WHAT OPERATORS NEED TO KNOW ABOUT BLOWERS

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What are blowers?
and
Why do we need them?

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Why do we need them?

- Diffused-air aeration systems consist of submerged devices that introduce air as bubbles beneath the water surface (perforated membranes, jets, coarse bubble diffusers)
- Air flow must be provided under pressure to the submerged devices through pipes

What are blowers?

- Blowers are low pressure, high capacity compressors that provide the air flow to diffused-air aeration systems

Types of Blowers

- Multi-stage Centrifugal
- Rotary-Lobe, Positive-Displacement
- High-speed Turbo

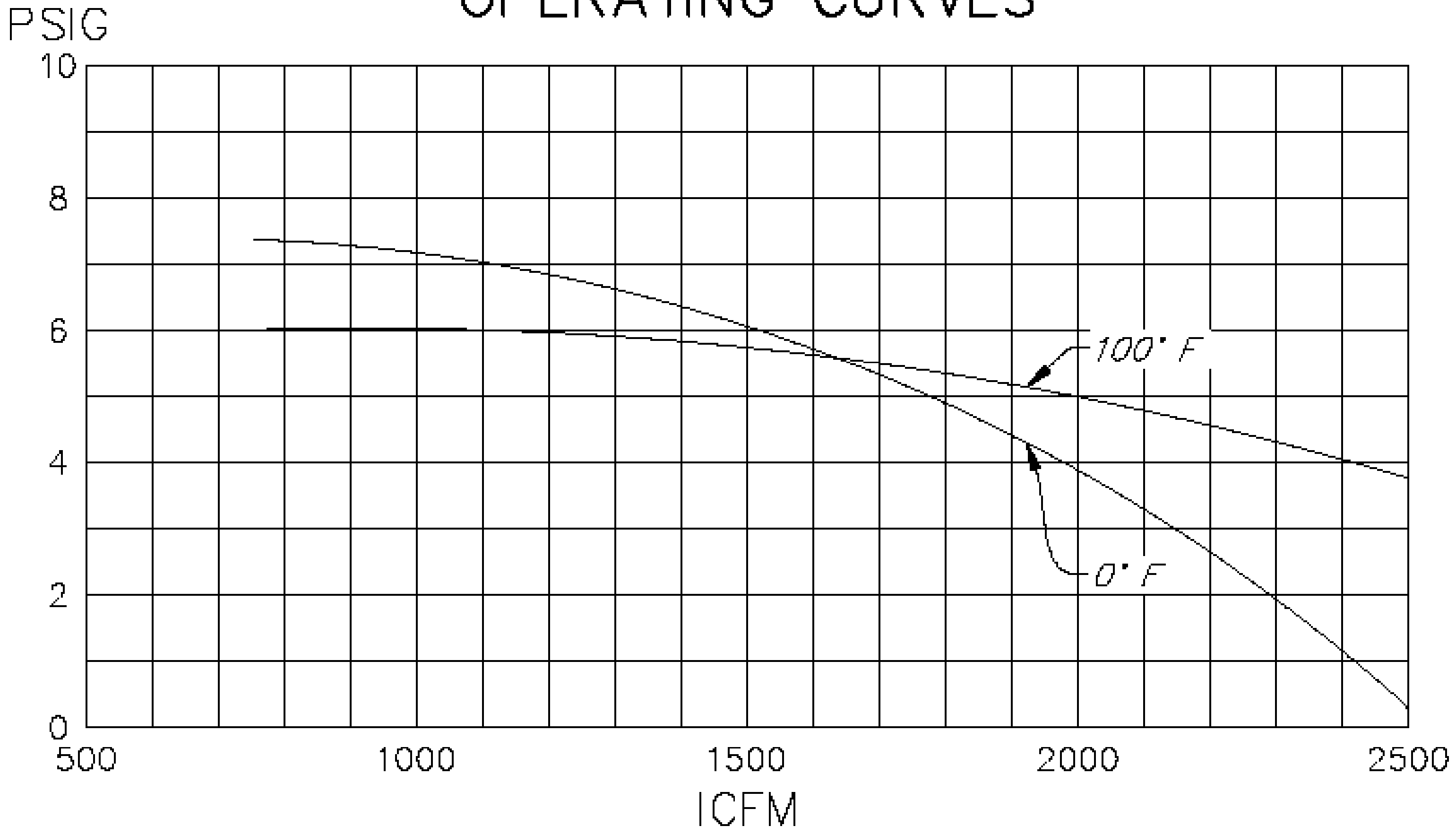
Multi-stage Centrifugal Blowers

- Historically, the “work horse” blower at wastewater treatment plants
- Available in a wide range of air flow rate capacities
- Moderate noise and does not require acoustic insulation
- Efficiency ranges from about 50% (throttled) to about 70% (unthrottled)
- Usually direct driven at 3,600 RPM constant speed
- Usually throttled to optimize energy usage down to about 50% of design volumetric flow rate using an inlet butterfly valve, but can be throttled using a variable speed drive

Multi-stage Centrifugal Blowers (continued)

- Has a relatively “flat” capacity versus pressure curve; therefore, a slight increase in discharge pressure results in a significant reduction in volumetric flow rate
- Requires external air flow rate and discharge pressure measurement along with electric inlet modulating butterfly valve and/or variable speed drive in order to configure for automatic energy usage optimization operation

MULTI-STAGE CENTRIFUGAL BLOWER OPERATING CURVES



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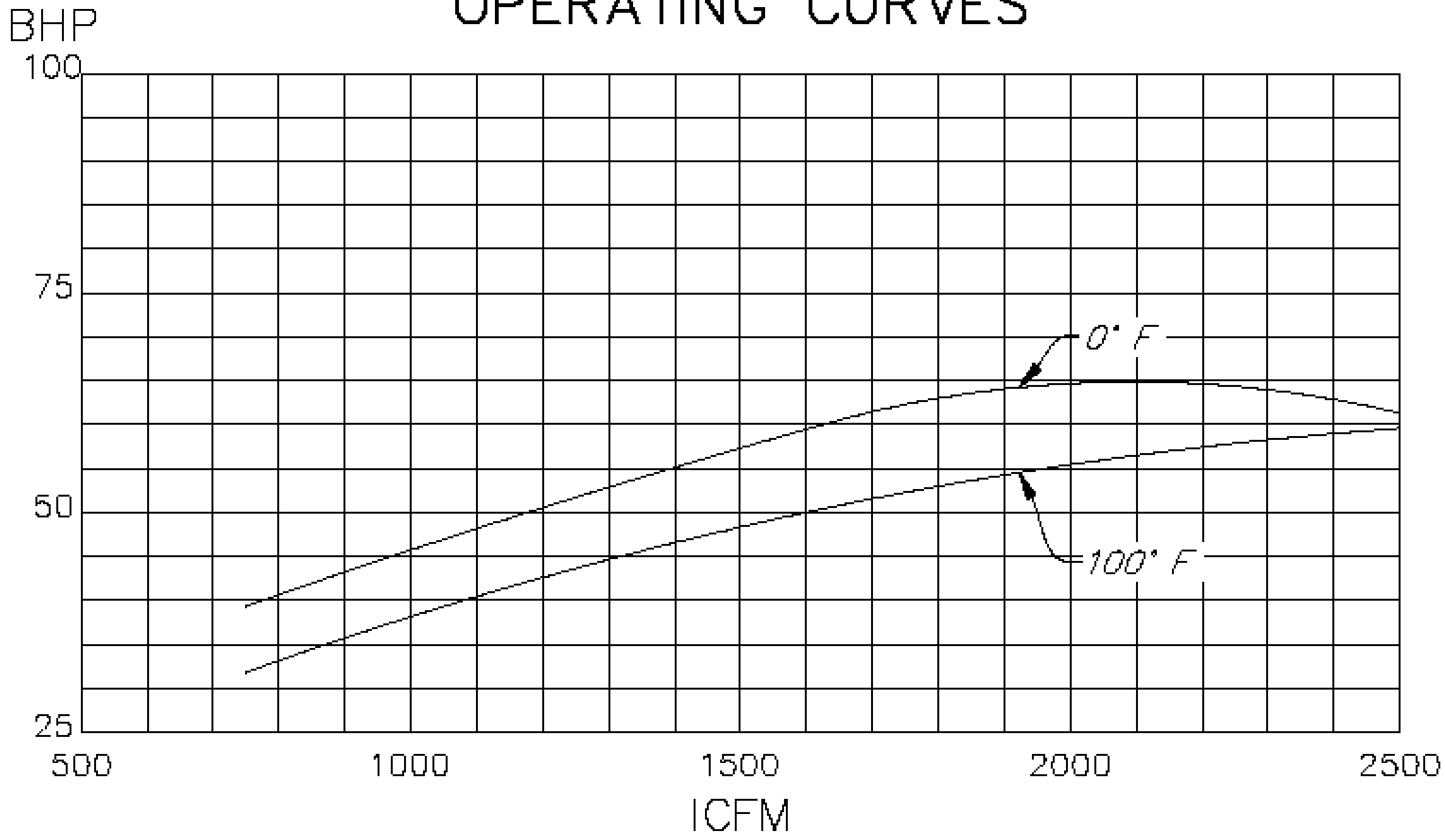
MULTI-STAGE CENTRIFUGAL BLOWER OPERATING CURVES



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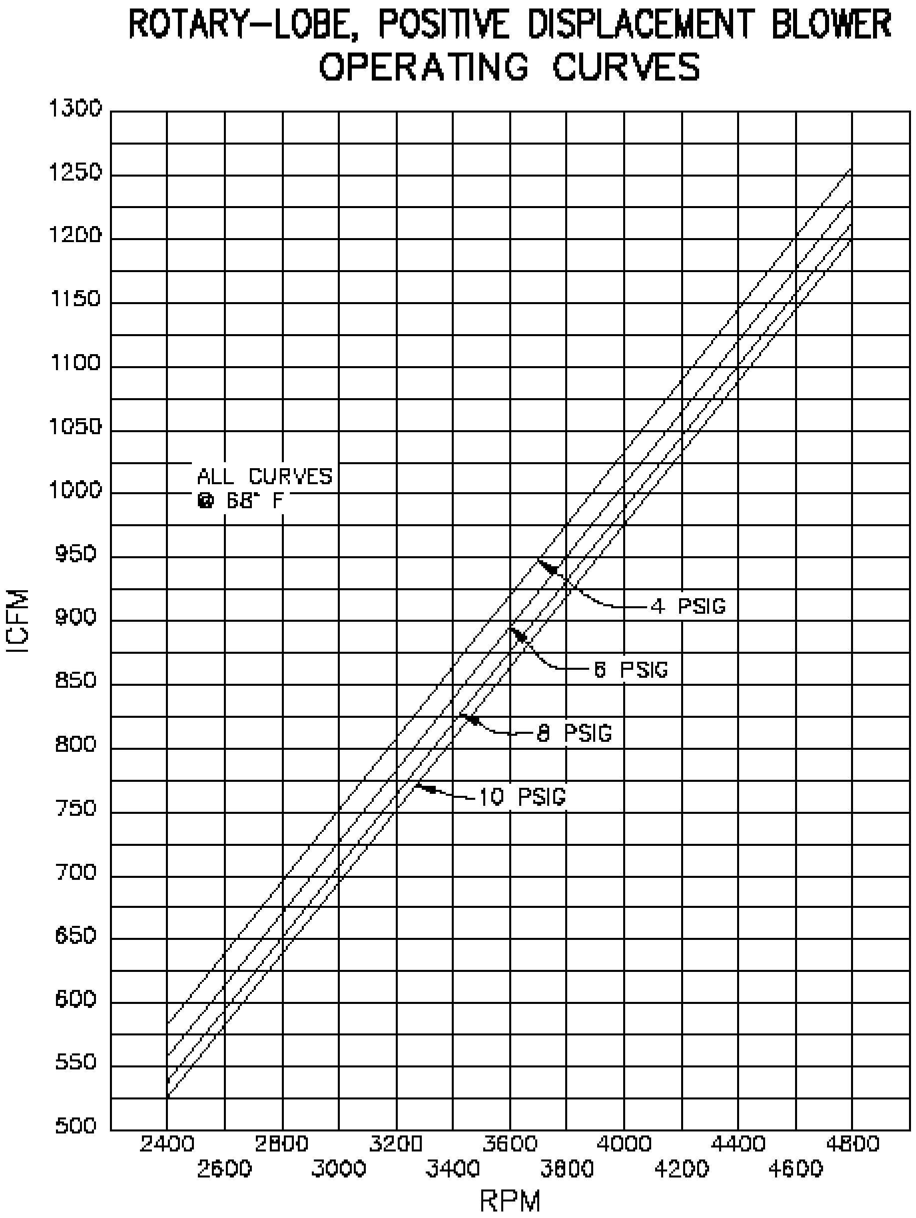
Rotary-Lobe, Positive-Displacement Blowers

- Typically available in lower air flow rate capacities
- Extremely loud and usually requires acoustic insulation type enclosure
- Has a relatively “steep” capacity versus pressure curve; therefore, minor changes in discharge pressure only cause minor changes in volumetric flow rate. Typically used on variable depth reactors such as sequencing batch reactors and aerobic sludge digestors.
- Efficiency ranges from about 45% to about 65%


ROTARY-LOBE, POSITIVE DISPLACEMENT BLOWER
OPERATING CURVES
ICFM
RPM
ALL CURVES
@ 68° F
4 PSIG
6 PSIG
8 PSIG
10 PSIG
1300
1250
1200
1150
1100
1050
1000
950
900
850
800
750
700
650
600
550
500
2400
2600
2800
3000
3200
3400
3600
3800
4000
4200
4400
4600
4800

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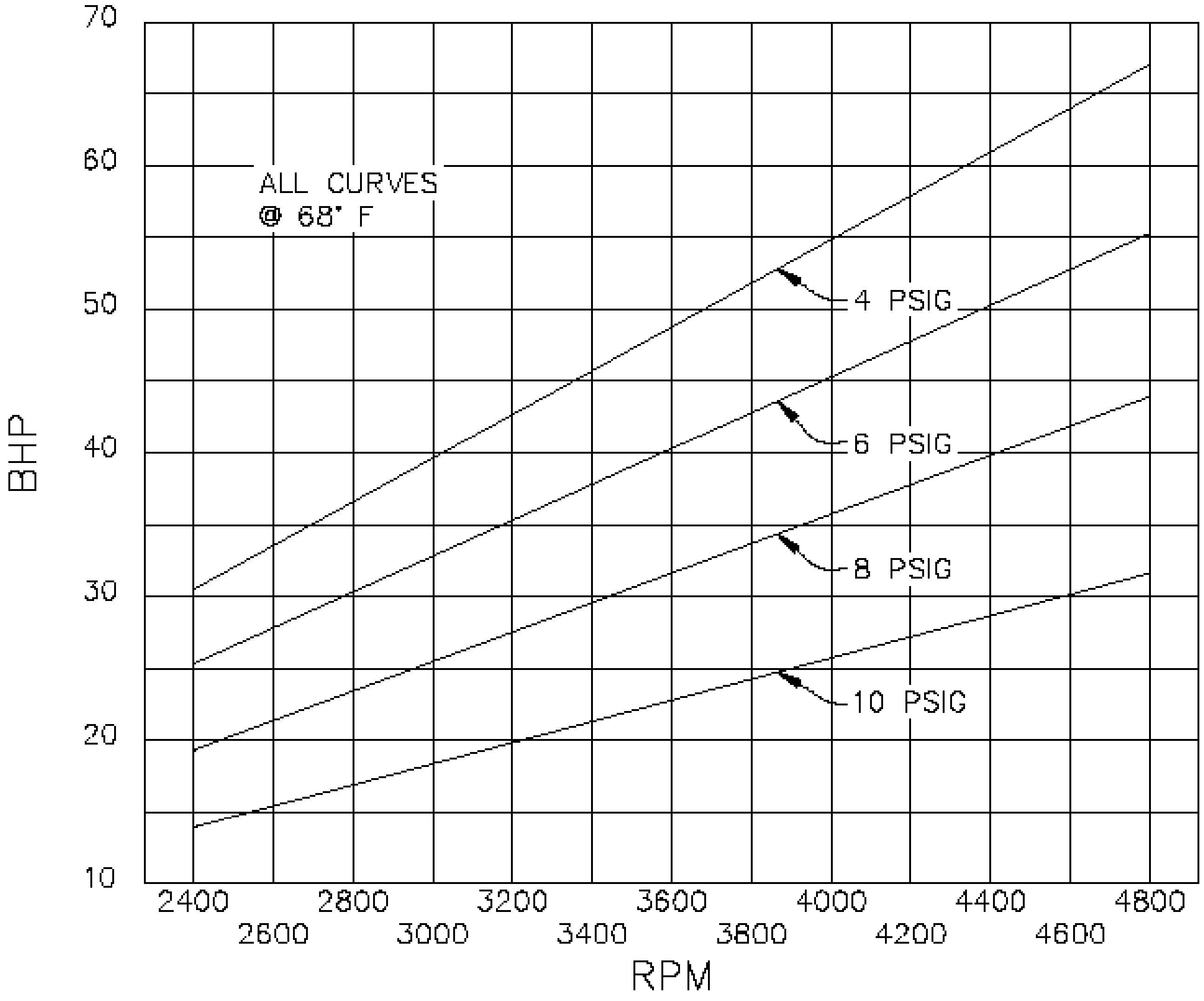
ROTARY-LOBE, POSITIVE DISPLACEMENT BLOWER OPERATING CURVES



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Rotary-Lobe, Positive-Displacement Blowers (continued)

- Easily adaptable for use with variable speed drives to modulate volumetric flow rate to optimize energy usage down to about 50% of design volumetric flow rate. Throttling using the discharge valve increases inefficiency and is not desirable.
- Requires external air flow rate and discharge pressure measurement along with variable speed drive in order to configure for automatic energy usage optimization.

High-speed Turbo Blowers

- Newest blower technology
- Available in capacities comparable to multi-stage centrifugal blowers
- Efficiency ranges from 70% to 80% reported by manufacturers
- Furnished as an "engineered system" including single stage blower/very high speed (30,000 RPM) motor integral unit, custom integral variable speed drive, discharge air flow rate and pressure monitoring instruments and complete blower control and protection system. The engineered system is housed in an enclosure that allows air conditioning of the motor and control and protection system.

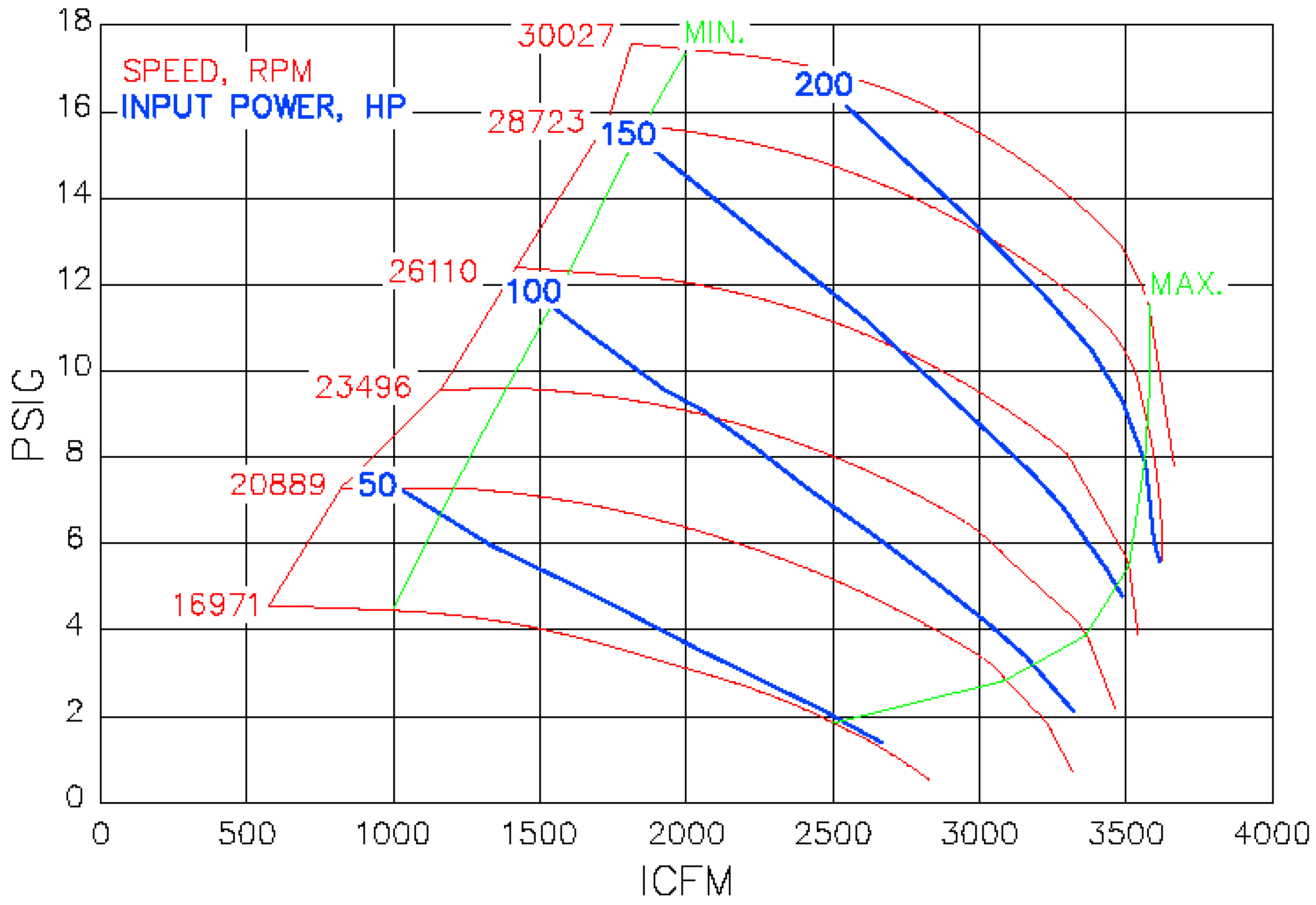
High-speed Turbo Blowers (continued)

- System enclosure minimizes noise
- Controls can be configured to provide a constant air flow rate at varying discharge pressure (i.e., varying reactor water levels) or a constant pressure at varying air flow rates
- Must consider the following characteristics that differ between manufacturers:
  - ❖Air foil bearings versus magnetic bearings
  - ❖Engineered system enclosure cooling requirements

High-speed Turbo Blowers (continued)

- Integral variable speed control based on air flow rate or discharge pressure along with ability to vary air flow rate to about 50% of design volumetric rate makes optimization of energy usage inherent in high-speed turbo blowers installation

HIGH SPEED TURBO BLOWER OPERATING CURVES



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Air Flow Rate Terminology

- SCFM is "standard cubic feet per minute" and for wastewater blower applications usually means the air entering the blower inlet is at 14.7 PSIA, 68°F and 36% relative humidity
- ICFM is "inlet cubic feet per minute" and is calculated by adjusting SCFM for actual site air temperature, barometric pressure and relative humidity
- ACFM is "actual output cubic feet per minute" and if ICFM calculations account for the drop in barometric pressure across the inlet filter, ACFM = ICFM

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Common Mistakes Made in Applying Blowers to Wastewater Treatment Needs

- Not converting SCFM to ICFM. For the temperatures, barometric pressures and relative humidities experienced in Tennessee, this can result in 8% to 12% air flow rate errors.
- Not adjusting ICFM to account for barometric pressure loss across the inlet filter and silencer. This is usually about 0.2 PSIA.
- Not calculating ICFM and associated blower horsepower for minimum expected air temperature. At 0°F, this can result in under sizing a blower motor by up to 20 percent.
- Not including relative humidity in ICFM calculations.