Reinhold Environmental Ltd.

2007 APC Round Table & Expo Presentation

July 8-10, 2007
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Hosted by TVA

EFFECTS OF POOR AIR HEATER PERFORMANCE ON BACK END APC EQUIPMENT

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Paragon Airheater Technologies

AIR HEATER PERFORMANCE AFFECTS:

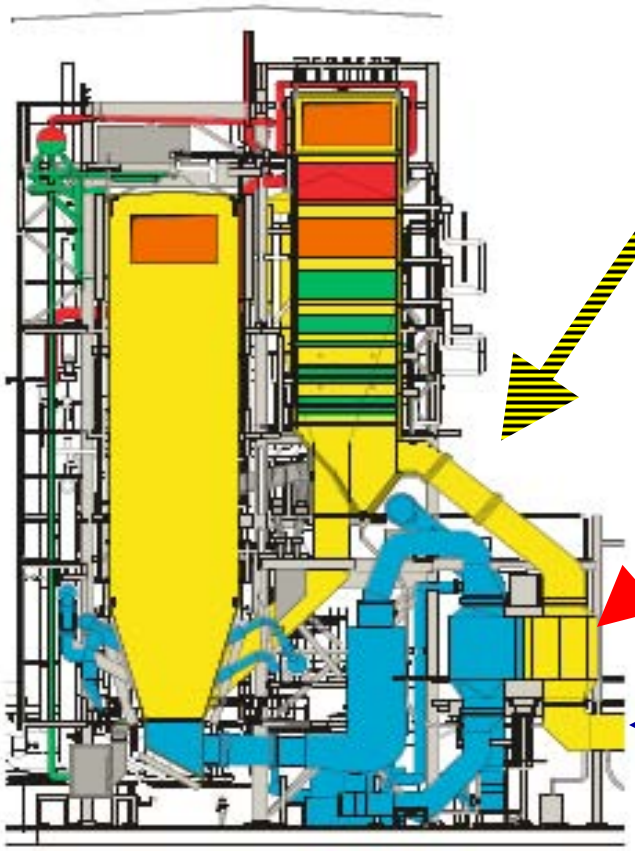
- **Flue Gas Volume**
- **Flue Gas Temperature**
- **Gas Velocity Distribution**
- **Temperature Stratification**
- **ABS Plugging**

ESP MICROMETER MEASURMENTS

PRIMARY PROBLEM AREAS:

- **Leakage Rates**
- **Deteriorated Or Plugged Element**

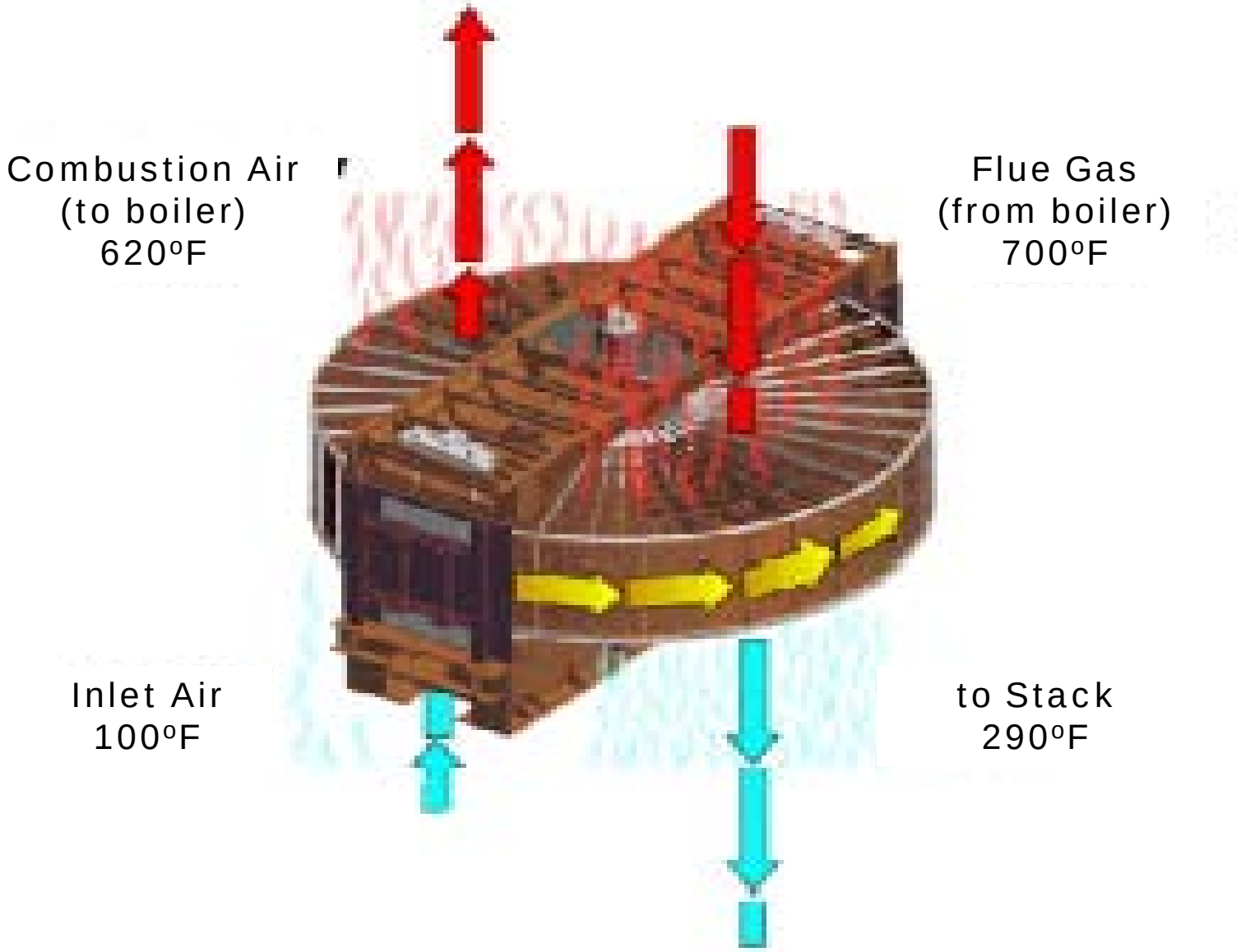
OVERVIEW



HOT FLUE GAS
TO AIR HEATER

AIR HEATER

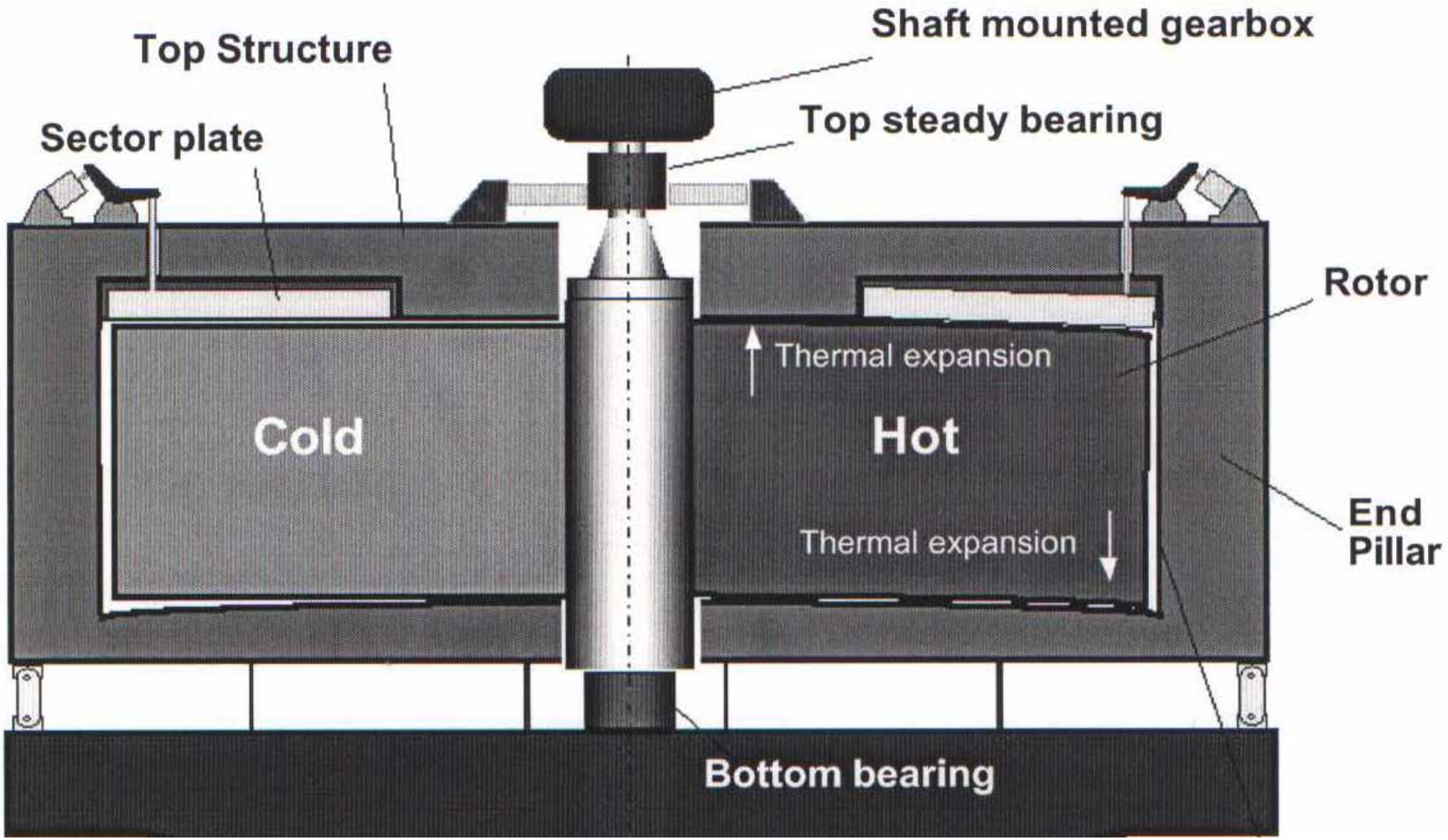
WARMED AIR TO
BOILER



TYPICAL TEMPERATURES IN AN AIRHEATER

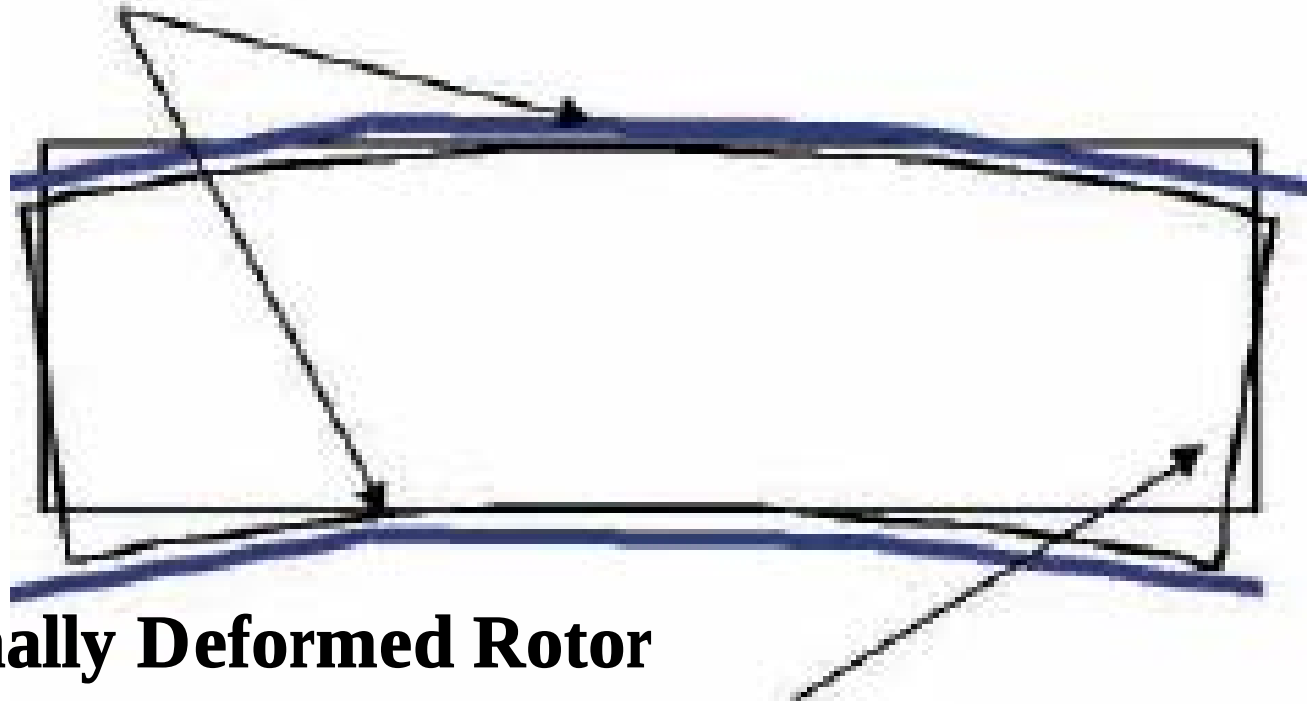
LEAKAGE PROBLEMS

Leakage Can Account For 25%
Of The Total Gas Outlet Flow



ROTOR DISTORTION AT TEMPERATURE

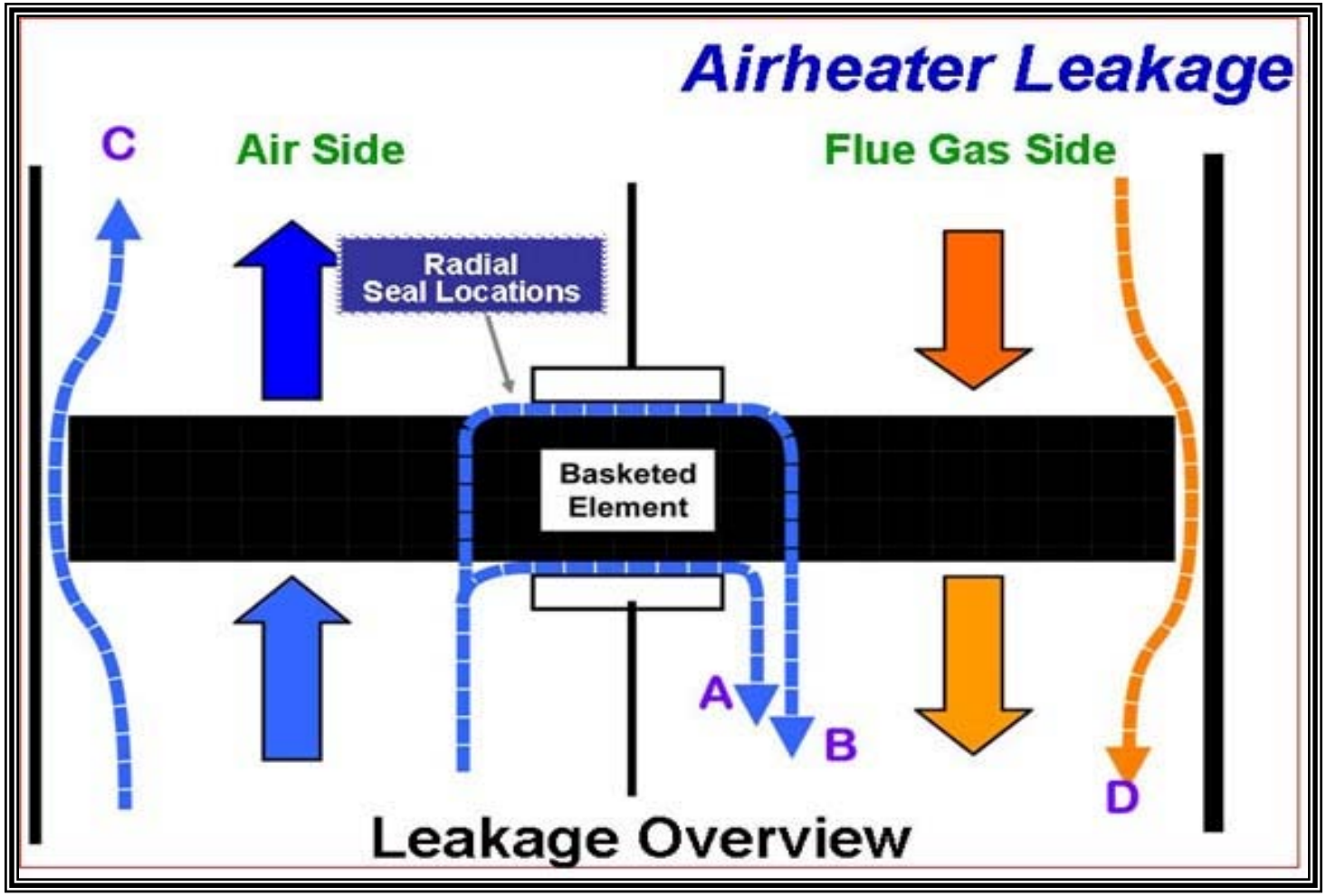
Tracking Sector Plates-
Move With Load

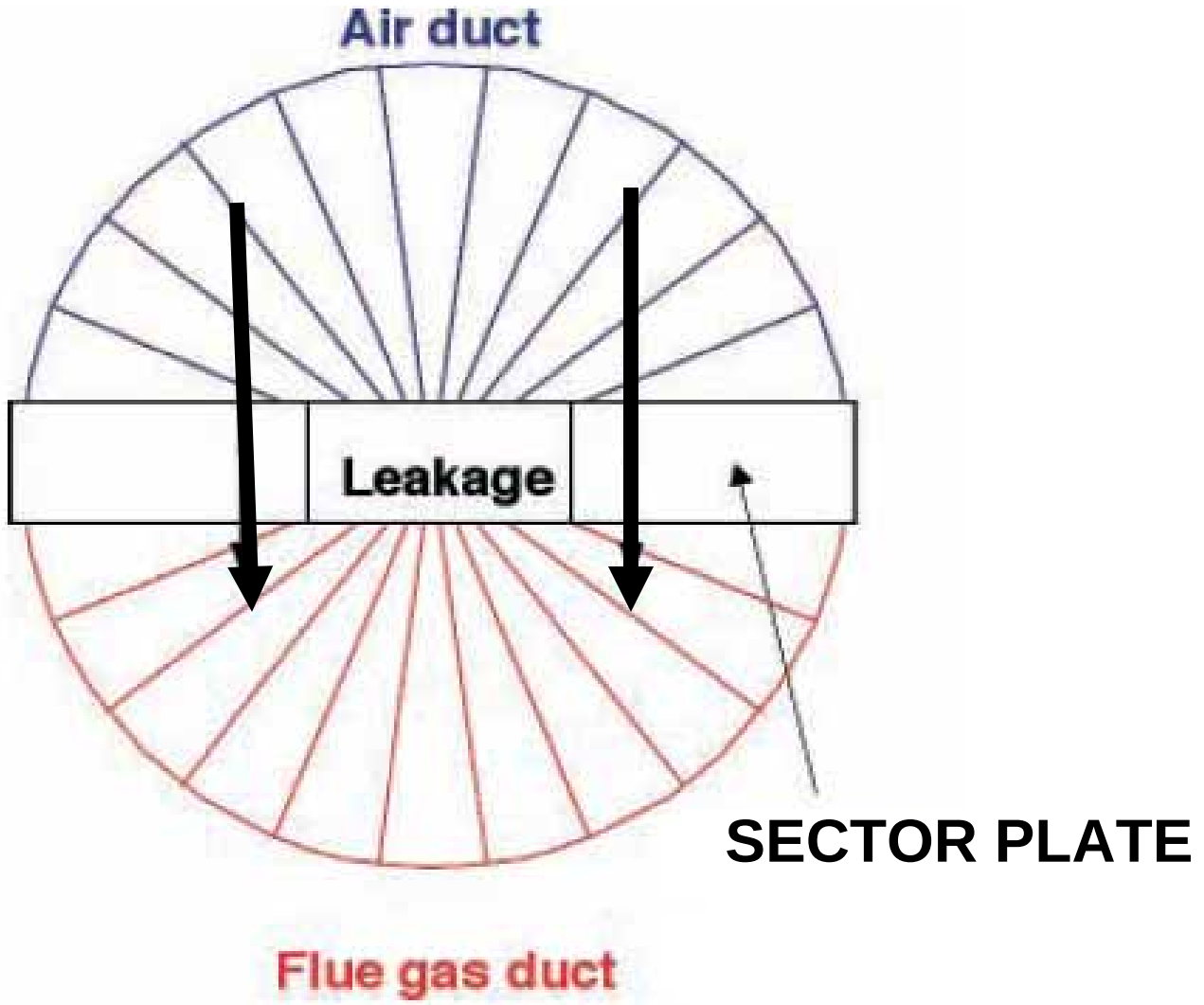


Thermally Deformed Rotor

DISTORTION OF ROTOR AT OPERATING TEMPERATURE

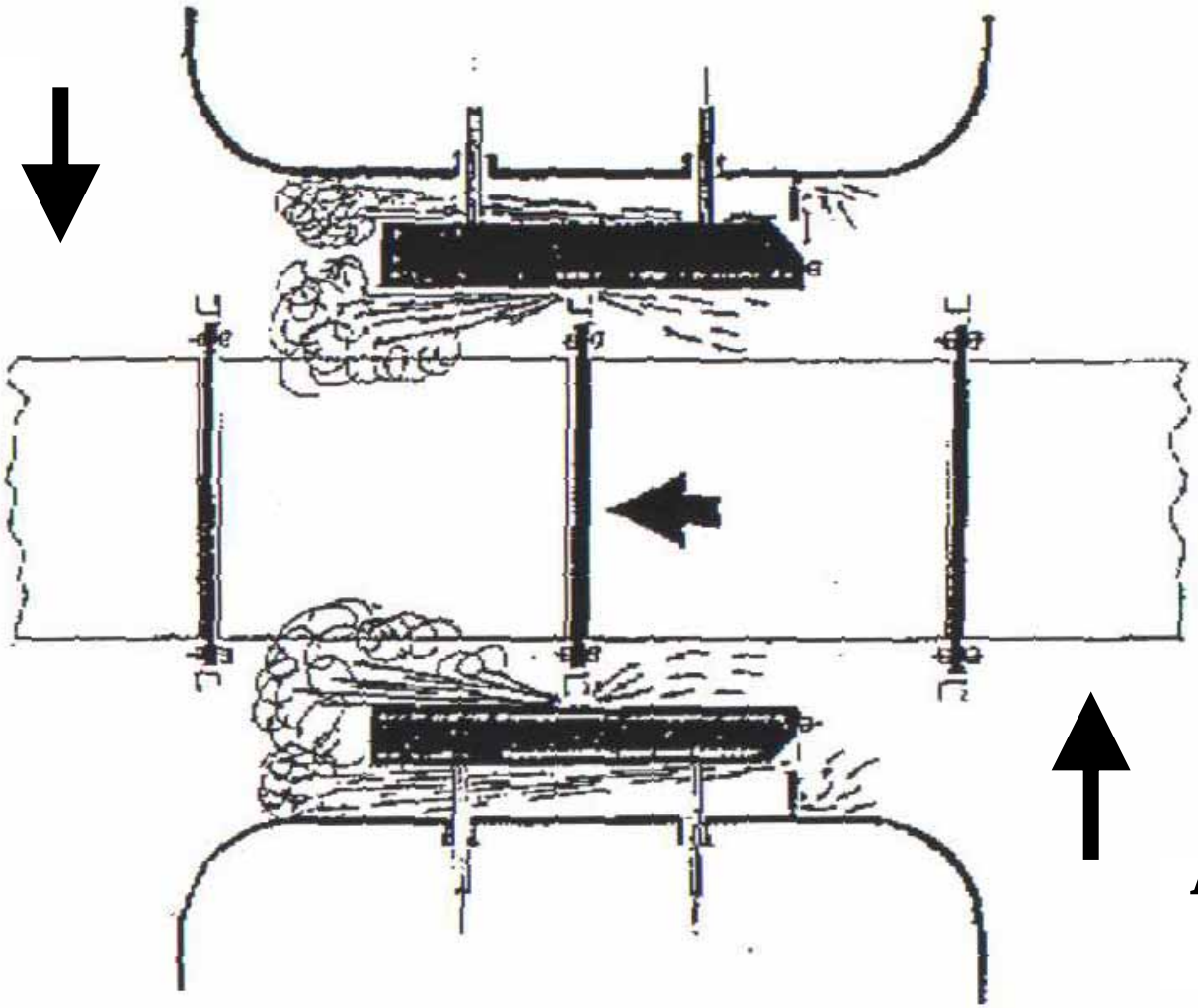
LEAKAGE PATHS IN THE AIRHEATER





LEAKAGE PATH THROUGH RADIAL SEALS

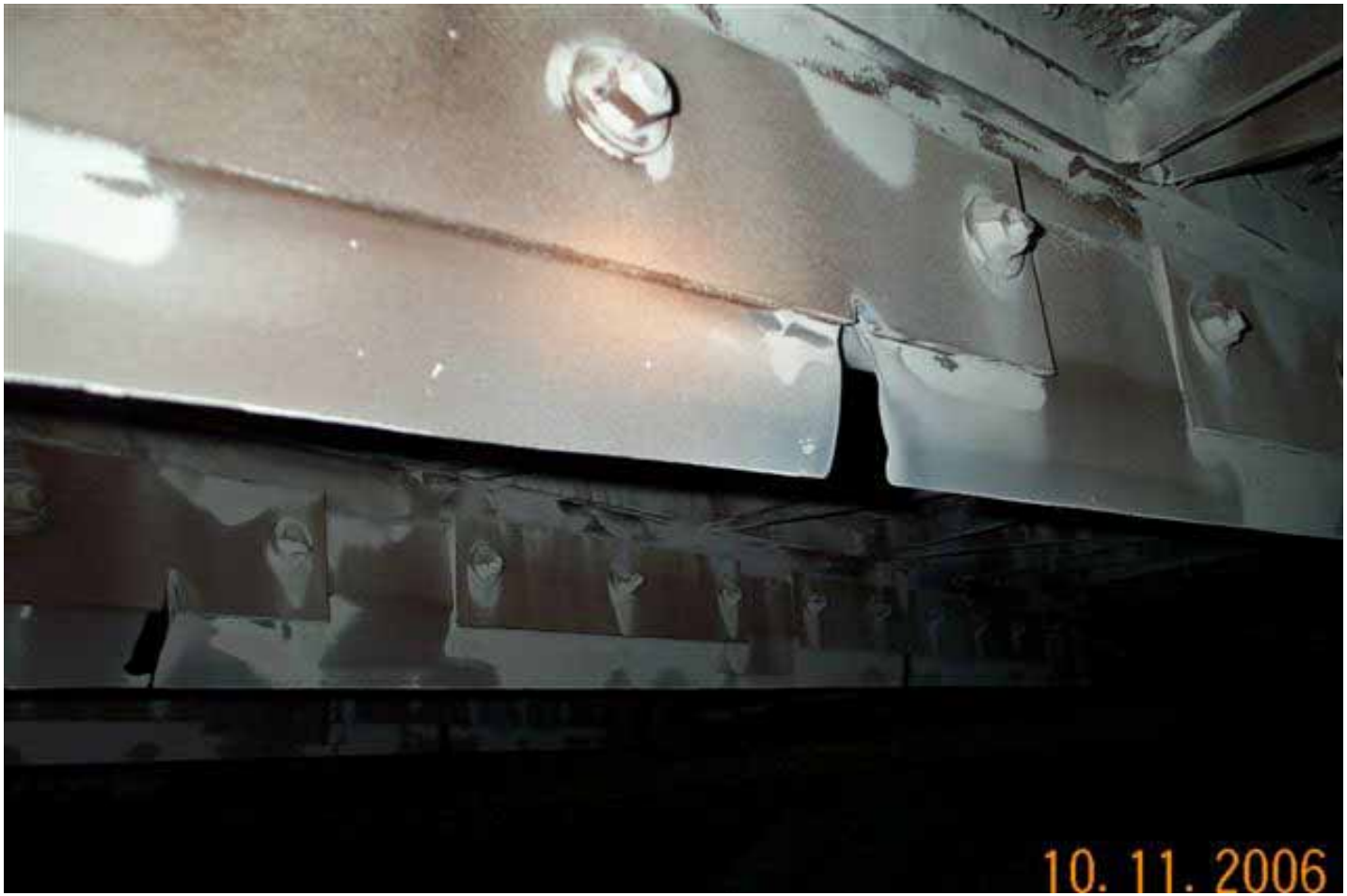
HOT GAS



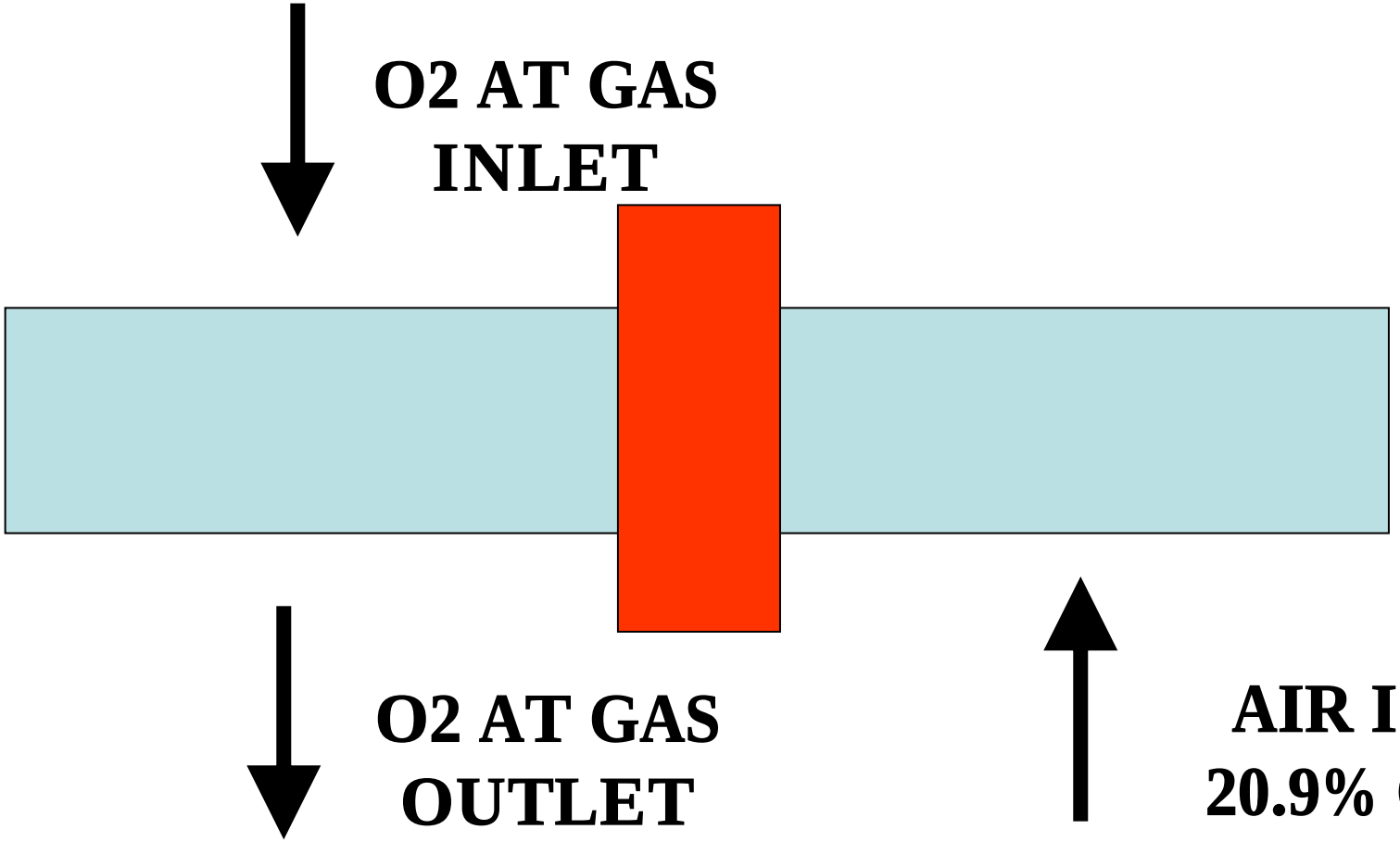
AIR IN

LEAKAGE THROUGH RADIAL SEALS

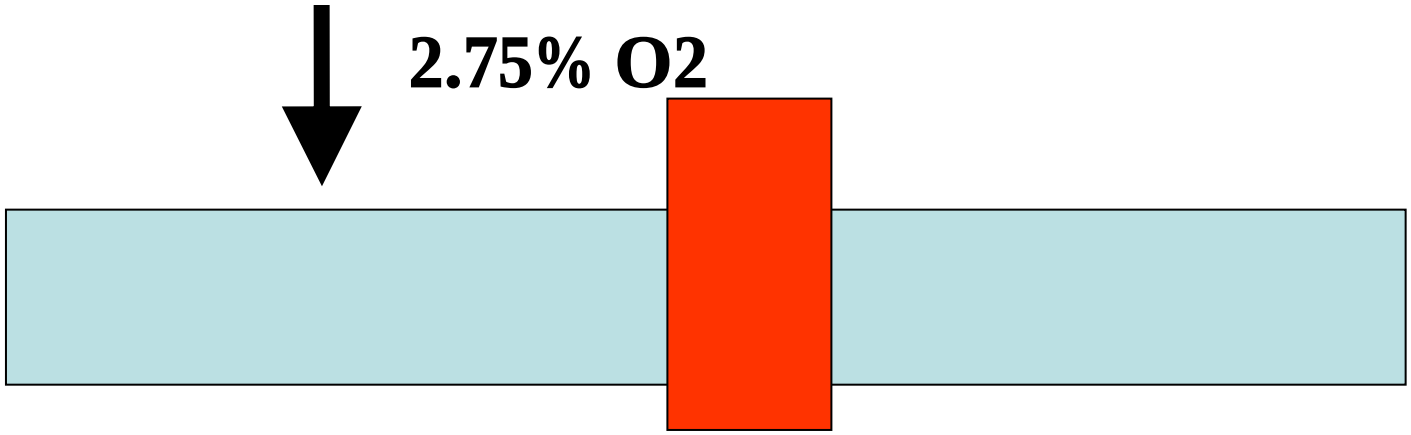
EROSION CAUSED BY RADIAL SEAL LEAKAGE

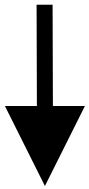


GAPS BETWEEN STANDARD RADIAL SEALS (DAMAGED) AND SECTOR PLATE



LEAKAGE DATA POINTS

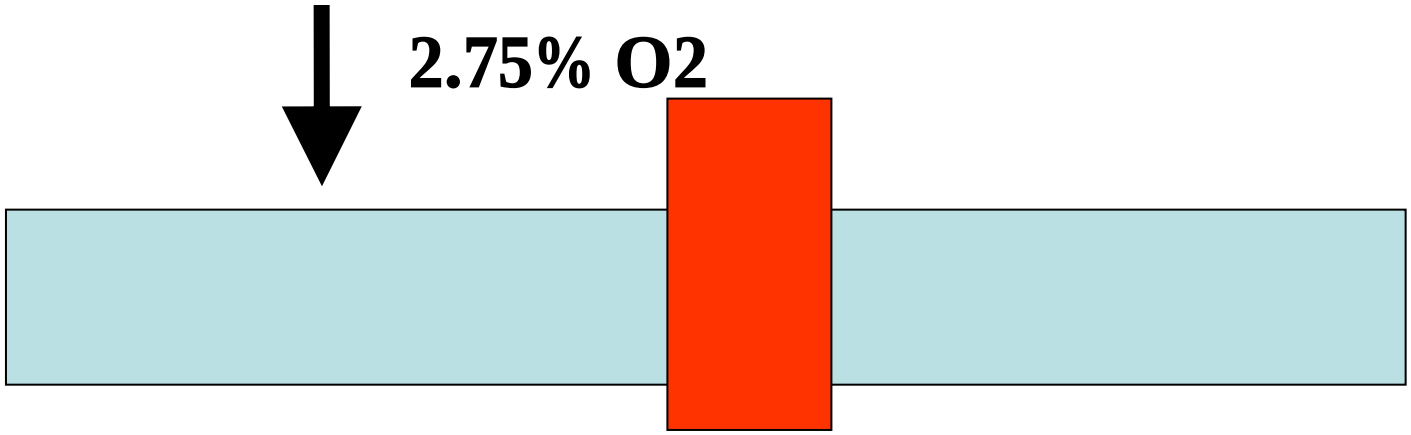




5.5% O2
AT GAS
OUTLET

AIR IN
20.9% O2

CALCULATED LEAKAGE = 19.8%



7.5% O2
AT GAS
OUTLET

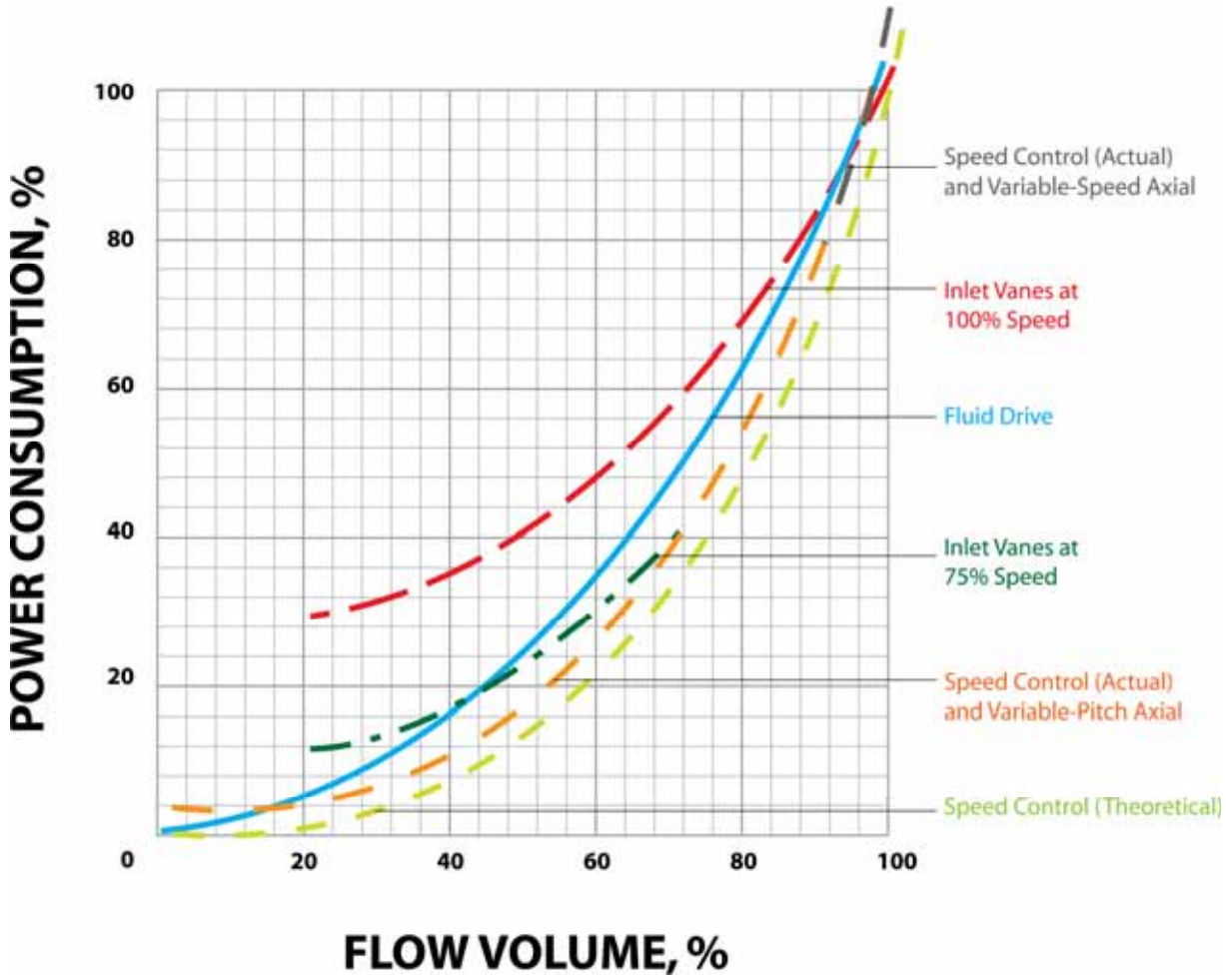
AIR IN
20.9% O2

CALCULATED LEAKAGE = 34.1%

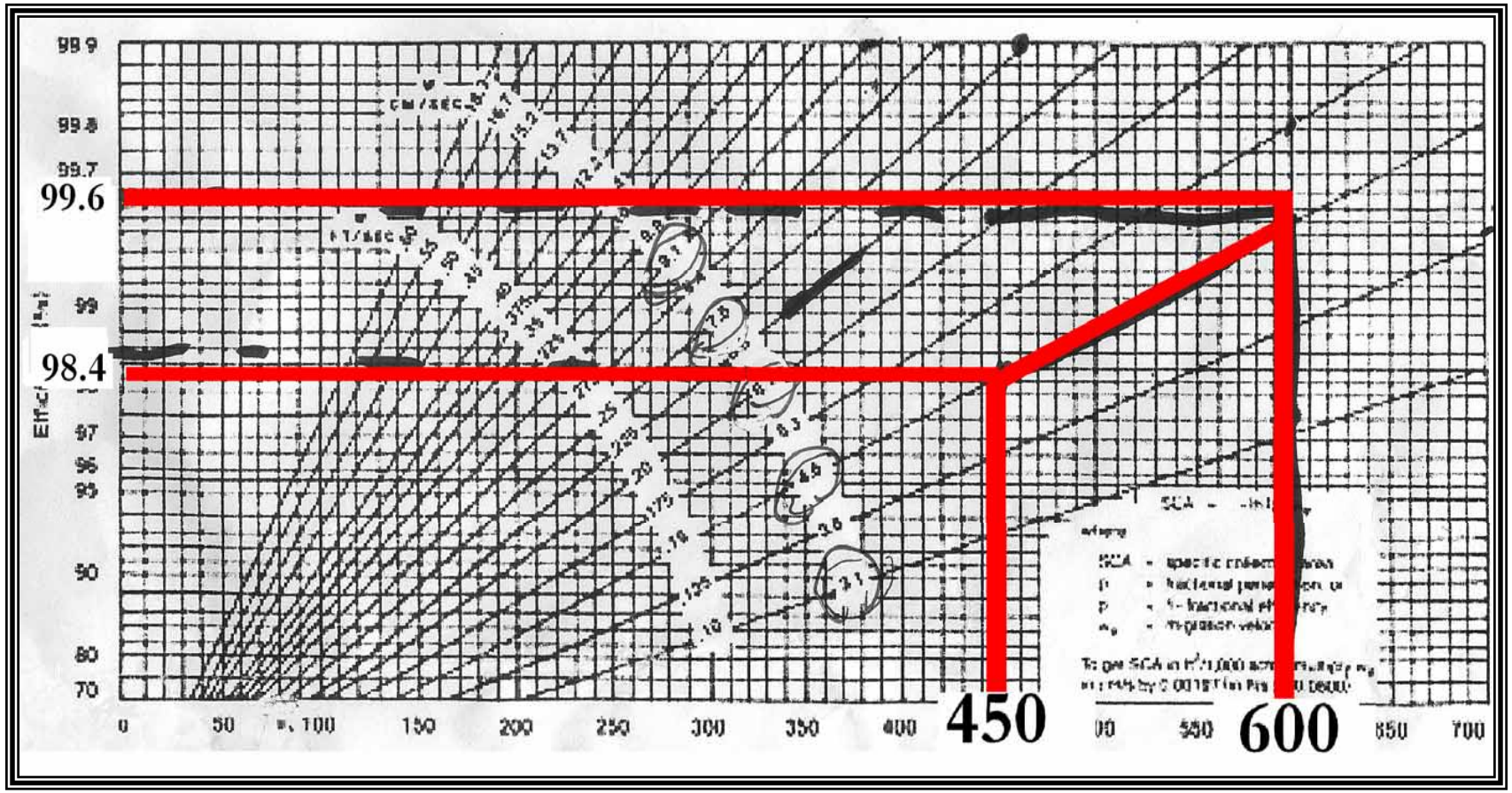
FAN	Before (AMPS)	After (AMPS)
3A ID FAN	**572**	**459**
3B ID FAN	**691**	**468**
3A FD FAN	**131**	**125**
3B FD FAN	**128**	**113**

FAN POWER SAVINGS FROM REDUCED LEAKAGE

Power Consumption vs. Volumetric Flow



EFFECTS OF LEAKAGE ON ESP PERFORMANCE

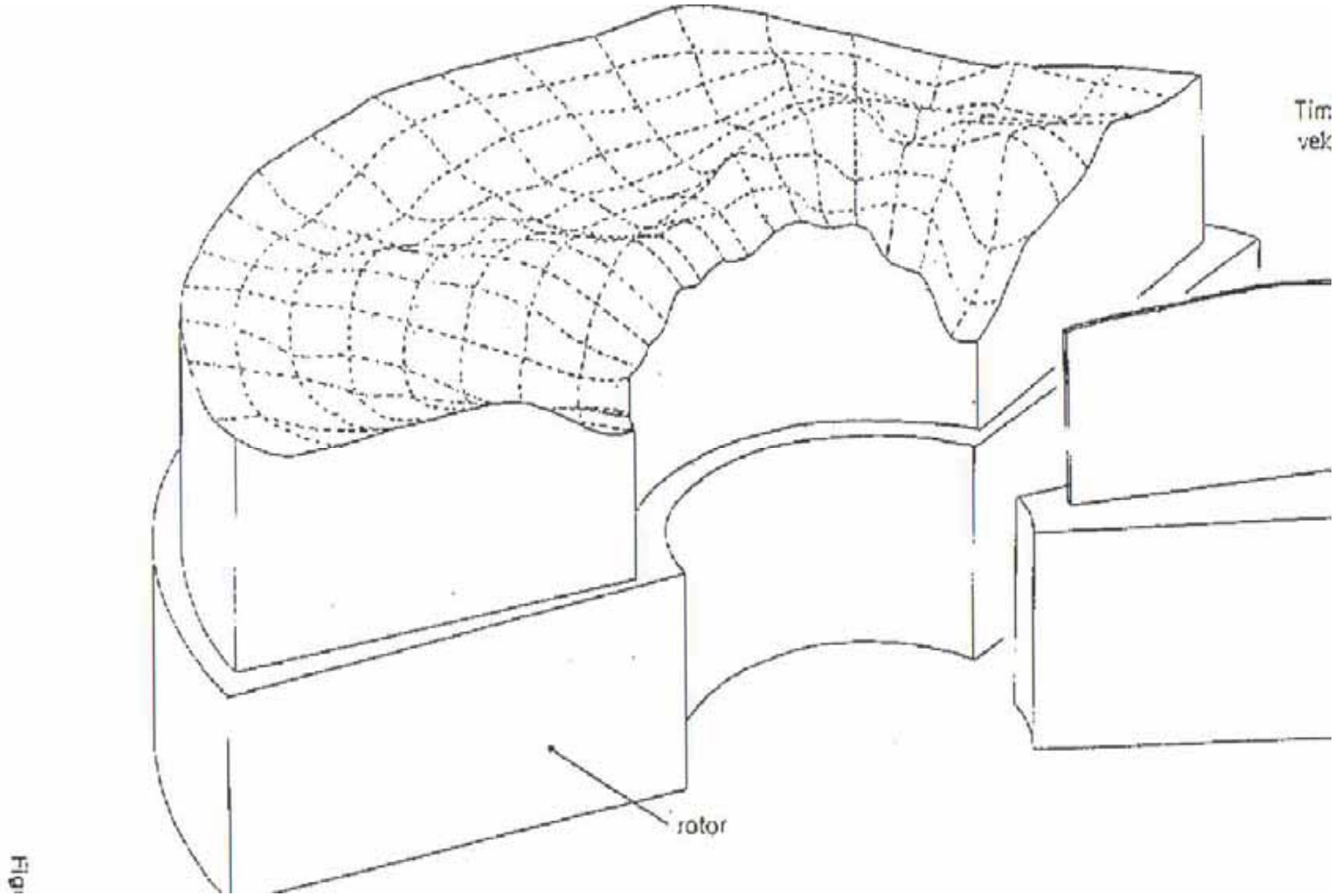


BEFORE CONTACT

CONTACT WITH SECTOR PLATE

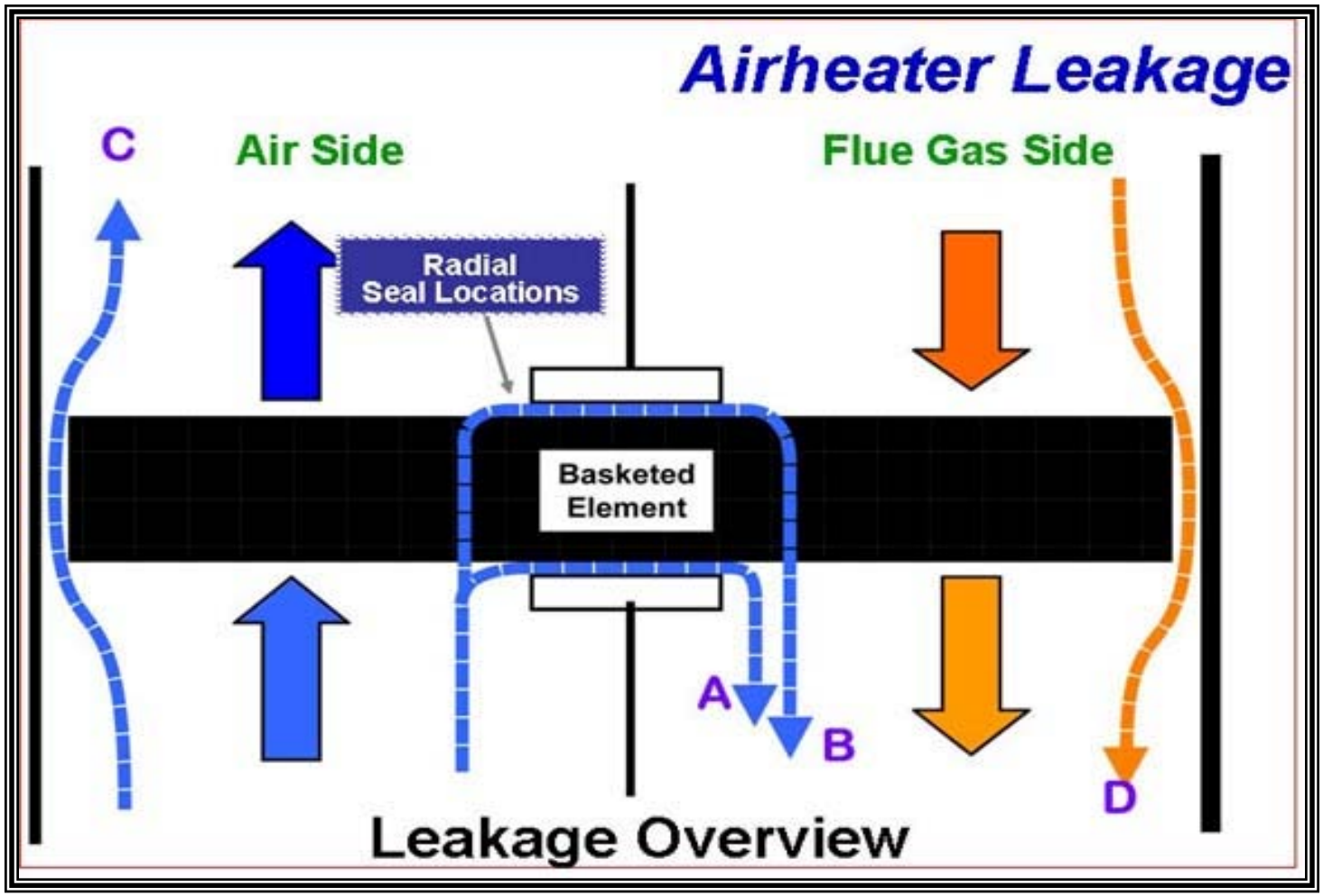
DURAMAX RADIAL SEAL

FLOW AND TEMPERATURE DISTRIBUTION



TYPICAL FLOW PROFILE

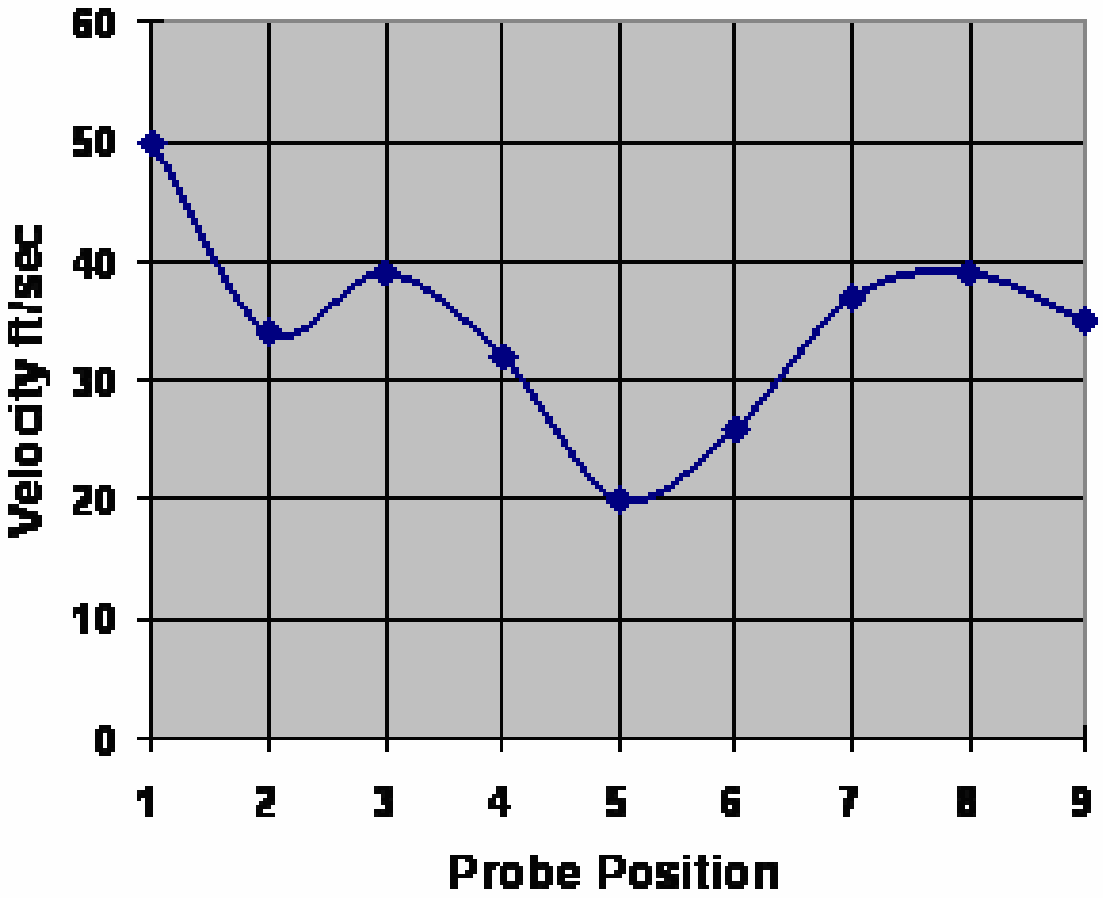
LEAKAGE PATHS IN THE AIRHEATER



TYPICAL LEAKAGE GAPS IN CIRC SEALS

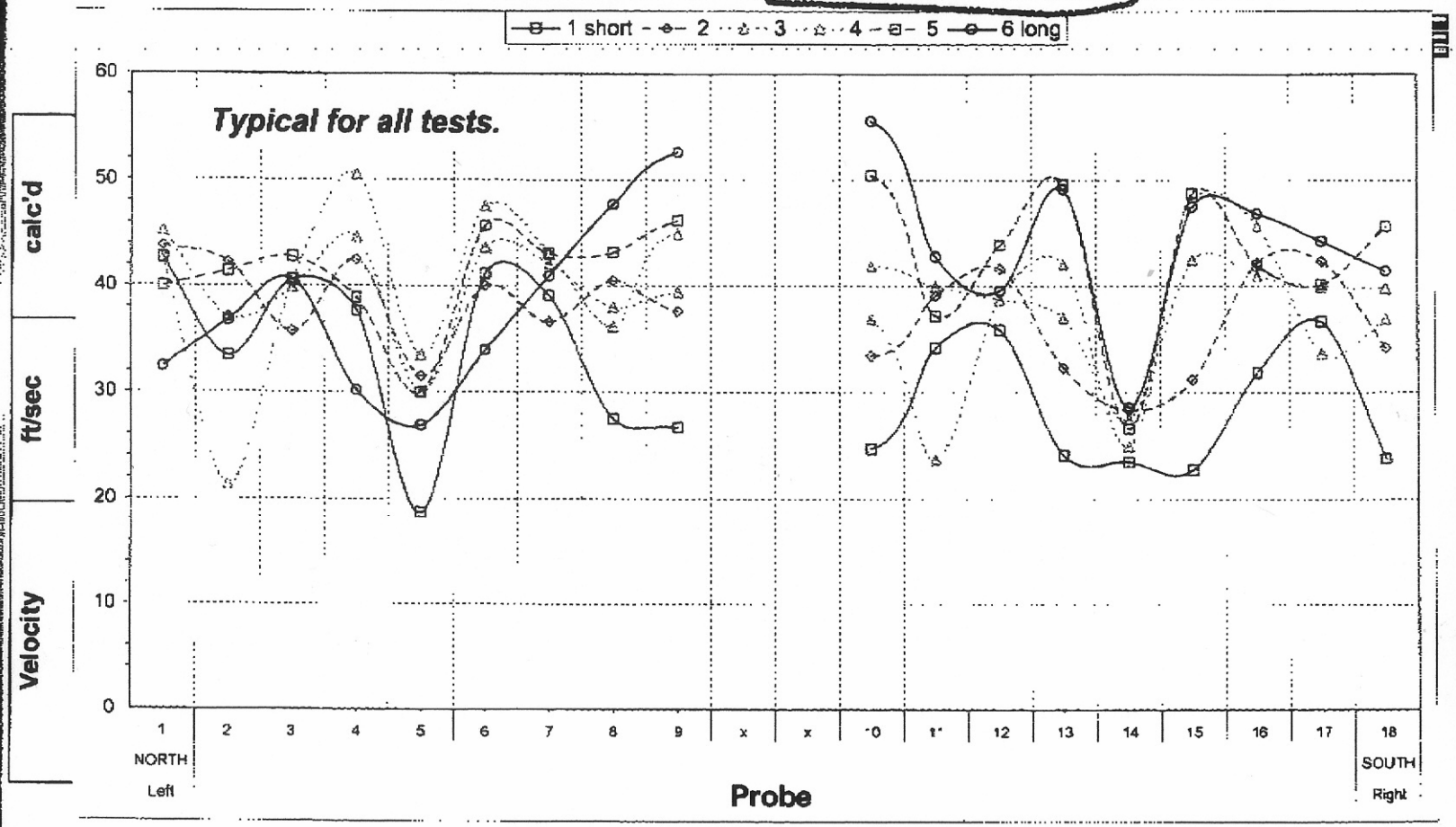
PERIMETER LEAKAGE GAP BETWEEN BYPASS SEAL AND ROTOR

Flue Gas Velocity Distribution

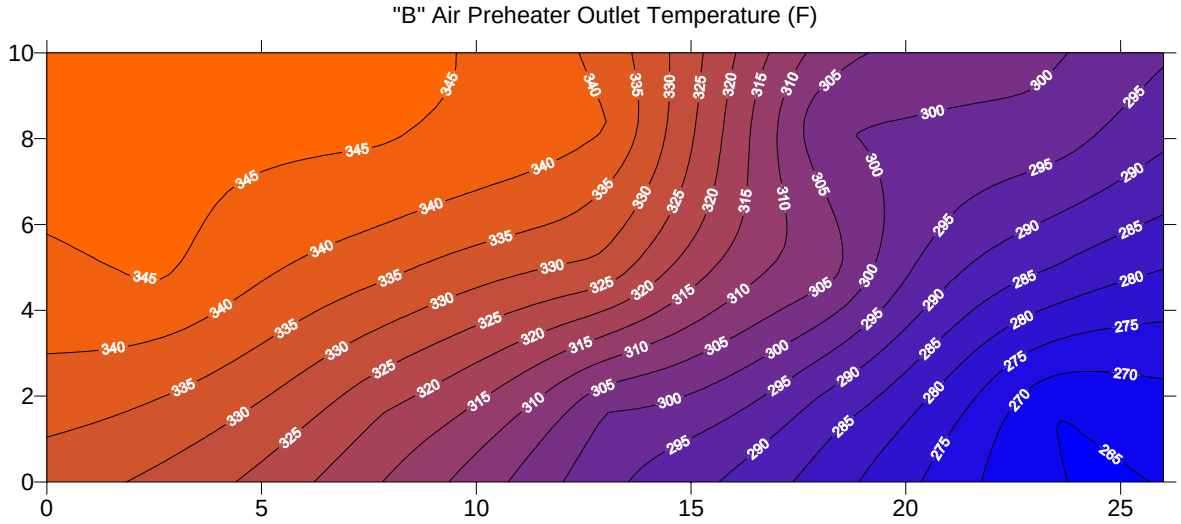


3. Flue Gas Flow Calculations: Test 1: 613 MWn, no ID fan bias

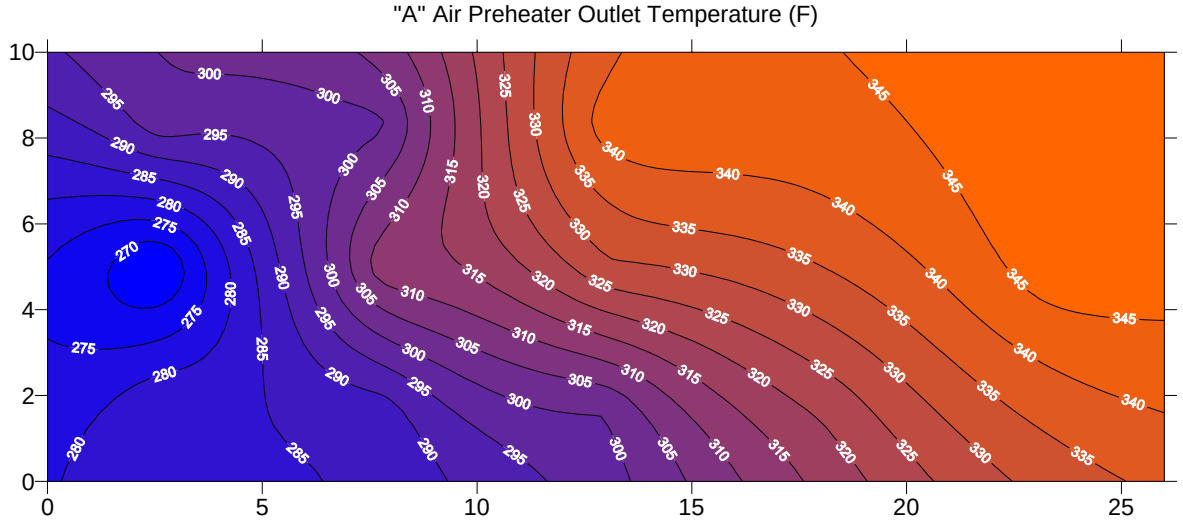
Test ID:	Test Date	Start time	End time	Test Load / Description	Location	Parameter	Units	Basis, other
1	9/3/2003	13:15	16:30	Max load, bias as found	ESP Inlet	Velocity	ft/sec	calc'd



AH OUTLET TEMPERATURE PROFILE

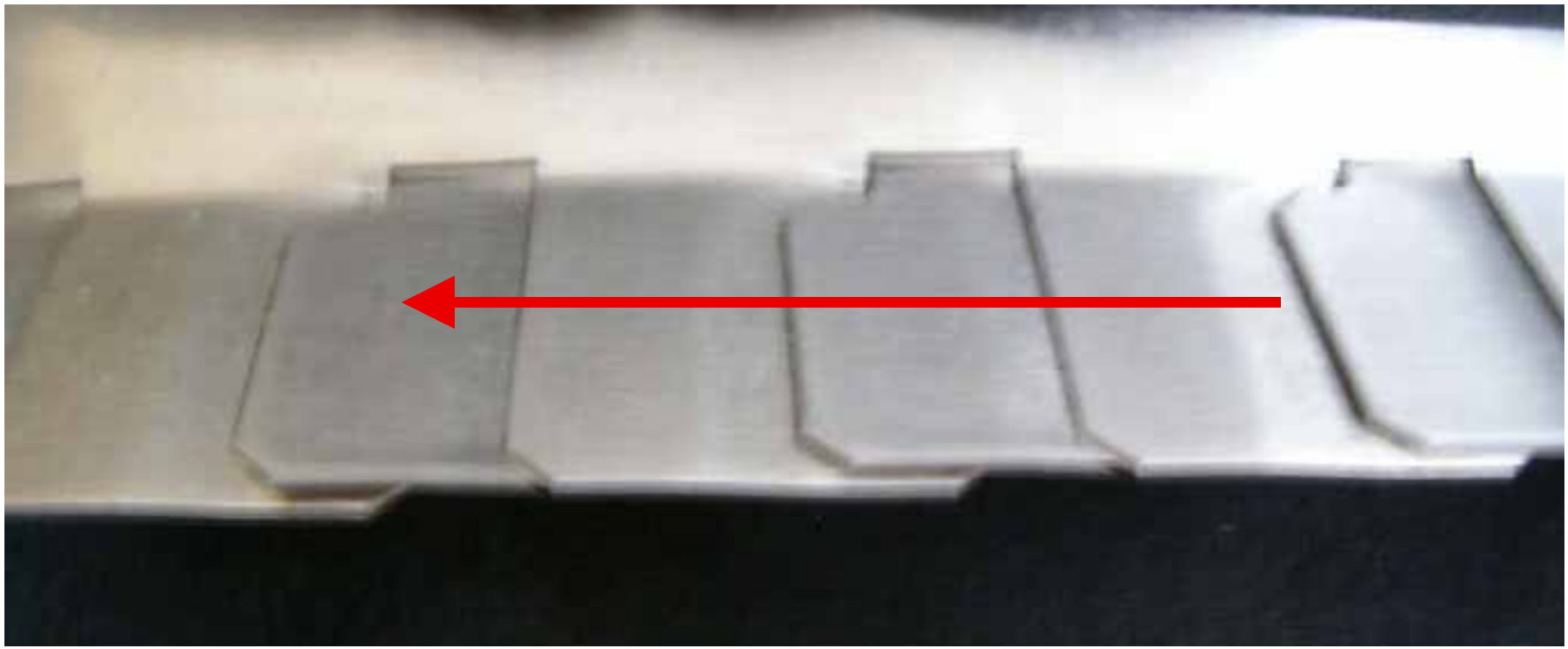


Crist Unit 7
Air Preheater Outlet Temperature (F)
Profile Looking Toward Stack



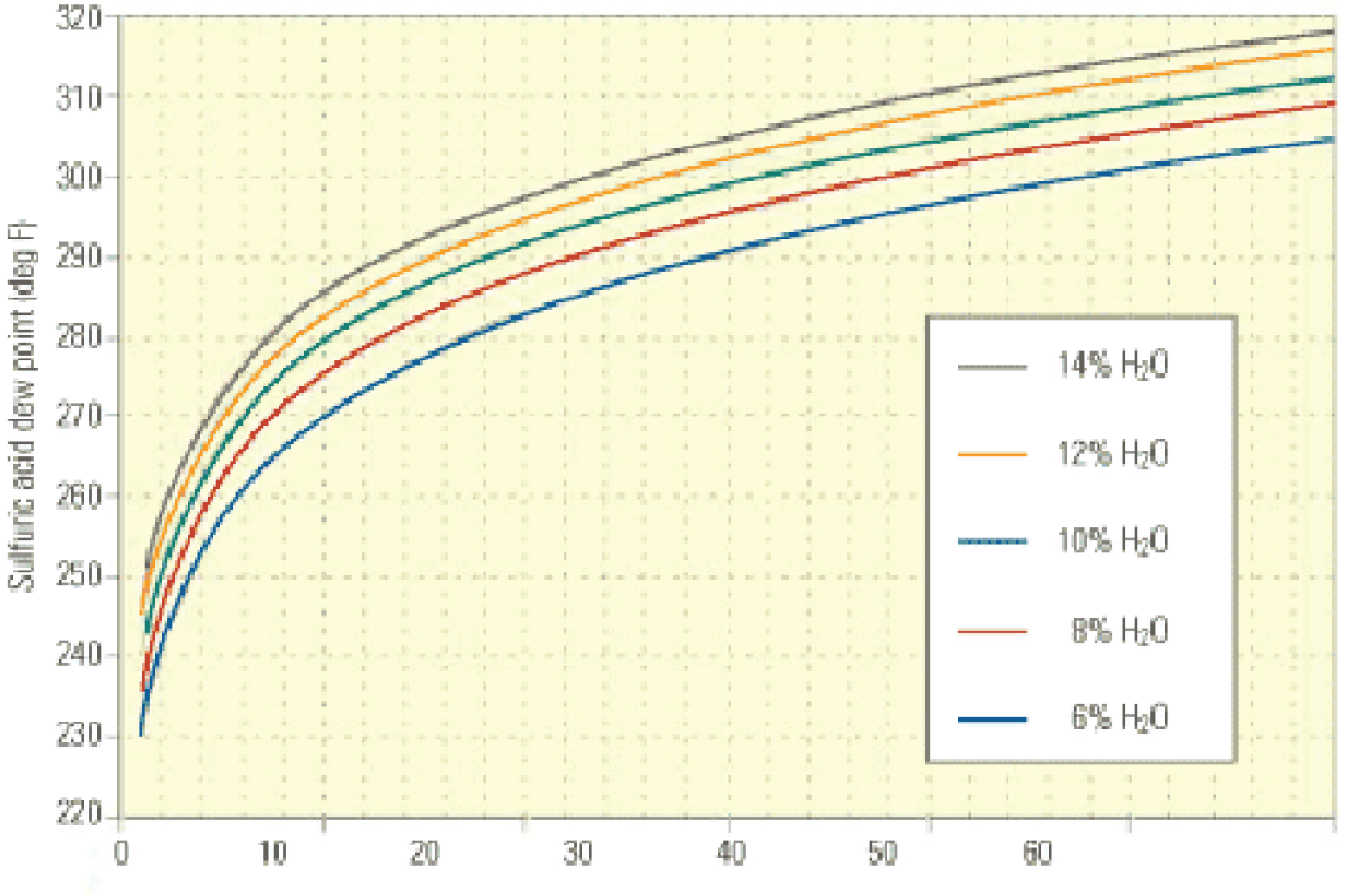
DURAFLEX CIRC SEAL

DURAFLEX CIRC SEAL



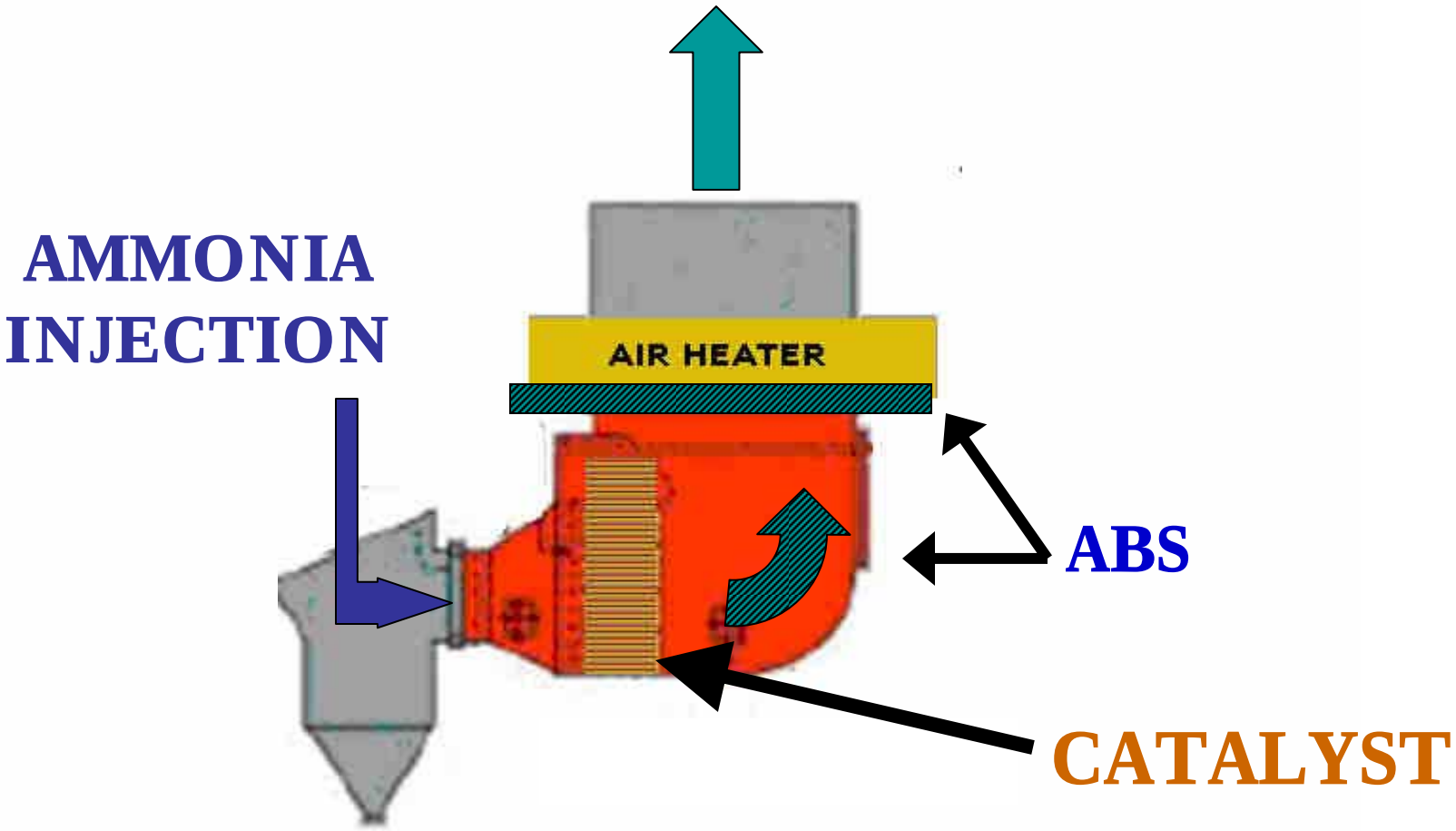
SCR/SNCR AND ABS

Flue Gas Temperature Effects



SO_3 DEW POINT PROFILE

SCR IN RELATION TO AIR HEATER



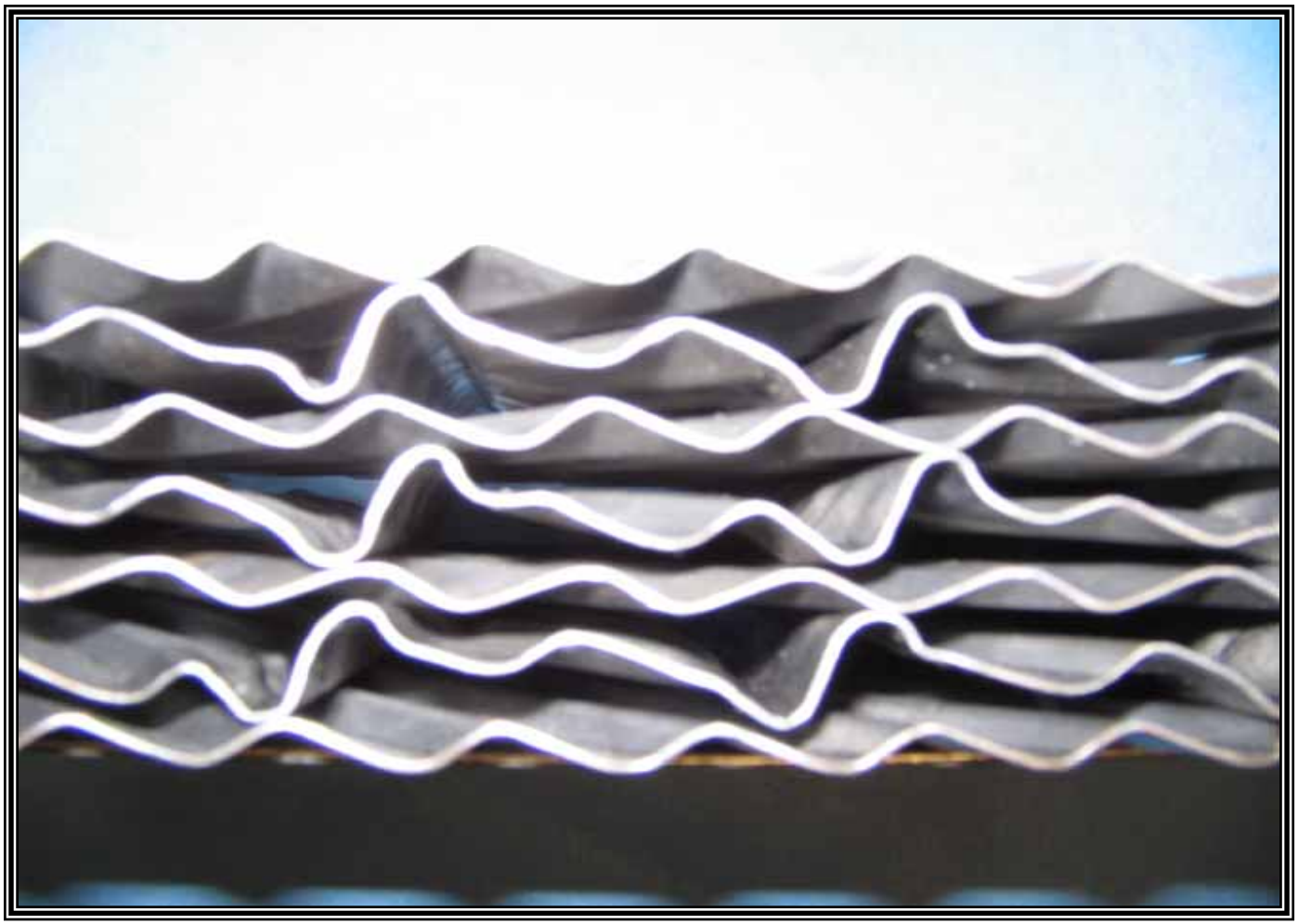
FORMATION OF AMMONIUM BISULFATE

$$NH_3 + SO_3 + H_2O = NH_4HSO_4$$

ABS BUILD-UP AT PRECIPITATOR INLET

Ammonium bisulfate deposits at ESP inlet in a coal-fired boiler with ammonia injection for NO_x control.

TYPICAL DU ELEMENT



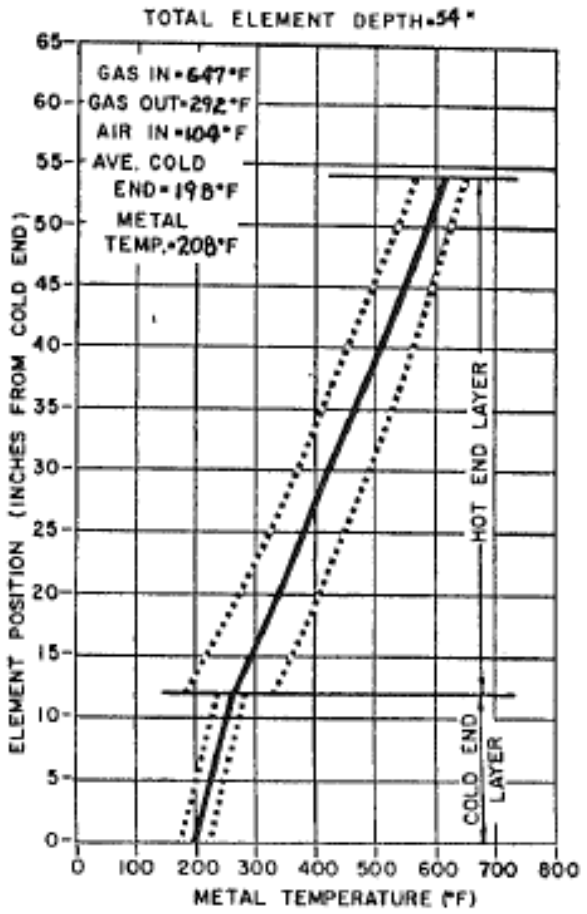
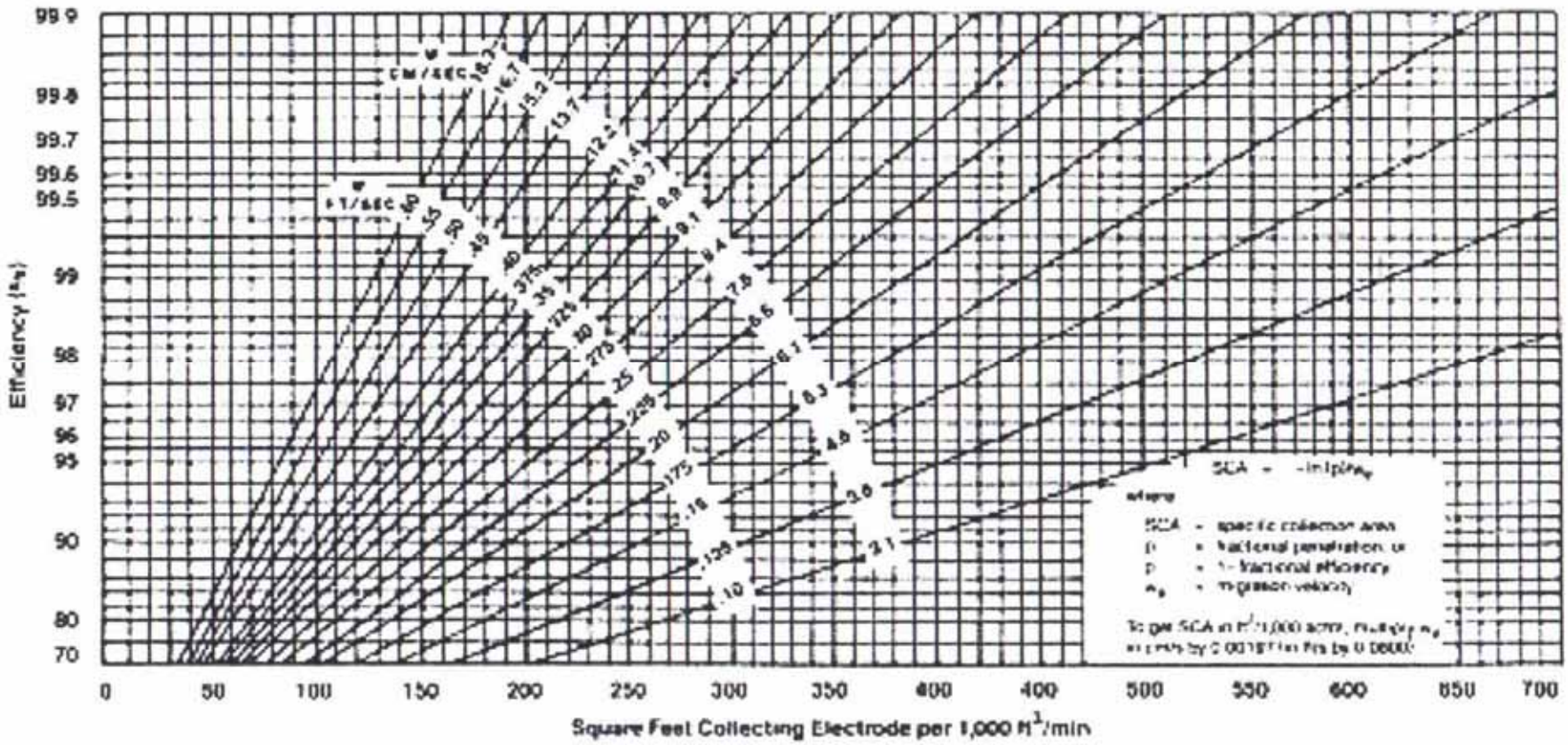
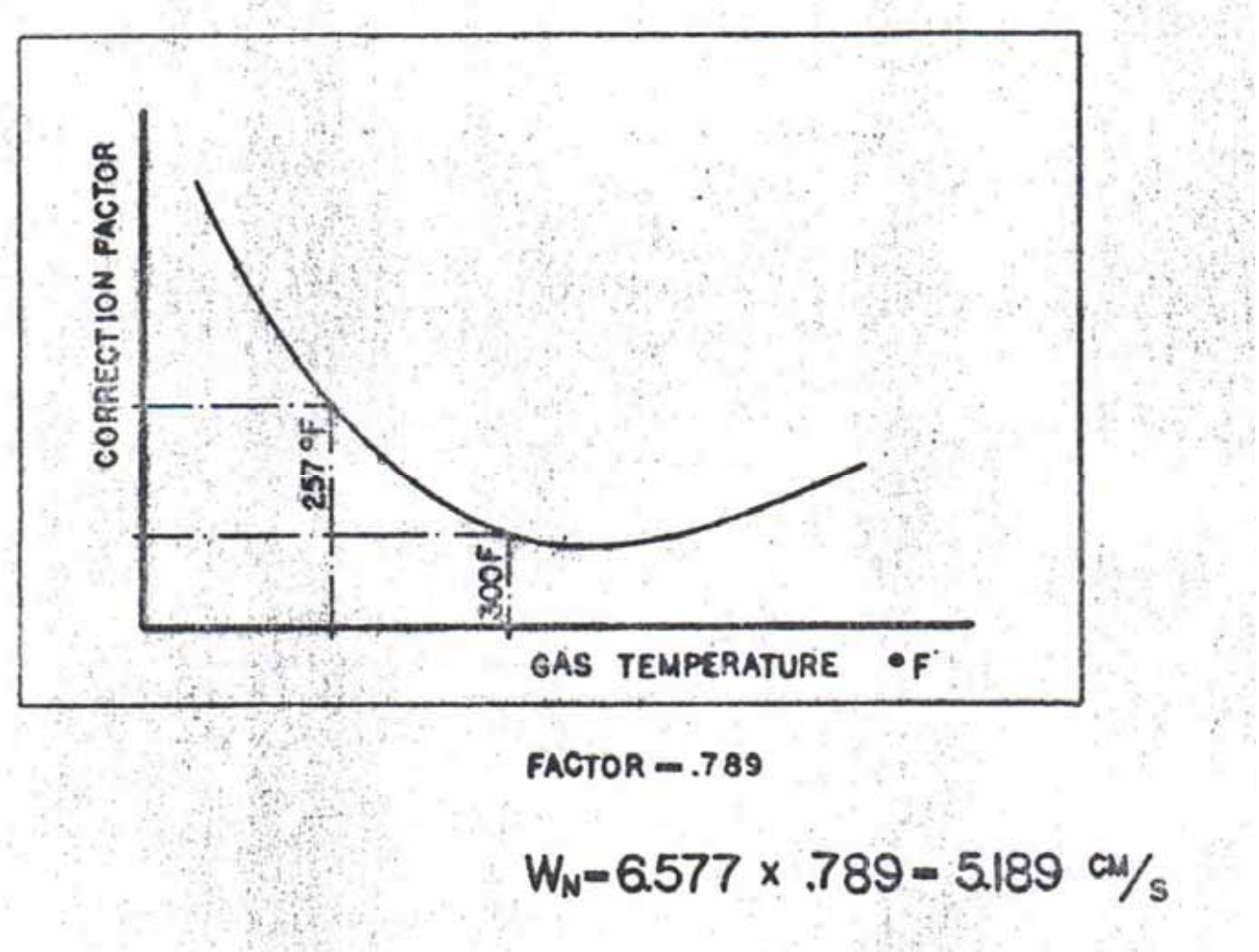


Fig. 2. Ljungstrom Air Preheater Heating Element Metal Temperature Gradient


Efficiency (%)
99.9
99.8
99.7
99.6
99.5
99
98
97
96
95
90
80
70
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Square Feet Collecting Electrode per 1,000 ft³/min

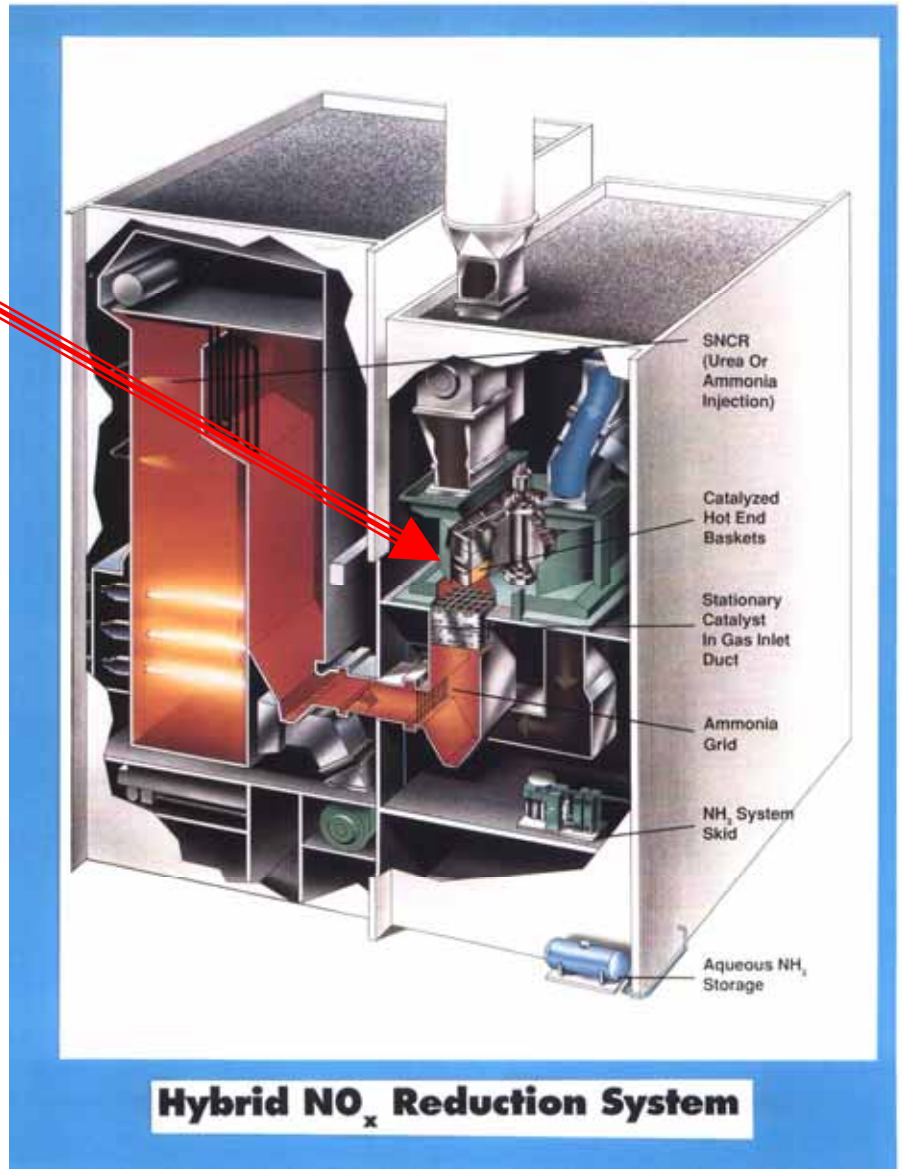


EFFECT OF TEMPERATURE ON MIGRATION VELOCITY

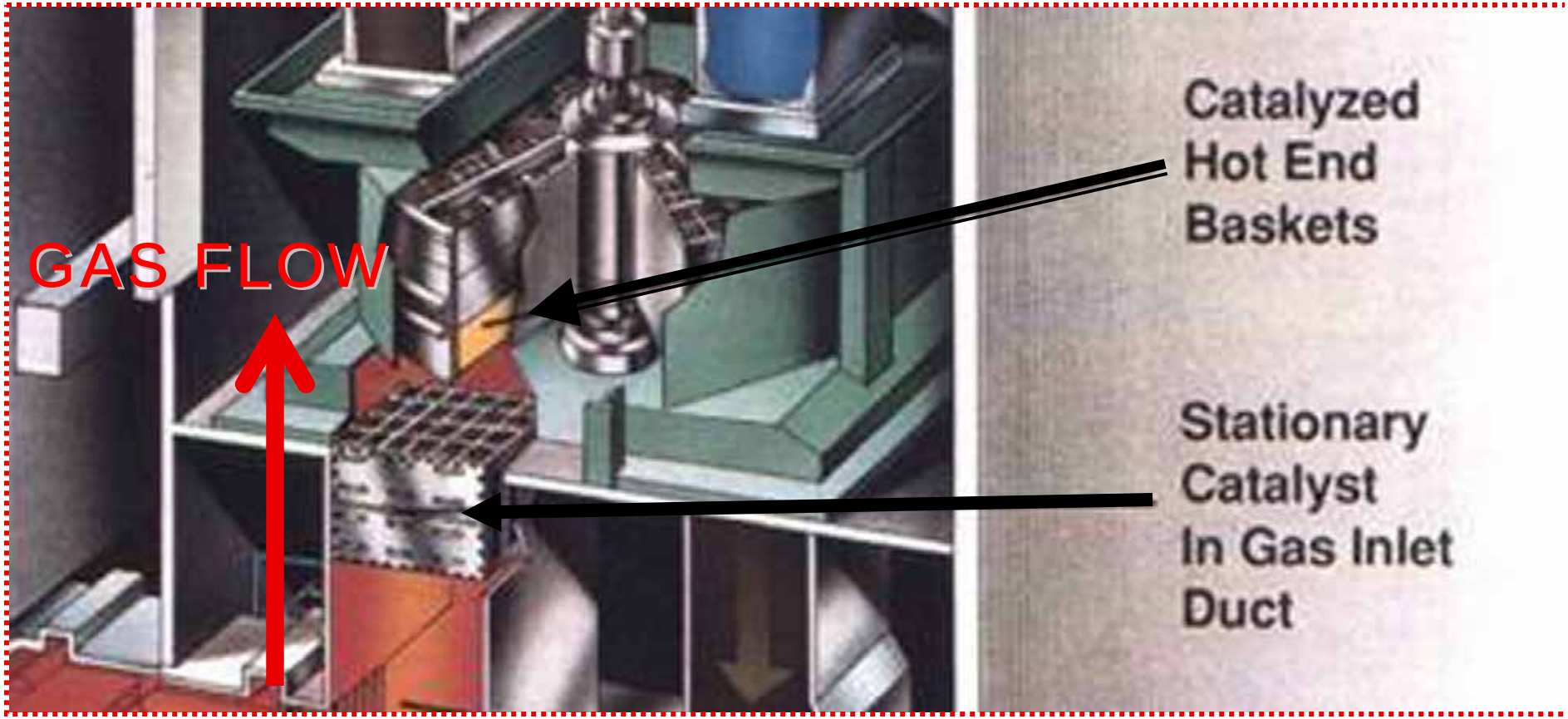
AIR HEATER ELEMENT FAILURES RELATED TO ABS BUILDUP

CATALYTIC AIR HEATER

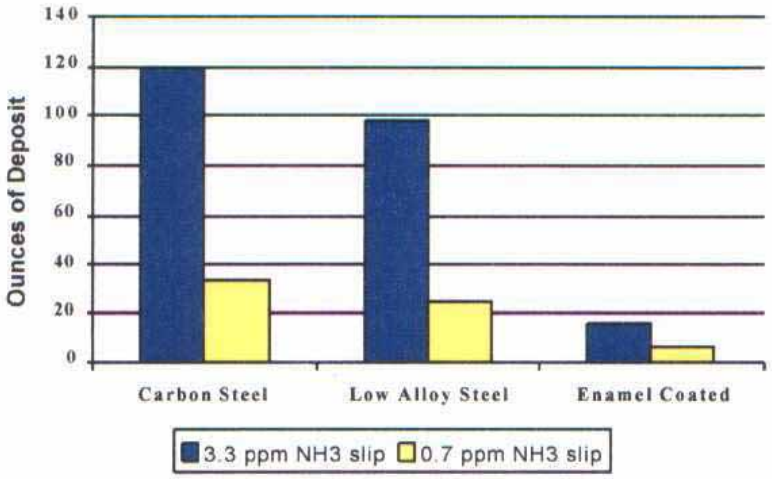
CATALYST LAYER

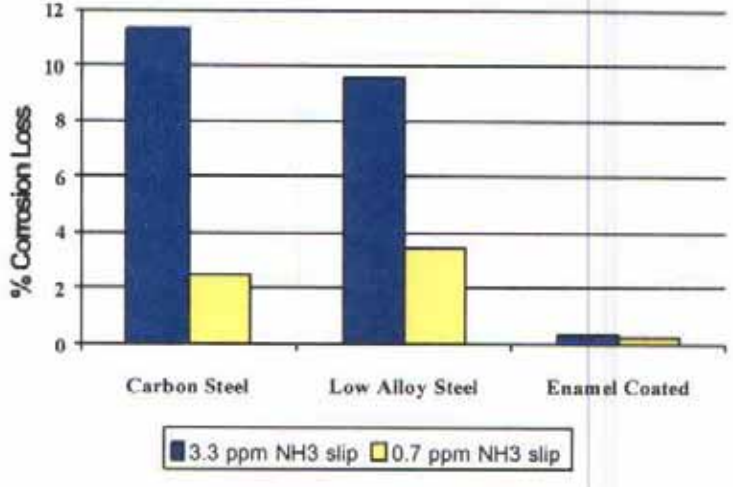


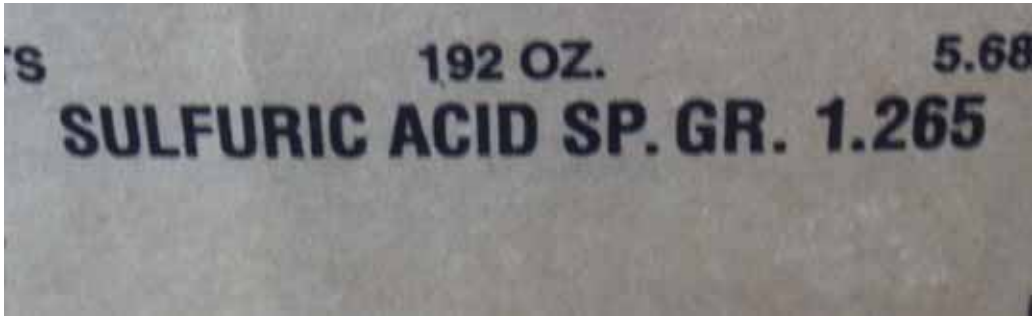
CATALYST IN AIR HEATERS



BENEFITS OF CORROSION RESISTANT AND LUBRIC COATING IN THE ABS ZONE

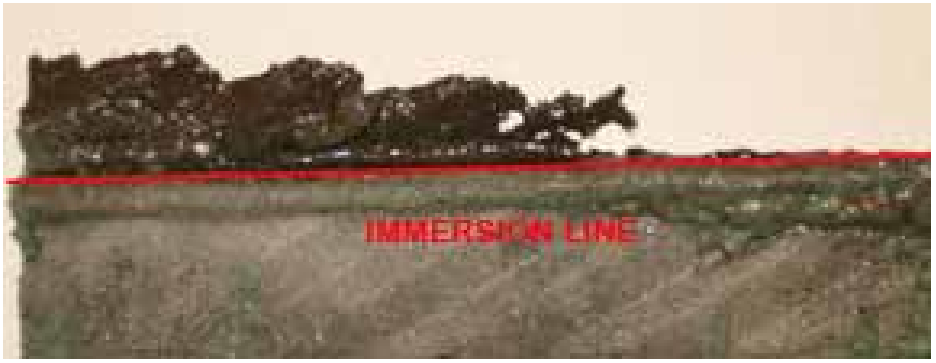






COLD CORROSION TEST COATED AND UNCOATED SAMPLES

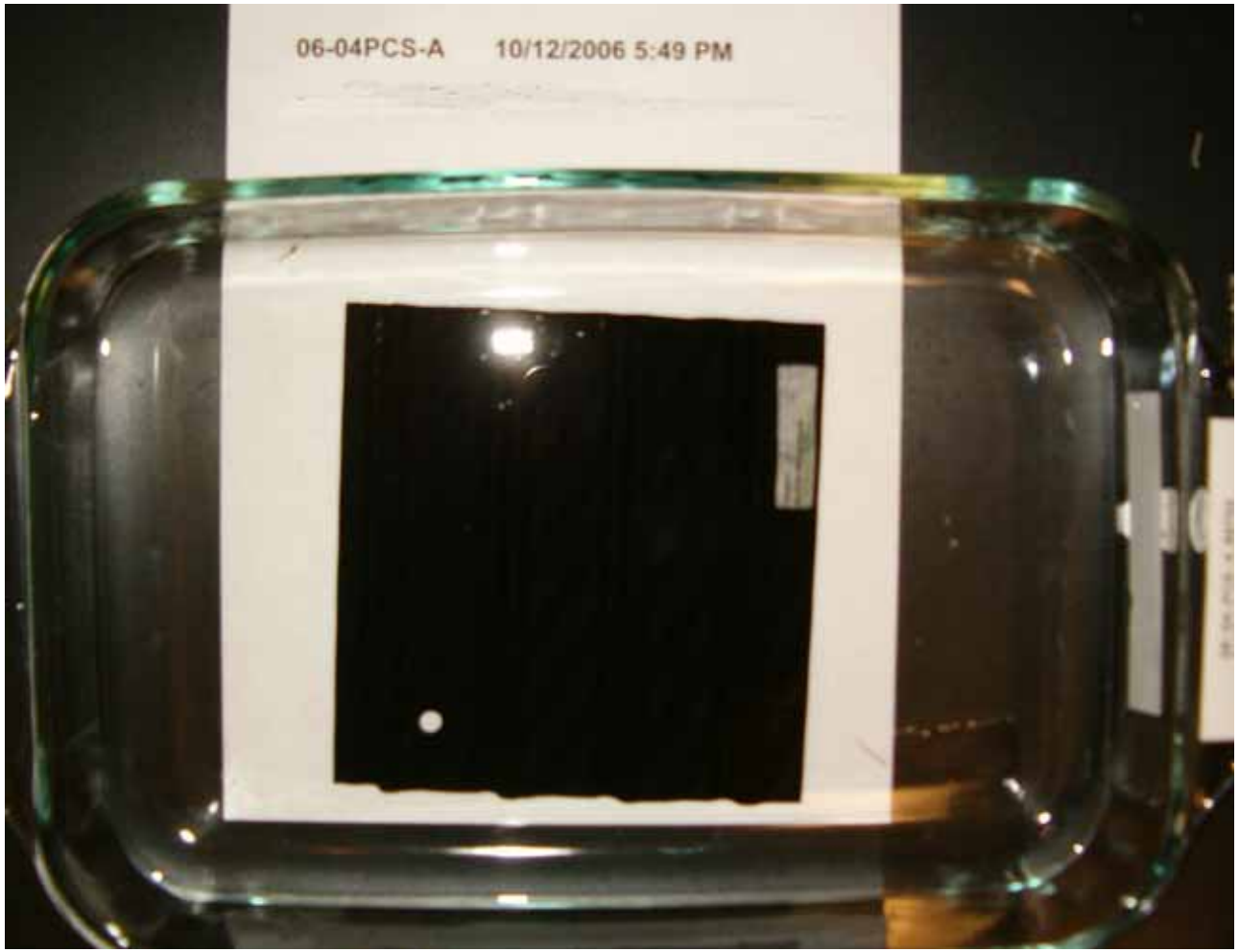
30 DAY COLD ACID TESTS



UNCOATED LACR

PARAGON COATING

SAMPLE COLD TEST



Effects of Poor Air Heater Performance on Back End APC Equipment

John Guffre

Paragon Airheater Technologies

ESP MICROMETER MEASURMENTS