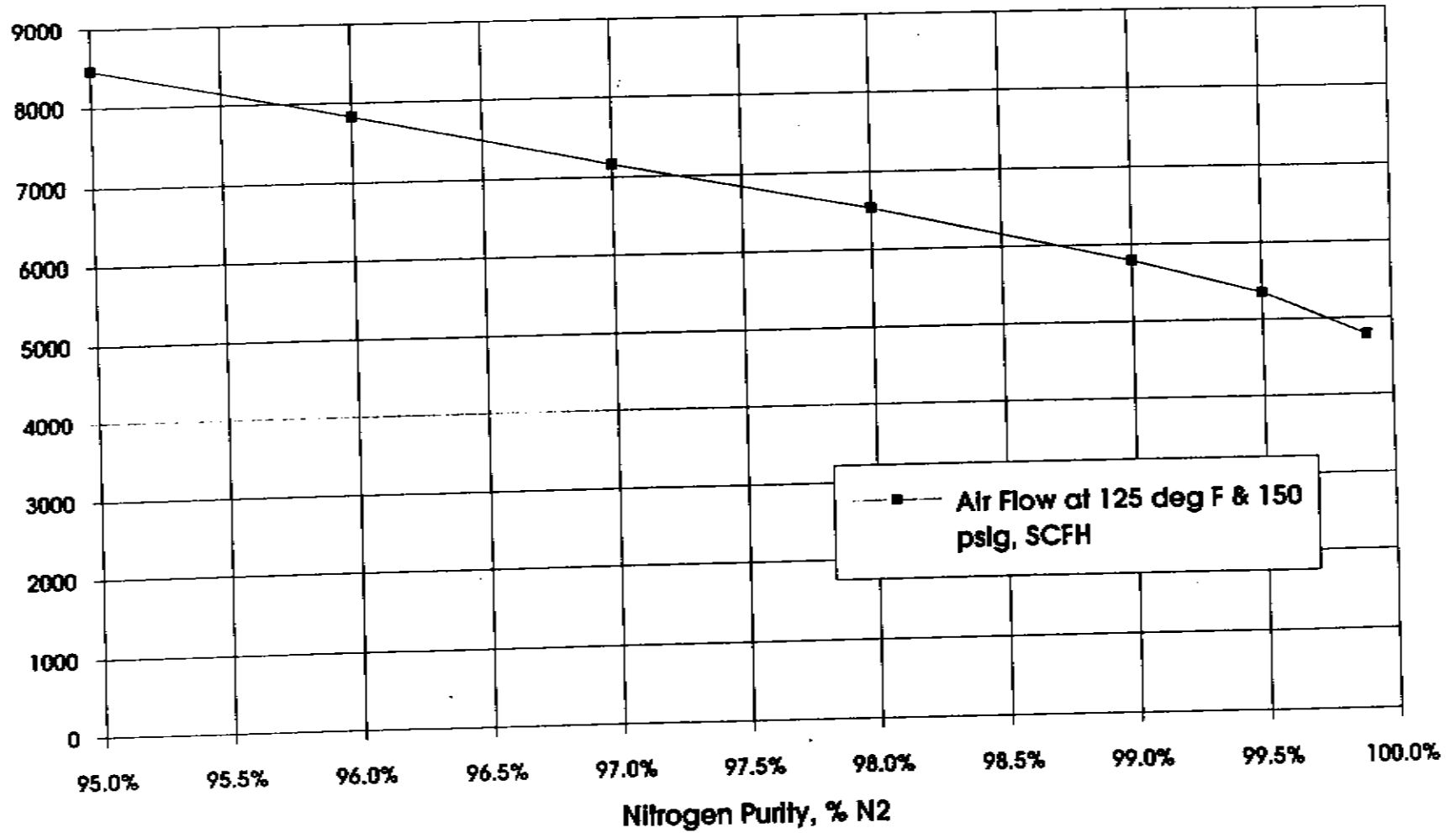
Temperature Sensitivity of PRISM Membrane Systems



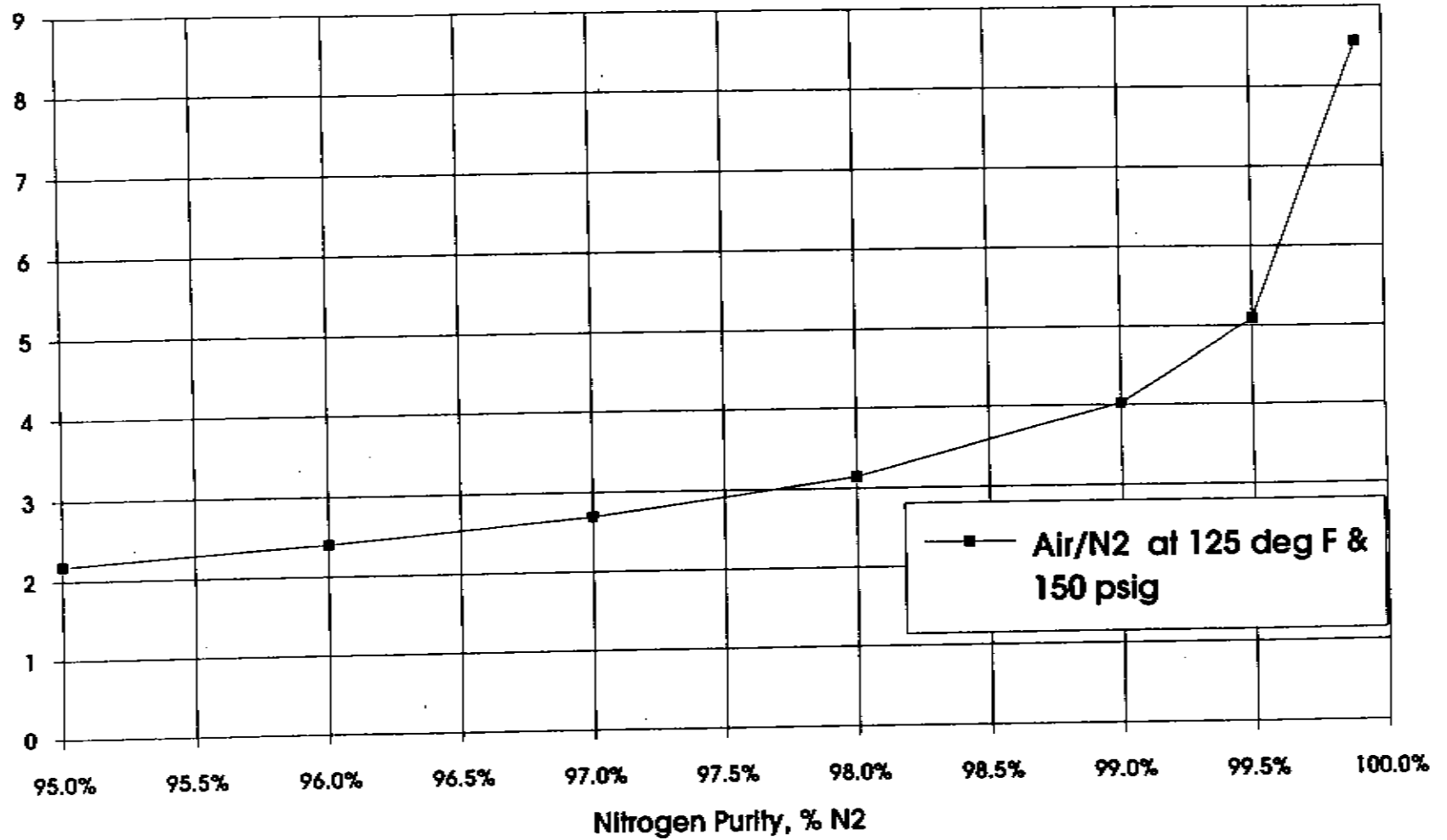
Purity Sensitivity of PRISM Membrane Systems



Purity Sensitivity of PRISM Membrane Systems



Purity Sensitivity of PRISM Membrane Systems



4/1/07

PROCESS CONTROL

- PROCESS AIR TEMPERATURE
- ENCLOSURE TEMPERATURE
- PRODUCT OXYGEN CONTENT
- OPERATING PRESSURE
- FLOW

THE DEGREE TO WHICH THE ABOVE ARE PART OF THE CONTROL SCHEME DEPENDS ON THE SYSTEM MODEL.

PROCESS AIR TEMPERATURE

- MAINTAIN CONSTANT OPERATING TEMPERATURE FOR STABLE PERFORMANCE
- SUPERHEAT THE FEED AIR TO AVOID CONDENSATION
- ELECTRIC HEATER
- MAXIMUM = 140 F
- CONTROLS:

SUPPLY AIR HIGH TEMPERATURE ALARM AND/OR SHUTDOWN
-MAY BE DELAYED TO ALLOW FOR SHORT-TERM HIGH TEMPERATURE EXCURSIONS
HEATED AIR HIGH TEMPERATURE ALARM AND/OR SHUTDOWN
HEATED AIR LOW TEMPERATURE ALARM AND/OR SHUTDOWN
-BYPASSED TEMPORARILY AT STARTUP TO ALLOW SYSTEM TO WARM UP
ELECTRIC HEATER ELEMENT HIGH TEMPERATURE ALARM AND/OR SHUTDOWN

ENCLOSURE TEMPERATURE

- HELPS TO MAINTAIN CONSTANT MEMBRANE OPERATING TEMPERATURE
- HEAT IS PROVIDED BY:
 - ELECTRIC FLEXIBLE STRIP HEATER
 - PERMEATE GAS EXITING FROM SEPARATOR(S) DIRECTLY INTO ENCLOSURE

PRODUCT OXYGEN CONTENT

- CONTINUOUS MONITORING OF PRODUCT % O₂
- CONTROLS:

PRODUCT VENTED WHEN % O₂ > SETPOINT
SYSTEM SHUTDOWN IF % O₂ > SETPOINT FOR PRESET TIME PERIOD

OPERATING PRESSURE

- PRIMARY CONTROL BY COMPRESSOR CONTROLS
- LIMITED BY SYSTEM DESIGN
- FEED AIR REGULATOR MAY BE REQUIRED

SYSTEM DESIGN LIMITATIONS
FEED AIR PRESSURE FLUCTUATIONS TOO SEVERE

FLOW

- NOT CONTROLLED
- SYSTEM WILL TRY TO KEEP UP WITH DEMAND
- FLOW LIMITING SYSTEM:
CONSTANT FLOW CONTROLLER
BACK PRESSURE REGULATOR