TECHNICAL Manual

ENGB NATURAL GAS BOOSTERS

Externally Accessible Motor Wiring

Cool-Flow Technology™

Sliding Tank Housing

Customizable Outlet Positioning

*** New, Advanced Features**
*** Volume to 120,000 ICFH**
*** Static Gains in Excess of 41” WC**
*** Explosion-Proof Motor**

ETTER Engineering has been providing process heating and combustion solutions since 1940. Our vast experience in the 20th century led us to develop the ETTER Natural Gas Booster - a booster designed for the 21st century, with the flexibility to fit whatever specifications your application calls for.

ETTER manufactures a complete line of packaged booster systems called the gasPOD™ - true “Plug and Play™” designs that arrive at the job site ready to begin work.

We also offer UL-approved check valves and a variety of other accessories and services to guarantee your gas booster installation is as quick and easy as possible.

TABLE OF CONTENTS:

Model Number:________________________________

Serial Number:________________________________

Natural gas booster design has gone unchanged for decades...*UNTIL NOW.*

1.0 LIMITED WARRANTY

TWO YEAR WARRANTY STATEMENT

LIMITED WARRANTY: ETTER Engineering warrants all new complete units that are manufactured by ETTER to be free from defects in material and workmanship for a period of 24 months from date of shipment of the product from ETTER. ETTER warrants that all manufactured replacement parts from ETTER for the ENGB Gas Boosters will be free from defects in material and workmanship for a period of 180 days from date of shipment of the product from ETTER. Any factory rebuilt equipment will be warranted to be free from defects in material and workmanship for a period of 180 days from date of shipment of the product from ETTER.

If, within that period, ETTER receives from Buyer written notice of any alleged defect in, or non-conformance of any product & if, in ETTER's sole judgment, the product does not conform or is found to be defective in material or workmanship, then Buyer shall, at ETTER's request, return the part or product F.O.B. ETTER shipping point & ETTER, at its option & expenses, shall repair or replace the defective part or product or refund the Buyer the full price paid for such part or product. Dismounting & reinstallation of defective or nonconforming parts is done at Buyer's expense. Any repayment of purchase price shall be without interest. ETTER's sole responsibility, & Buyer's exclusive remedy hereunder shall be limited to such repair, replacement, or refund of the purchase price as above provided.

The warranties of ETTER do not cover: a.) Failures not reported to ETTER within the warranty period specified above; b.) Failure or damage due to misapplication, abuse, improper installation or abnormal conditions of temperature, dirt or other corrosive matter; c.) Failure due to damage due to operation, either intentional or otherwise, above rated capacity or in an otherwise improper manner as specified within the ETTER ENGB Technical Manual; d.) Products which have been in any way tampered with or altered by anyone other than an authorized representative of ETTER; e.) Products damaged in shipment or otherwise without fault of ETTER; f.) Expenses incurred by buyer in an attempt to repair or rework any alleged defective product; g.) Defects in material & workmanship which are attributable to drawings & specifications provided by buyer; h.) Components manufactured by others are warranted only in accordance with the warranty, if any issued by such other OEM manufacturers. The two year warranty covers the mechanical fabrication known as the "booster" proper and the booster motor.

ETTER makes no statement of warranty or guarantee of performance unless provided in writing by ETTER separate of this document. Should any dispute of performance of the equipment arise in the field it may require a third party such as an independent laboratory because of incorrect inconsistent field conditions surrounding the installed booster. The performance must be evaluated in laboratory like conditions per AMCA Standards in order to validate the tabulated data provided by ETTER. The tabulated performance conveyed in the ETTER ENGB Technical Manual is based directly on the empirical testing of the equipment in an AMCA Standards laboratory environment.

LIMITATION OF LIABILITY: ETTER's sole responsibility & Buyer's sole & exclusive remedy with respect to any breach of warranty under this agreement shall be limited to repair and/or replacement. ETTER's total responsibility & liability for any & all claims, damages of any nature, losses, liabilities or costs of corrective efforts, including but not limited to those relating to any warranty or guarantee arising out of, or related to performance of this agreement or the products covered hereunder, or the performance thereof shall not exceed the original product's purchase price. In no event shall ETTER be liable for any special, indirect, incidental or consequential damages of any kind, including but not limited to: loss of use or productive facilities or equipment; lost profits, personal and property damage; expense incurred in reliance on ETTER's performance hereunder; or lost production, whether suffered by Buyer or any third party. ETTER disclaims all liability for any & all costs, claims, demands, charges, expenses or other damages, either direct or indirect, incidental to all property damages arising out of any cause of action based on strict liability. Freight charges on warranty replacements are the sole responsibility of the Buyer.

2.0 APPLICATION OF A GAS BOOSTER

Gas boosters are applied when there is insufficient pressure available to run a piece of equipment. The gas booster can be thought of as a specialized pump or fan that handles natural gas and other flammable gases. Its uniqueness is that in an effort to eliminate shaft seals and their associated leaks the fan's motor has been encased in the gas stream. In order to accomplish this safely, the gas booster's motor is a Class 1 Div I explosion-proof motor and the entire unit is hermetically sealed.

The booster can be applied to various commercial and industrial applications. These include:

• The most common is for a gas fired piece of equipment that has a higher minimum supply pressure than that provided by the local utility. This is most prominent in older cities with supply infrastructures that are over burdened, however, with today's more demanding equipment, boosters are no longer limited to just older locations.

• The booster can also help resolve undersized piping systems that result from a Plant or Building's growth over time. The building and its supply may have been fine twenty years ago, but over time new facilities and equipment may have been added, taxing the system. A booster can resolve pressure deficiencies, but can never address volume deficiencies - that's an issue with the Gas Company.

• Natural Gas fired equipment can often be backed up by a Propane-Air mixture that is similar to Natural Gas. Often the Propane-Air mixture may require an additional boost for proper application, which is another use for a Gas Booster.

• Landfill Gas (LFG) is tapped methane that is escaping from the decaying materials present in the landfill. This gas (LFG) is typically lower in BTU content than natural gas, but is still a viable fuel known as bio-fuel. The issue with LFG as it comes from the landfill is the gas is essentially at atmospheric pressure (or 0 PSIG), and needs to be boosted to be applied as a fuel.

• Digester Gas (DG) projects, which are similar to LFG applications, take the methane gases collected from above a Waste Water Treatment Plant's digester and use it as a bio-fuel. Once again this fuel is captured at a very low pressure and needs to be increased.

• Both LFG and DG applications require special attention, as they also contain corrosive chemical compounds (referred to as "sour gases") that can be corrosive to standard materials of construction.

Natural gas booster design has gone unchanged for decades...*UNTIL NOW*.

As a result, these units must be specially ordered and the wetted surfaces of construction are specially fabricated for corrosion resistance.

2.1 APPLYING BOOSTERS FOR GASES OTHER THAN NATURAL GAS

• The tables and data contained in this manual are all based on performance with Natural Gas. This is the most common of all gaseous fuels used in both Commercial and Industrial applications.

• In order to project the performance of the booster to a gas with a specific gravity (Sg) other than Natural Gas you **must** apply the following Fan Rules of Physics:

☐ Static Gain(new gas) = (Sg(new gas)/ Sg(Natural Gas)) x (Static Gain(Natural Gas))

☐ HP(new gas) = (Sg(new gas)/Sg(Natural Gas)) x (HP(Natural Gas))

3.0 SAFETY PRECAUTIONS:

• Read and follow all instructions in this manual. Contact your authorized ETTER Engineering Representative with any questions.

• Follow proper methods for lifting during installation and removal.

• Remove all crating and packing materials, including inlet and outlet covers prior to booster installation.

• Inspect inlet and outlet openings for foreign matter and tools before connecting piping.

• Do not climb on or stand on booster.

• Install flexible pipe connections on inlet and outlet connections.

• Verify that all piping and all accessories are properly installed.

• Only licensed electricians should install the proper switch or starter and make any necessary connections.

• Lock and tag all electrical circuits **open** when servicing equipment.

• Verify all connections are correct based on the booster nameplate.

• Operate booster with sufficient restriction to avoid motor overloading.

• Do not operate booster in surge conditions - Damage to booster may result.

• Use only ETTER approved parts and service for repairs.

4.0 HANDLING AND STORAGE

All ETTER Gas Boosters have been tested at our factory before shipment. The booster is a balanced assembly of rotating parts, and extreme care should be taken so as to not disrupt this balance due to harsh handling.

Boosters should be inspected upon delivery to ensure no damage was incurred during shipping; if damage is suspected, immediately notify both the shipper and ETTER Engineering.

4.1 LIFTING AND MOVING

Proper safety precautions must be taken to avoid damage to the booster or injury to on-site personnel when lifting and/or moving the ENGB.

Only experienced personnel using acceptable rigging practices should lift and/or move the ENGB.

The ENGB can be moved by forklift, overhead crane, or hoist. Always ensure lifting equipment is sufficiently rated for the load involved.

4.2 STORAGE

If storing the ENGB for any period of time, the booster should be covered and placed level in a cool, dry environment free from dirt, contaminants, extreme temperatures, and vibration. Inlet and outlet discharge openings should remain capped.

4.3 UNPACKING

When unpacking the ENGB upon delivery:

• Inspect shipping crate, booster, and any additional parts or accessories for damage.

• Confirm order is correct by checking against shipping manifest.

• Remove and save all shipping documents and booster literature (Installation Guide and Technical Manual).

(HANDLING & STORAGE Cont.)

• Remove any packing materials.

• Ensure ETTER Security Label(s) are properly affixed and have not been damaged.

• Read all included warnings and instructions before continuing.

5.0 INSTALLATION

NOTE: ***All federal, state, and local gas, plumbing, and electrical codes should be followed and take precedence over these instructions. These requirements are location-sensitive.***

Local codes and regulations differ; therefore a licensed electrician and plumber should be used to make all required connections.

5.1 LOCATION

The ENGB should be installed in a cool, dry place free from dirt and other contaminants in accordance with local codes.

If at all possible, the installation location should be large enough to provide sufficient access to the booster from all directions.

For more details on routine access, please see model-specific drawing documentation contained within this document for indication of spatial requirements.

5.2 LEVEL HOUSING

The ENGB does not require a special base for installation, but a level concrete floor or substantial mounting pad is highly recommended.

For long-term physical maintenance, a concrete housekeeping pad is preferable, and recommended, however it is not required.

5.3 MOUNTING BOOSTER TO BASE

The ENGB should be lagged to the floor or other substantial framework (regarding its mass) using the mounting holes provided in the base. (For location of mounting holes, see booster drawings contained in this manual for specific dimensions).

The base must not be flexed or stressed in any manner, as this will create misalignment issues and affect internal rotating parts, which may cause damage to the unit.

5.4 KEEP IN MIND THE WIRING TERMINAL BOX

There are three main points of interface when installing a booster: the inlet pipe connection, the outlet pipe connection, and the wiring terminal box. When locating and determining your piping runs, the installing contractor should be aware of the location of the wiring terminal box and provide allowance for proper access to both the inlet piping flange bolts and the wiring of the box by the installing electrician.

5.5 PRESSURE TESTS/MAX OPERATING PRESSURE

The ENGB is rated to 7 PSIG MOP. Pressure in excess of 7 PSIG MOP may cause permanent damage to the booster housing.

When performing any pipe tests which involve high pressure air, the installing contractor must either bypass the booster or totally disconnect the booster to avoid damaging the booster and voiding the manufacturer’s warranty. Always consider pressure ratings or associated instruments and components like gauges and switches when determining pressure for test.

6.0 PIPING CONSIDERATIONS

Applications that call for the use of a gas booster suffer from a shortage of supply pressure. As a result, the installing contractor and/or design engineer should make all practical attempts to reduce piping line losses in the system. In order to accomplish this, the following should be considered:

• A typical simplex piping schematic is provided in **fig. 1-1** and identifies typical piping and components.

• Piping discharge orientation can be customized per installation to help facilitate installation. See **fig. 1-2** for available options.

• Minimize length of piping runs wherever possible by situating the equipment to reduce the lengths of run.

• Minimize the number of piping transitions including elbows, contractions, expansions, tees and other significant changes in flow velocity.

(6.0 PIPING CONSIDERATIONS Cont.)

• Valve type selection should also be considered as this dramatically affects pressure drop. For instance, a globe style valve takes a very large pressure drop due to the flow path internally compared to a butterfly or ball valve. **See fig. 2** for additional information.

• Select the proper piping size for the flow and run of pipe. Gas flow through long runs of pipe causes a frictional loss or line loss **(see fig. 2).** The smaller the pipe, the higher the frictional line loss factor. As a result, as the length of run increases the design engineer should look at increasing the piping diameter to reduce the overall line loss.

• Never subject an ENGB Gas Booster to pressure in excess of 7 PSIG as damage may result. The booster should only be subjected to gaseous flows and should never be hydrostatically tested (pressure tested with water) as damage will result.

• Piping must not subject booster to any undue stresses. The house piping shall be properly supported and isolated from the booster inlet and outlet using approved flexible connectors.

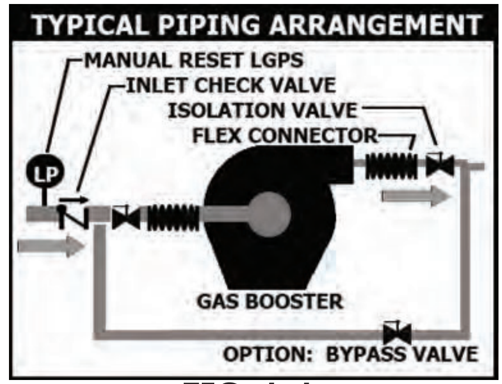


FIG. 1-1

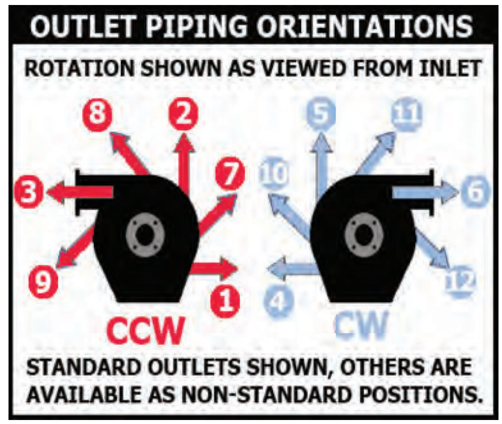


FIG. 1-2

PRESSURE LOSS DUE TO FRICTION FOR LOW PRESSURE NATURAL GAS LINES

TABLE VALUES ARE THE PRESSURE DROP IN INCHES WC FOR FLOW THRU 100 EQUIVALENT FEET OF SCHED 40 PIPE

FLOW SCFH	1-1/2"	2"	2-1/2"	3"	4"	6"	8"
1000	0.8						
2500	5.2	1.3	0.5				
5000	20.7	5.4	2.1	0.7			
10,000			8.4	2.8	0.7		
20,000				11.2	2.8	0.3	
30,000					6.2	0.7	
40,000					11.0	1.2	0.3
50,000					17.3	2.0	0.4
60,000						2.8	0.6
70,000						3.8	0.8
80,000						5.0	1.1
90,000						6.3	1.4
100,000						7.8	1.7

EQUIVALENT LENGTH OF PIPE FOR TYPICAL VALVES & FITTINGS

TABLE VALUES ARE THE EQUIVALENT FEET OF SCHED 40 PIPE FOR ONE OF THE LISTED ITEMS

ITEM	1-1/2"	2"	2-1/2"	3"	4"	6"
ELBOW 90	2.7	3.5	4.0	5.2	6.8	10.2
ELBOW 45	1.9	2.4	3.0	3.7	5.5	8.2
TEE, THRU	2.7	3.5	4.0	5.2	6.8	10.2
TEE, BRANCH	8.0	10.5	12.5	15.3	20.1	30.5
BUTTERFLY	2.7	3.6	4.2	5.0	6.5	8.0
LUBR PLUG	10.0	13.0	15.0	18.5	25.0	35.0
GATE	0.9	1.1	1.3	1.6	2.1	2.6
GLOBE	45.0	58.0	70.0	85.0	115.0	142.0
SWING CHECK	10.0	13.5	16.0	20.0	27.0	40.0

FIG. 2

7.0 ELECTRICAL CONSIDERATIONS

7.1 BOOSTER NAMEPLATE

The ENGB Booster Nameplate **(fig. 3)** provides the installing contractor with all pertinent information at a glance, including motor voltage, phase, rotation (CW or CCW) horsepower, motor serial number, date code, booster serial number, application information (Natural Gas, Landfill Gas, or LPG/Air Mixtures).

Before installing the booster, confirm the job-site wiring correctly matches up with the specifications listed on the booster nameplate.

DO NOT run the booster on any voltage and phase other than listed on the name plate, or serious damage and/or harm could occur.

7.2 LOCAL ELECTRICAL CODES

All federal, state, and local electrical codes should be followed and take precedence over these instructions. These requirements are location-sensitive.

Where applicable, wiring methods to and from the booster must be consistent with the area classification per NEC section 500.

Only a licensed electrician should be used to make all required electrical connections.

7.3 MOTOR PROTECTION

All boosters must be wired through an appropriately sized motor starter circuit.The motor starter circuit can be either a NEMA style, with adequately sized overloads, or an IEC style with adequately sized motor circuit protector. Follow the manufacturers sizing for selection. When possible with IEC style protection, select the high inrush models for optimized performance. The general wiring schematic **(fig. 4)** shows a typical system wiring. Required low-gas pressure interlocks and other control features may be required.

7.4 MOTOR STARTING

The motors are designed to be run either continuously, or cycle with minimum run times. The minimum run time must be part of the control circuit, which will allow the motor and motor protection equipment to cool off after the initial inrush of starting. The boosters are designed to run, if necessary, without flow for the duration of the minimum run time. The motors must not be started more than once within a one hour period - a minimum run time of 60 minutes is necessary to satisfy this requirement.

7.5 FAN ROTATION

It is important that the rotation of the booster is the same as that posted on the rotational arrow. Incorrect rotation will result in less than rated pressure performance, and can result in motor damage.

To check the rotation:

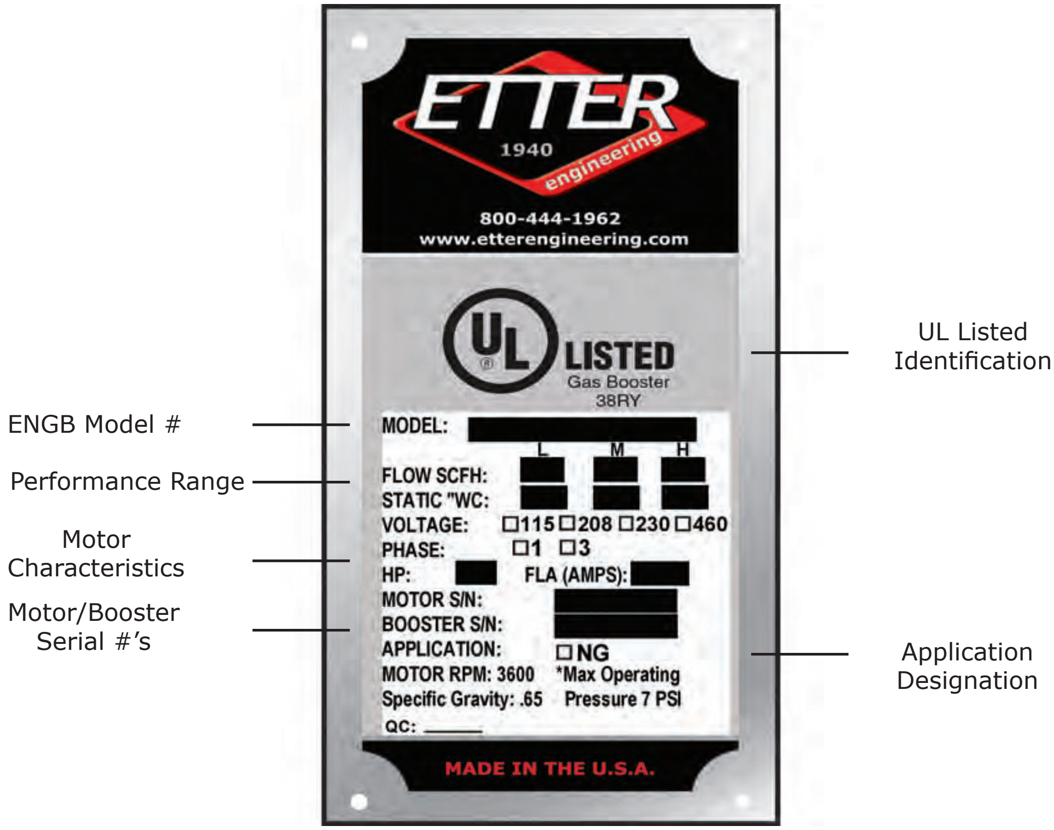
1) Shut off inlet gas valve(s)

2) Remove the rotational check plug in the end of the booster

3) “Bump” the motor, and view the rotation of the wheel

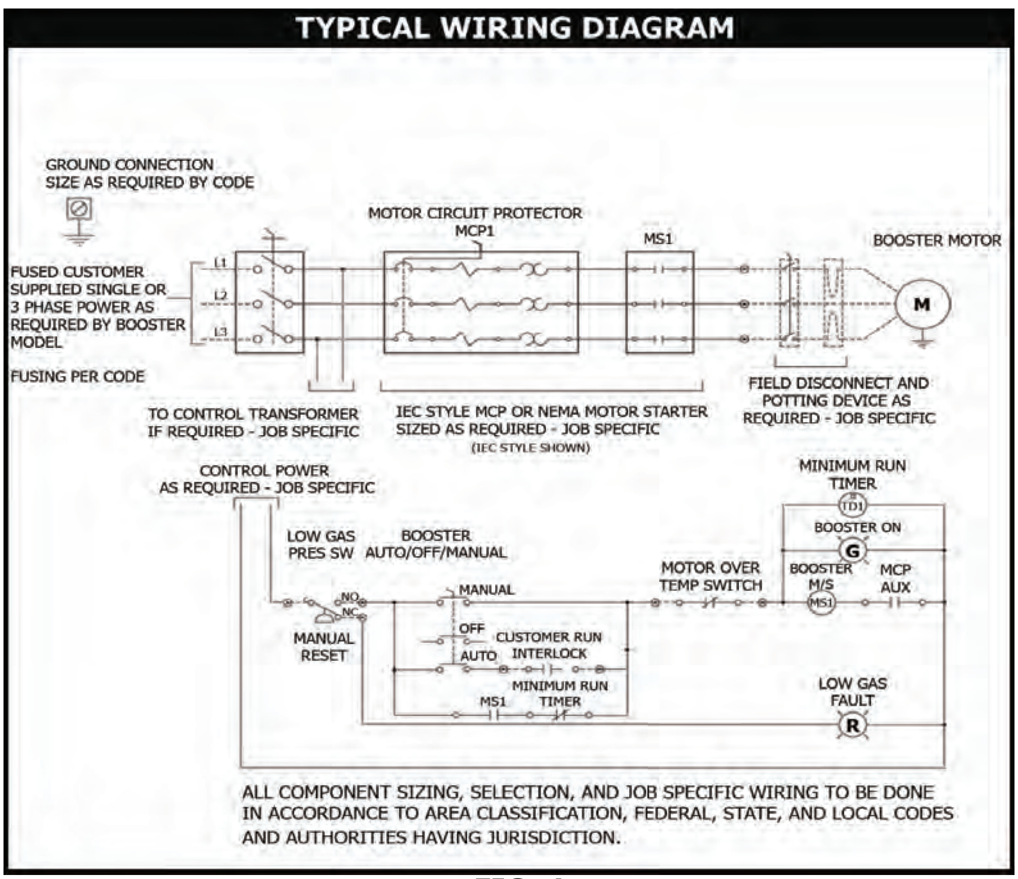
4) If rotation is correct, replace the plug with approved thread sealant, then continue with the startup procedure

5) If the rotation is incorrect, lock-out and tag-out the power, and swap two of the motor leads on the motor starter circuit. This will reverse the motor direction. Once confirmed, replace the plug with approved thread seal and then continue with the startup procedure.



ETTER
1940
engineering
800-444-1962
www.etterengineering.com
UL
LISTED
Gas Booster
38RY
MODEL:
L M H
FLOW SCFH:
STATIC "WC:
VOLTAGE: 115 208 230 460
PHASE: 1 3
HP: FLA (AMPS):
MOTOR S/N:
BOOSTER S/N:
APPLICATION: NG
MOTOR RPM: 3600 *Max Operating
Specific Gravity: .65 Pressure 7 PSI
QC:
MADE IN THE U.S.A.
UL Listed Identification
ENGB Model #
Performance Range
Motor Characteristics
Motor/Booster Serial #'s
Application Designation

FIG. 3



TYPICAL WIRING DIAGRAM
GROUND CONNECTION SIZE AS REQUIRED BY CODE
MOTOR CIRCUIT PROTECTOR MCP1
MS1
BOOSTER MOTOR
FUSED CUSTOMER SUPPLIED SINGLE OR 3 PHASE POWER AS REQUIRED BY BOOSTER MODEL
L1
L2
L3
M
FUSING PER CODE
TO CONTROL TRANSFORMER IF REQUIRED - JOB SPECIFIC
IEC STYLE MCP OR NEMA MOTOR STARTER SIZED AS REQUIRED - JOB SPECIFIC
(IEC STYLE SHOWN)
FIELD DISCONNECT AND POTTING DEVICE AS REQUIRED - JOB SPECIFIC
CONTROL POWER AS REQUIRED - JOB SPECIFIC
MINIMUM RUN TIMER
TD1
BOOSTER ON
G
LOW GAS PRES SW
BOOSTER AUTO/OFF/MANUAL
MOTOR OVER TEMP SWITCH
BOOSTER M/S
MCP AUX
MS1
MANUAL
NO
NC
MANUAL RESET
OFF
AUTO
CUSTOMER RUN INTERLOCK
MINIMUM RUN TIMER
MS1
LOW GAS FAULT
R
ALL COMPONENT SIZING, SELECTION, AND JOB SPECIFIC WIRING TO BE DONE IN ACCORDANCE TO AREA CLASSIFICATION, FEDERAL, STATE, AND LOCAL CODES AND AUTHORITIES HAVING JURISDICTION.

FIG. 4

8.0 SIZING A GAS BOOSTER

When sizing a gas booster, the designer must consider the following for the optimal installation:

NOTE: We have provided a worksheet on the adjacent page to help you document your sizing.

1. Create the list of the equipment that the gas booster is servicing including the flow rate (in SCFH or BTUH), minimum and maximum inlet gas pressures.

2. Evaluate the building's gas piping layout to determine the following:

a. Can the desired equipment to be serviced be fed by a common "boosted header"?
b. The convenient and practical point of installation of the booster.

NOTE: The local Gas Company will insist that the booster is installed downstream of their meter.

3. Determine or obtain from the Gas Company the minimum supply pressure to the building.

4. Using the tables provided in the **PIPING CONSIDERATIONS** of this manual, determine the inlet line losses from:

a. The meter to the inlet connection of the booster.
b. The outlet of the booster to the furthest piece of equipment being serviced.

5. From Step 1 above determine the highest "minimum supply pressure" required by the equipment being serviced.

6. Subtract from Step 5 the inlet supply pressure from the Gas Company from Step 3 above.

7. You now must account for your piping losses in the system from the meter to the equipment by adding Step 4a and 4b to your answer in Step 6. This is your gas boost requirement.

8. Determine your "connected load" by adding all equipment determined in Step 1.

8.1 SELECTING A GAS BOOSTER:

Historically, gas booster capacities have been expressed in Performance Tables which list the model, the flow and the static pressure of the booster. ETTER has provided the same, but has taken it a step further in providing actual performance curves for each of our booster and wheel combinations. You now have the choice, and here is what we can tell you of the two methods:

Performance Table: Provides a snap shot of information (typically peak performance) but does not provide you with the full picture. ETTER's performance tables have been enhanced for your reference and convenience, providing the user with three sets of data points: a Low Flow-Peak Static, a High Flow-Lower Static, and a Mid-Range data point.

Performance Curves: Using a performance curve provides the user with "the entire" picture when selecting a booster. It includes how the booster will perform above and below your design point which can be anywhere on the curve (or below it) and no longer is limited to one or a few data test points. In addition, it provides pertinent information regarding the Horsepower Performance at your design point, which is helpful when sizing and selecting your gas booster.

Curves are like watching a football game while looking through a wide angle lens - seeing the whole field and the play develop, while Tables would be viewing through a powerful zoom lens, seeing only a player or two at a time. Both have their advantages; we have provided both for your convenience.

8.2 SIZING & SELECTION NOTES

A) Equipment	Min. Equipment's Supply Pressure	SCFH
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______

B) Minimum Supply Pressure (From Gas Company): ______ "WC

C) Line Losses from:

a) Meter to Inlet Connection of Booster: ______ "WC

b) Booster Outlet to Furthest Equipment: ______ "WC

Now Calculate Your Needed Boost

D) Highest Minimum Supply Pressure Required: ______ "WC

(From Chart A Above)

- Line B: ______ "WC

+ Line C Total (C_a + C_b):

+ Line C: ______ "WC

Total Gas Boost Required = ______ "WC

E) Connected load (Add all equipment from Line A): ______ SCFH

9.0 ENGB NATURAL GAS CAPACITY CHART

FAM	ENGB	IN	OUT	WHEEL	HP	LOW FLOW "WC	LOW FLOW ICFH	MID FLOW "WC	MID FLOW ICFH	HIGH FLOW "WC	HIGH FLOW ICFH	MIN FLOW ICFH
ENGB2	120	1 1/2	1 1/2	D1	0.5	6.9	800	6.9	1,200	6.9	1,800	0
	130	2	2	D1	0.5	6.9	2,000	6.9	3,400	6.9	4,800	0
	140	3	3	D1	0.5	6.9	4,000	6.9	5,500	6.4	10,000	0
	147	4	4	D1	0.5	6.9	3,000	5.9	12,500	3.2	20,000	0
	150	6	4	D1	0.5	6.9	5,500	4.5	17,000	2.0	23,000	0
	157	4	4	D2	0.75	6.8	7,000	6.7	15,000	6.0	24,000	0
	160	6	6	D2	0.75	6.8	10,600	4.5	36,500	2.0	49,500	0
ENGB3	167	2	2	E1	0.5	9.0	2,000	9.0	3,400	9.0	4,800	0
	170	3	3	E1	0.5	8.9	4,000	9.2	8,500	9.0	10,000	0
	200	4	4	E2	1	9.1	5,000	9.1	15,000	9.1	21,000	0
	210	6	6	E2	1.5	9.1	20,000	8.9	31,000	8.6	38,000	500
	220	6	6	E2	2	9.1	20,000	8.5	40,000	6.9	60,000	500
	227	2	2	F1	1	11.2	2,000	10.6	3,400	10	4,800	0
	230	3	3	F1	1	11.3	4,000	11.3	6,200	11.0	10,000	0
	240	4	4	F1	1	11.3	6,500	9.0	17,500	6.5	22,000	0
	247	4	4	F2	1.5	12.0	10,000	11.2	16,000	10	24,000	500
	250	6	4	F2	1.5	11.3	15,000	11.0	21,500	10.5	26,000	500
	260	6	6	F2	2	11.3	15,000	10.2	29,000	8.8	39,000	500
	270	6	6	F3	3	11.4	20,000	11.4	30,000	11.3	39,000	1,000
	280	8	8	F3	5	11.4	20,000	10.8	70,000	9.2	102,000	1,000
	281	2	2	G1	1	13.7	2,000	13.5	3,400	13.1	4,800	0
	283	3	3	G1	1	13.7	4,000	13.6	8,500	13.4	10,000	0
	287	4	4	G1	1	14.8	8,000	14.4	14,000	13.0	23,500	0
	290	6	4	G1	1.5	13.7	11,000	13.4	16,500	12.8	23,500	500
	300	6	6	G1	2	13.7	11,000	11.0	30,000	7.3	40,000	500
	310	6	6	G2	2	14.8	20,000	14.2	28,000	13.2	37,000	500
	320	8	8	G2	3	13.6	28,000	12.7	50,000	9.3	84,000	1,000
	330	8	6	G3	5	13.4	30,000	13.2	57,000	13.0	69,000	1,000
	340	8	8	G3	7.5	13.4	30,000	13.1	60,000	12.0	100,000	1,500
	341	2	2	H1	1.5	18.2	2,000	18.0	3,400	17.6	4,800	500
	343	3	3	H1	1.5	18.2	4,000	18.1	7,000	17.9	10,000	500
	347	4	4	H1	2	18.2	10,000	18.0	17,000	17.5	22,000	500
	350	6	6	H1	2	18.8	8,000	19.2	16,000	18.8	24,000	500
	360	6	6	H1	3	19.2	18,000	18.2	30,000	15.0	44,000	1,000
	370	6	6	H2	5	18.0	10,000	17.2	35,000	15.2	64,000	1,000
	380	8	8	H2	5	18.0	10,000	14.7	70,000	8.8	120,000	1,000
ENGB4	390	3	3	J1	2	19.8	4,000	19.8	6,500	19.8	10,000	500
	400	4	4	J1	3	19.8	11,000	19.8	16,500	19.7	21,000	1,000
	410	6	6	J1	3	22.8	15,000	22.5	22,000	22.0	28,500	1,000
	430	4	4	J2	3	19.8	10,000	19.8	15,000	19.8	20,000	1,000
	440	6	6	J2	5	19.8	18,000	19.8	42,000	19.4	61,000	1,000
	450	8	8	J2	5	19.8	18,000	18.5	80,000	17.4	94,000	1,000
	460	3	3	K1	2	25.9	4,000	25.9	6,500	25.9	12,000	500
	470	4	4	K1	3	25.5	10,000	25.3	14,000	25.5	17,000	1,000
	480	6	6	K1	5	25.9	10,000	24.5	27,000	20.7	41,500	1,000
	487	4	4	K2	5	26.4	10,000	26.3	14,000	25.5	23,000	1,000
	490	6	4	K2	5	26.2	21,000	26.2	26,000	26.0	28,000	1,000
	500	6	6	K2	7.5	26.0	34,000	25.0	47,500	25.5	60,000	1,500
	510	8	8	K2	10	26.0	34,000	24.0	57,000	17.5	102,000	2,000
	520	4	4	K3	7.5	26.0	8,000	26.0	16,000	26.0	21,000	1,500
	530	6	6	K3	7.5	26.0	12,000	26.0	20,000	26.0	30,000	1,500
	540	8	6	K3	10	26.0	34,000	25.8	52,000	25.0	71,000	2,000
	550	3	3	L1	5	36.7	4,000	36.7	6,500	36.7	12,000	1,000
	560	4	4	L1	5	36.7	9,000	36.8	15,000	36.3	22,000	1,000
	570	6	6	L1	5	36.7	17,500	36.5	20,000	36.0	27,000	1,000
	580	6	6	L1	7.5	36.7	17,500	34.0	39,000	31.3	50,000	1,500
	590	4	4	L2	7.5	35.9	9,000	36.0	16,000	35.9	21,000	1,500
	600	6	6	L2	7.5	34.6	15,000	35.2	25,000	35.2	35,000	1,500
	610	8	8	L2	10	36.0	20,000	35.0	40,000	28.3	81,000	2,000
	620	4	4	L3	5	37.7	15,000	37.7	17,000	37.7	18,500	1,000
	630	6	6	L3	7.5	37.7	28,000	37.5	35,000	37.4	39,000	1,500
	640	8	6	L3	10	37.7	28,000	37.3	45,000	36.1	68,000	2,000
	649	3	3	M1	10	41.4	6,500	41.4	8,000	41.4	12,000	2,000
	650	4	4	M1	10	41.4	9,000	41.4	16,000	41.4	22,000	2,000
	660	6	6	M1	10	41.4	22,000	39.0	43,500	35.0	57,500	2,000

Capacity based on Natural Gas, 500 FASL, Sg=0.65, flows measured in Inlet Cubic Feet Per Hour (ICFH). Minimum flow ratings based on: ambient temperature not to exceed 100 °F, gas temperatures not to exceed 70 °F, elevation less than 2,500 FASL, and 168 operating hours at minimum flow rate. Contact the factory with criteria outside of these parameters.

9.1 HOW TO USE THE PERFORMANCE CURVES:

Let’s walk through an example using the curve below. We have determined our example booster needs a flow rate of 7,000 CFH at a boost of 4.6” wc. Using the curve below, let’s follow these steps:

1. Starting in the left-hand margin of the curve (the Y Axis), using the scale on the graph, establish where 4.6” wc would be.

2. Moving straight across horizontally from the point of 4.6” wc, determine where it intersects directly above 7,000 CFH from the bottom margin (the X Axis).

3. Mark an X at your design point on the graph. Notice that we are between curves (above the B1 Curve, but below the B2).

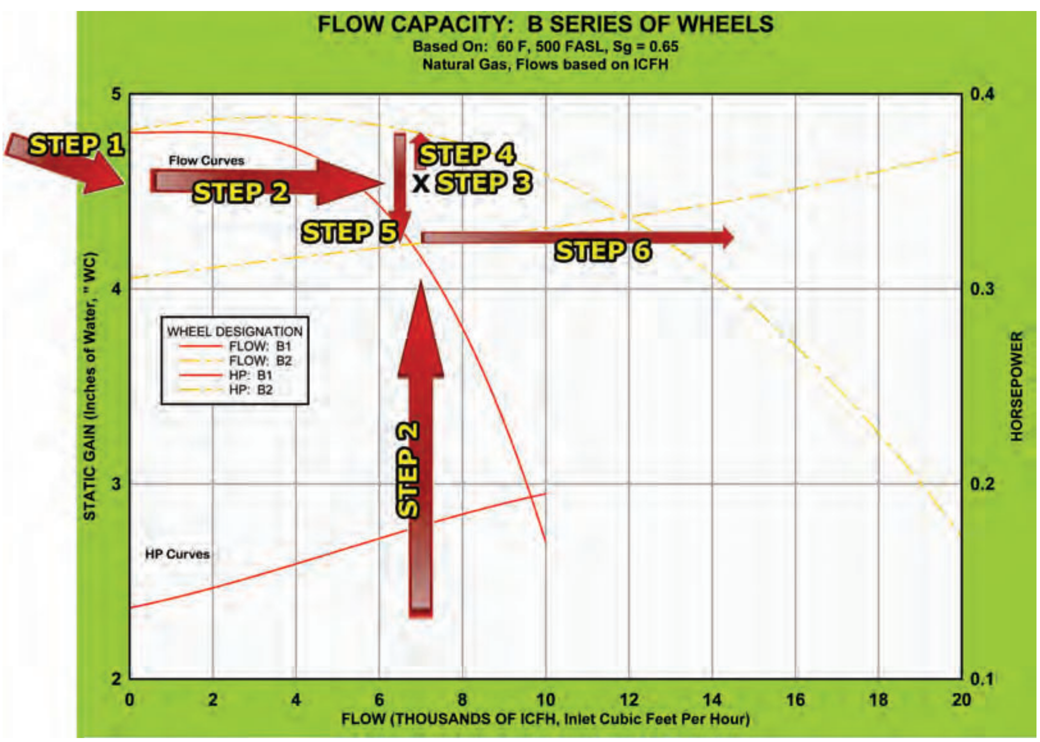
4. You must always select the “next larger” booster that will *over*-satisfy both your **flow** and **static boost** requirements. To do this, travel directly up vertically until you hit the next wheel curve. For this example, you move up to the B2 curve for your selection. If there is no curve above you, i.e., your point is **above** the highest curve on the chart, go to the next wheel series.

5. Now determine your horsepower requirements. From your **“X”** design point, move vertically up or down on the chart to the intersection of the matching HP curve to your fan wheel (in this example, HP: B2).

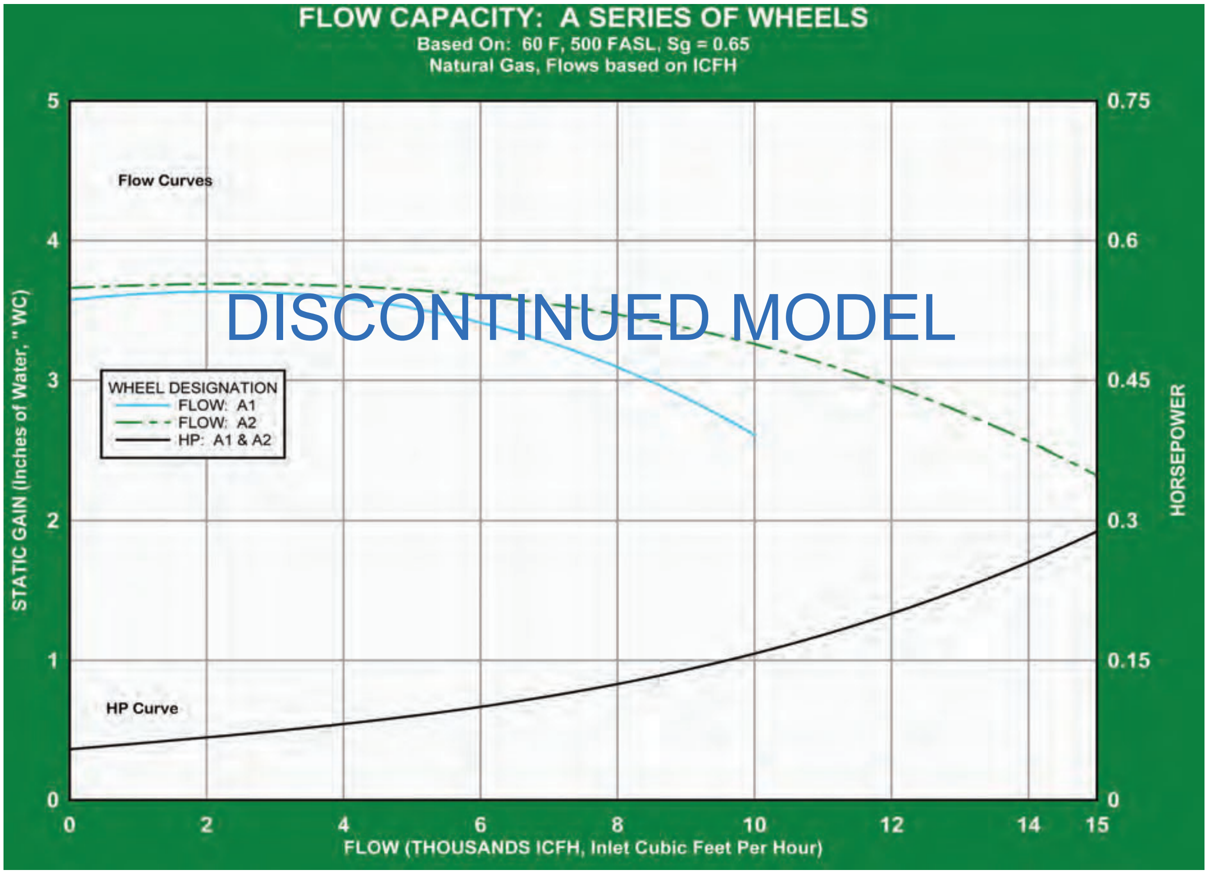
6. From that intersection, move straight across to the right to read your HP off the scale on the graph. In this example, you would have 0.33 HP.

7. ETTER uses a test block in selecting motor sizes and applying them to our boosters. Please use the following chart in establishing an actual motor selection:

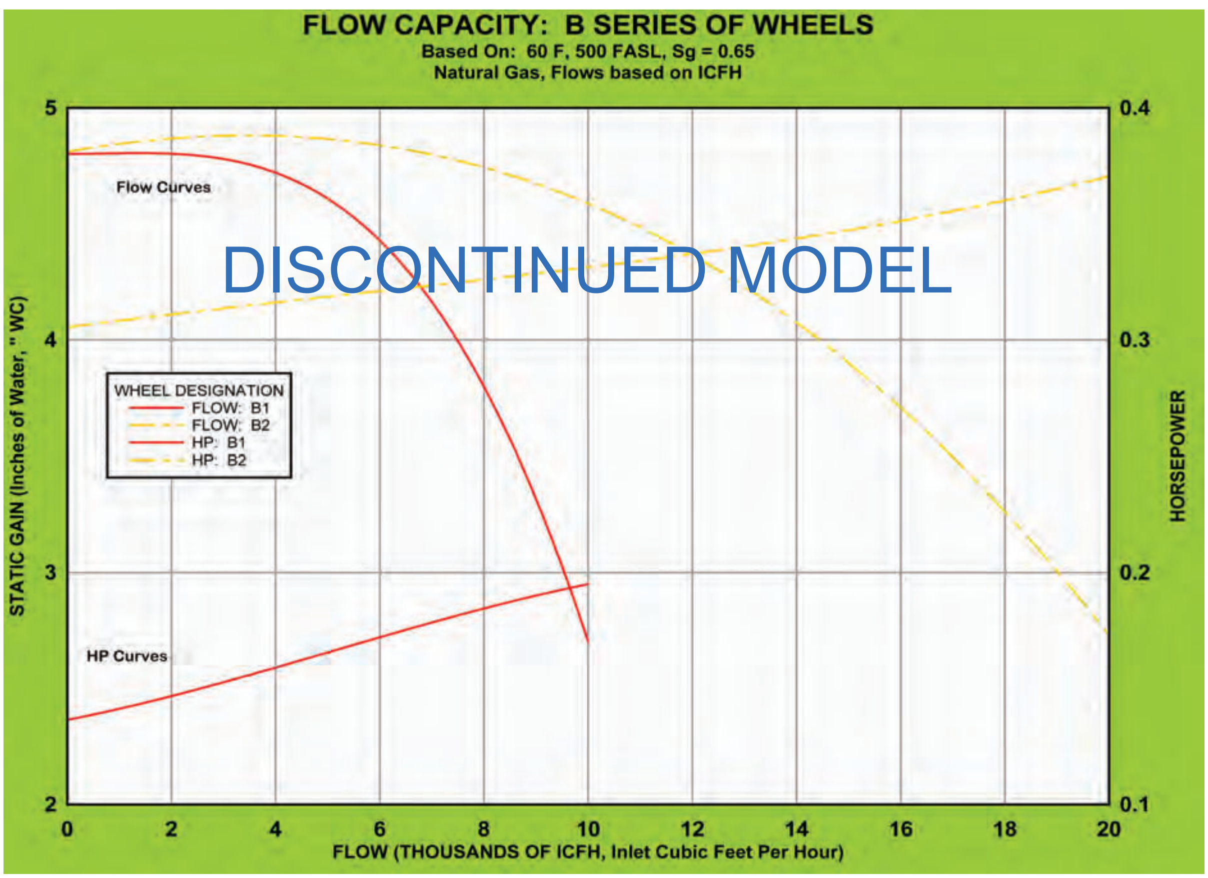
HP up to	0.48	.71	.95	1.43	1.9	2.85	4.75	7.13	9.5
Use this size motor	½	¾	1	1-1/2	2	3	5	7-1/2	10



ETTER

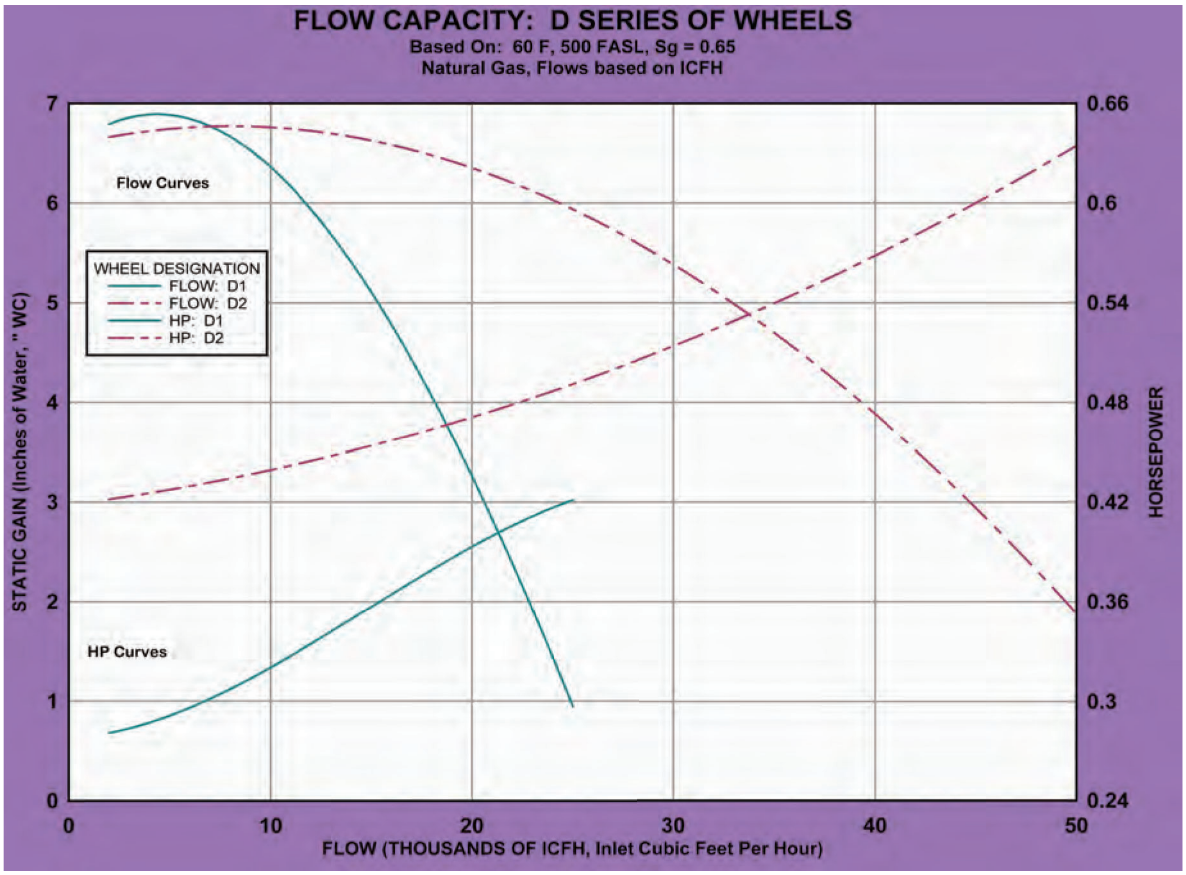


ENGB1 Performance Curves



The curves depicted on the above plots are fan wheel performance curves and are for general reference. For more specific performance for each model size and wheel please refer to the table on Page 9 of this Technical Manual.

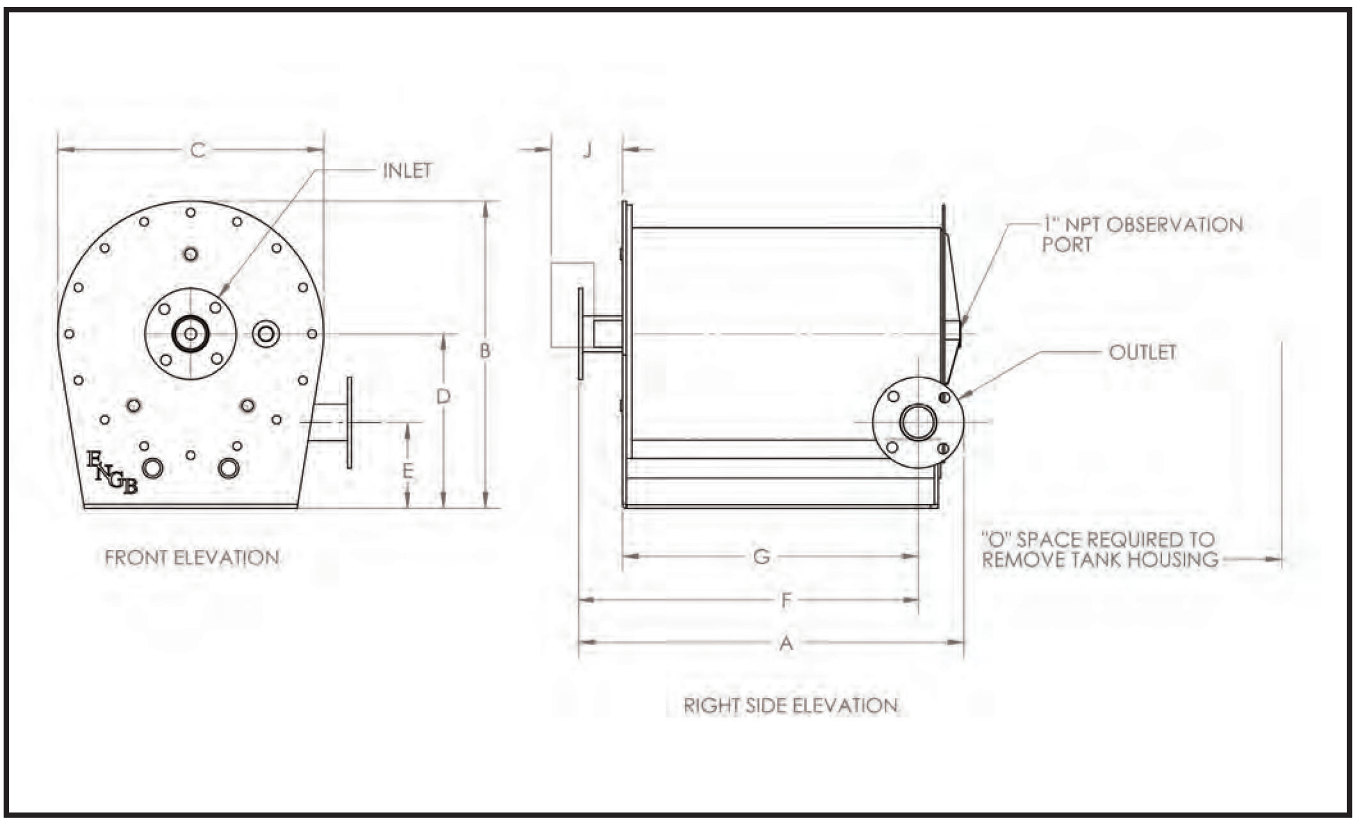
Natural gas booster design has gone unchanged for decades…*UNTIL NOW.*



The curves depicted on the above plots are fan wheel performance curves and are for general reference. For more specific performance for each model size and wheel please refer to the table on Page 9 of this Technical Manual.

ENGB1 & ENGB2 Dimensions

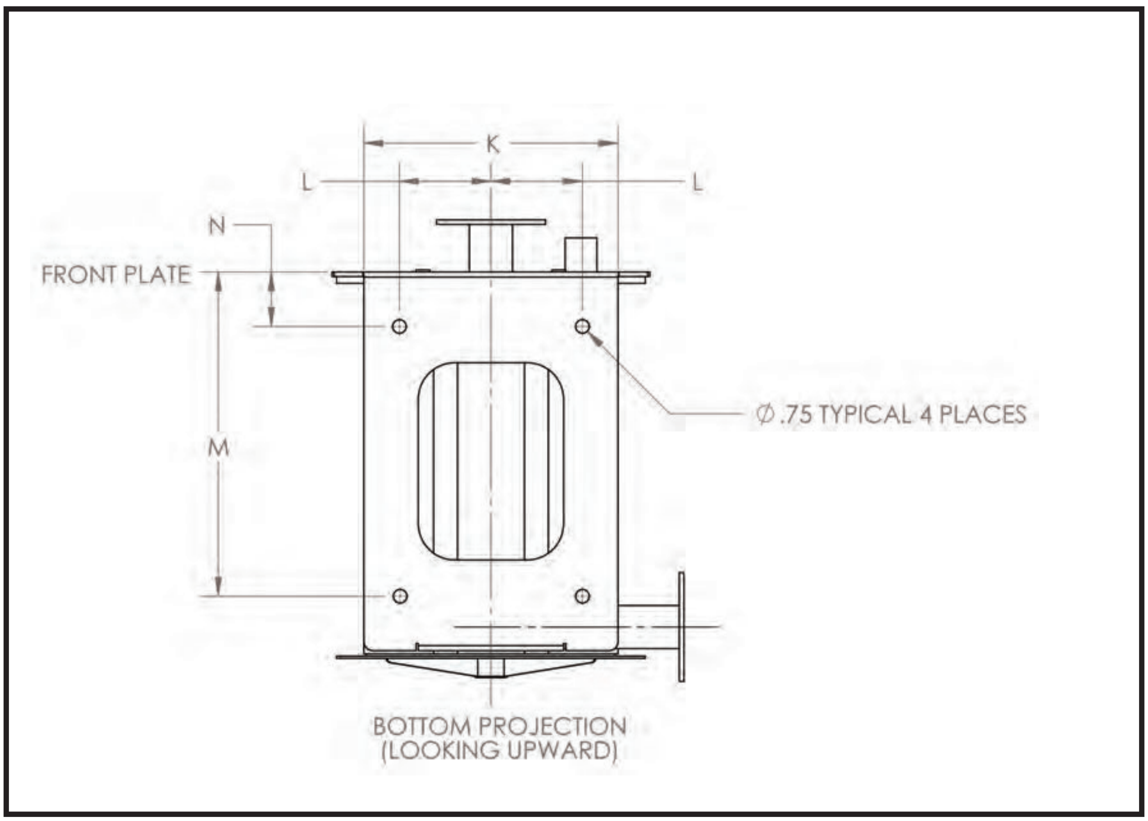
MODEL	INLET (INCHES)	OUTLET (INCHES)	WHEEL ID	MOTOR HP	OVERALL DIMENSIONS (INCHES)			PIPING RE
					A	B	C	D
NOTE: ENGB1 SERIES HAS BEEN DISCONTINUED								
ENGB-120	1.5	1.5	D1	1/2	28	24 3/4	19 1/2	15
ENGB-130	2	2	D1	1/2	28 1/2	24 3/4	19 1/2	15
ENGB-140	3	3	D1	1/2	29 1/4	24 3/4	19 1/2	15
ENGB-147	4	4	D1	1/2	30	24 3/4	19 1/2	15
ENGB-150	6	4	D1	1/2	30	24 3/4	19 1/2	15
ENGB-157	4	4	D2	3/4	30	24 3/4	19 1/2	15
ENGB-160	6	6	D2	3/4	31	24 3/4	19 1/2	15

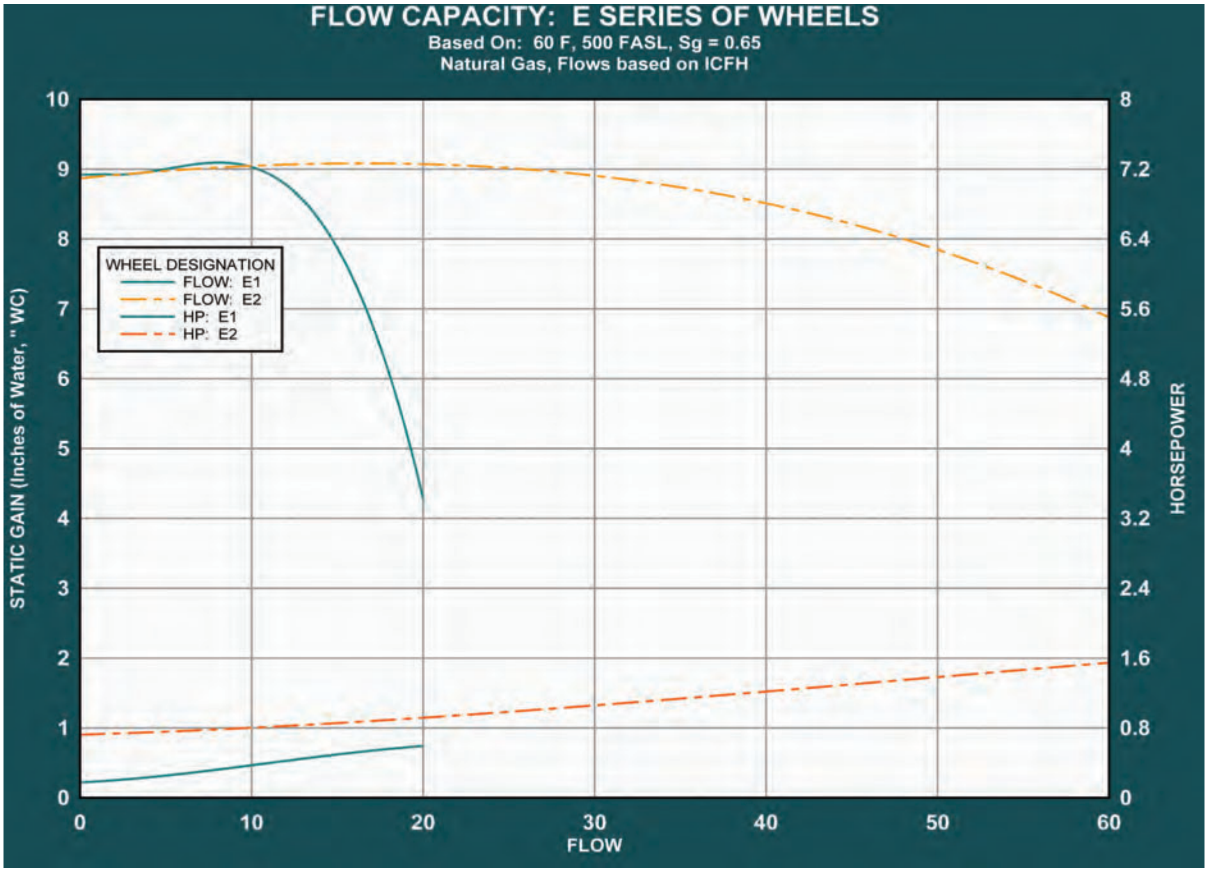


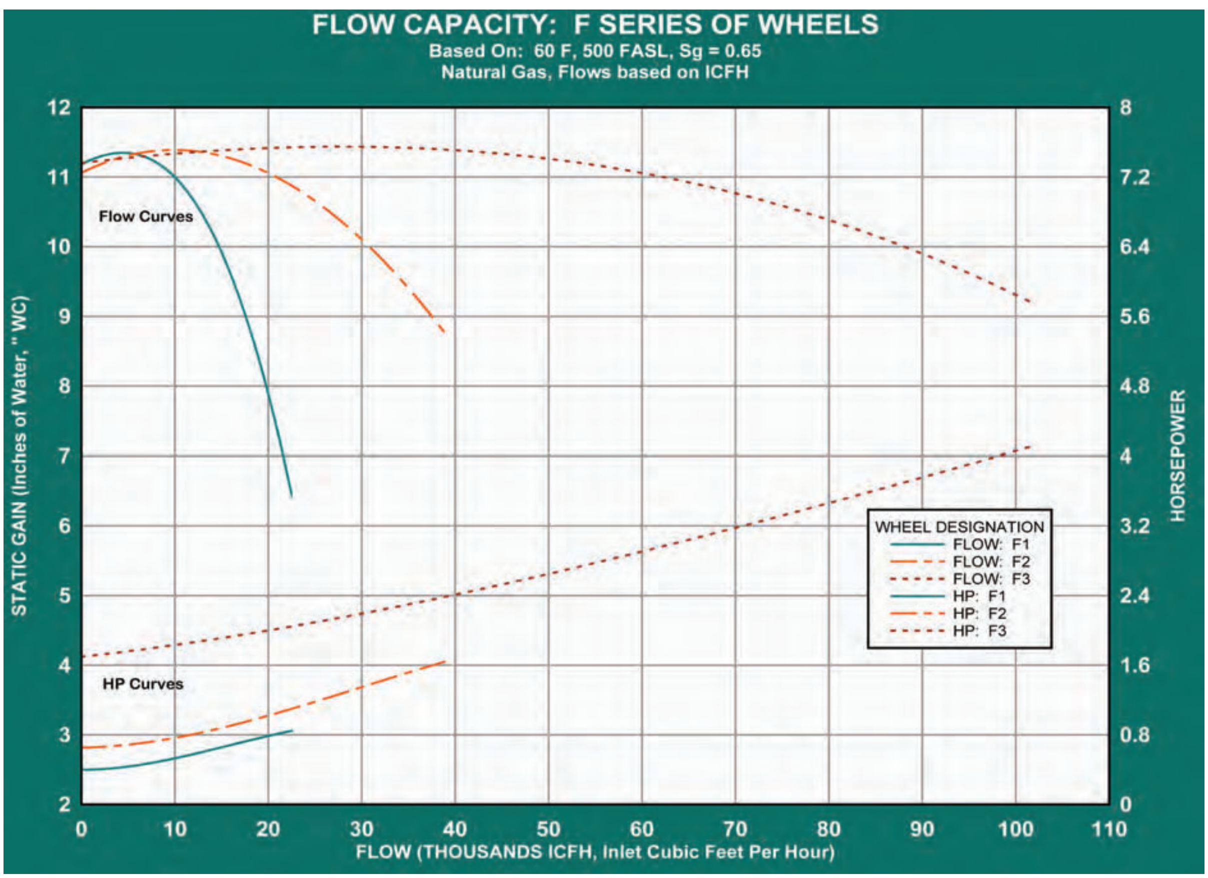
Natural gas booster design has gone unchanged for decades...*UNTIL NOW.*

NOTE: ENGB1 SERIES HAS BEEN DISCONTINUED

LATED DIMENSIONS (INCHES)			GENERAL DIMENSIONS (INCHES)						WEIGHT (LBS)
E	F	G	J	K	L	M	N	"O"	
8 1/8	24-1/2	19 3/4	7	15	5 1/2	14 7/8	4	32	220
8 3/8	24-1/2	19 3/4	7	15	5 1/2	14 7/8	4	32	220
8 7/8	24-1/2	19 3/4	7	15	5 1/2	14 7/8	4	32	220
9 3/8	24-3/4	20	7	15	5 1/2	14 7/8	4	32	260
9 3/8	24-3/4	20	7	15	5 1/2	14 7/8	4	32	220
9 3/8	24-3/4	20	7	15	5 1/2	14 7/8	4	32	260
10 3/8	26	21 1/4	7	15	5 1/2	14 7/8	4	32	225

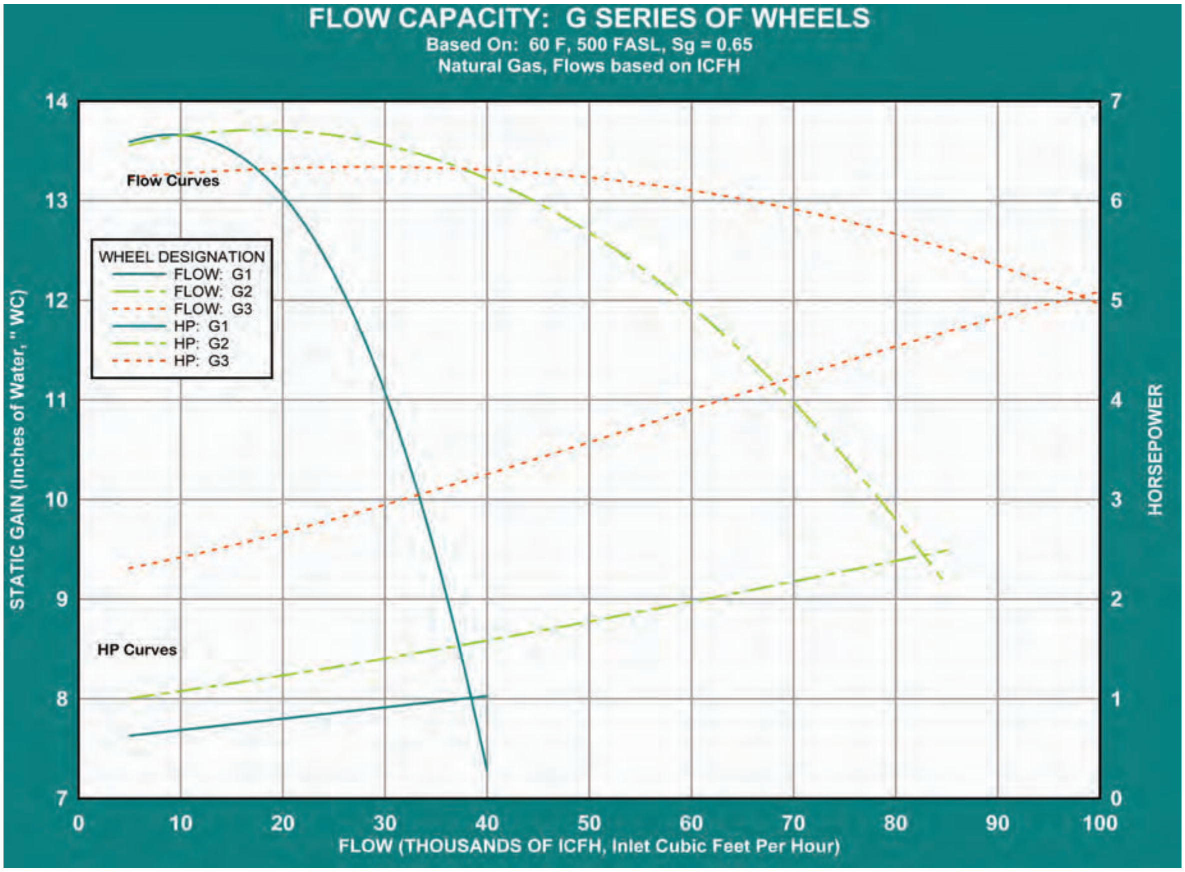


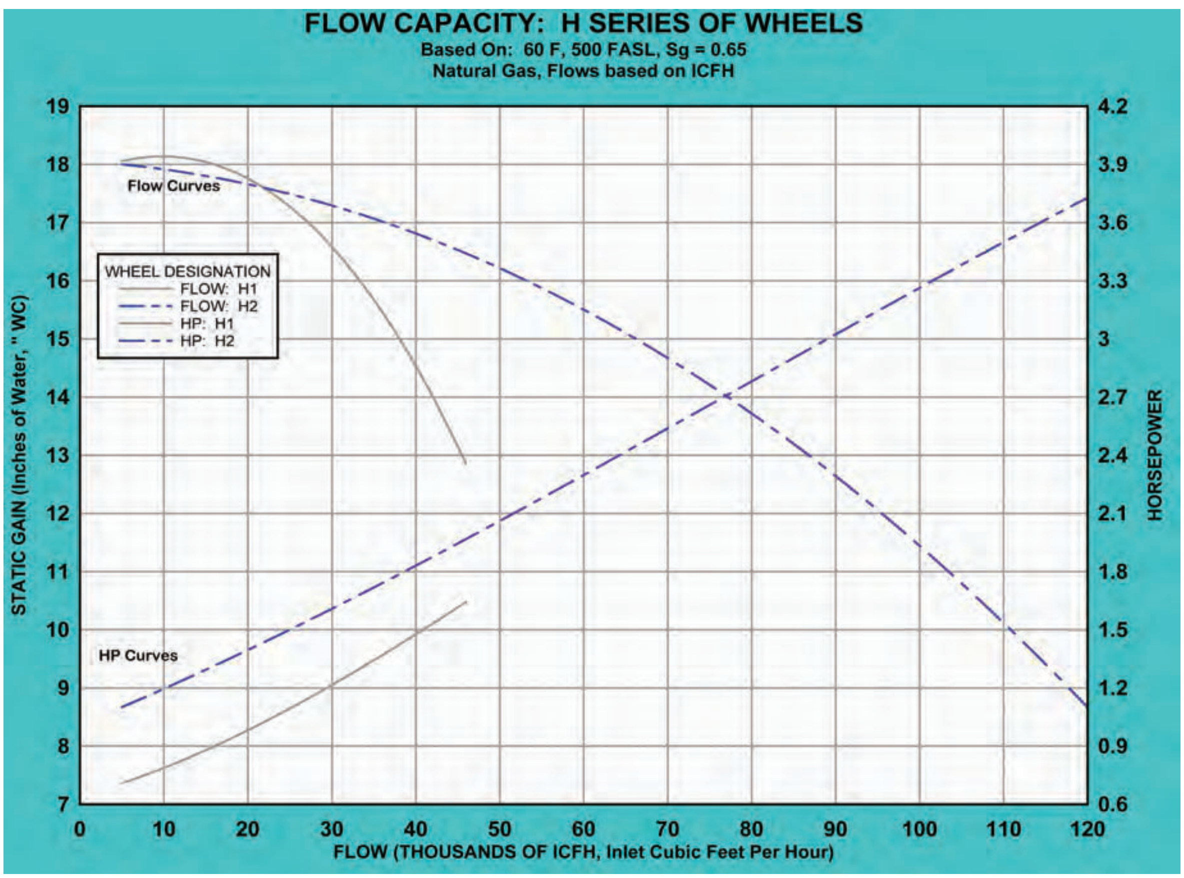




ENGB3 Performance Curves

The curves depicted on the above plots are fan wheel performance curves and are for general reference. For more specific performance for each model size and wheel please refer to the table on Page 9 of this Technical Manual.



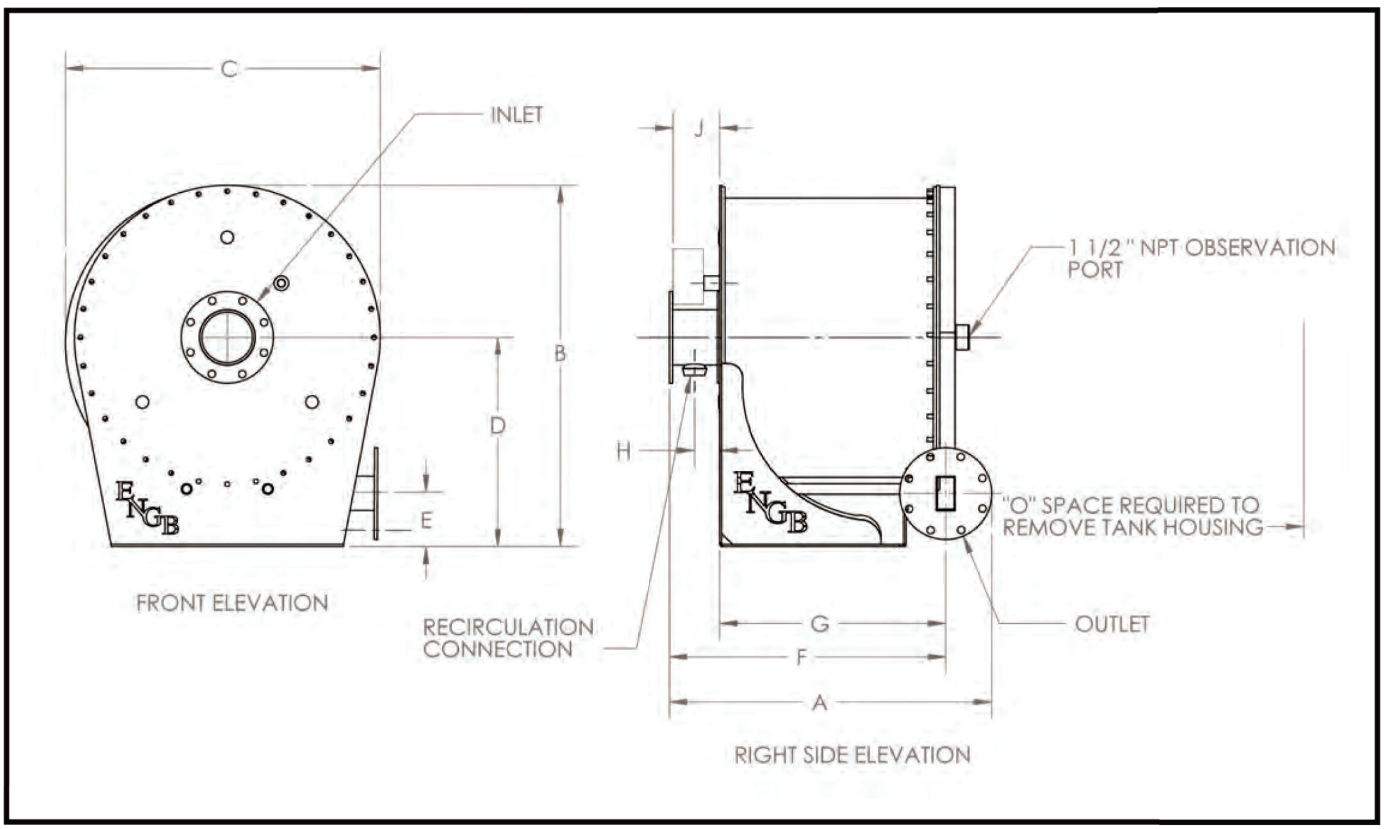


ENGB3 Performance Curves

The curves depicted on the above plots are fan wheel performance curves and are for general reference. For more specific performance for each model size and wheel please refer to the table on Page 9 of this Technical Manual.

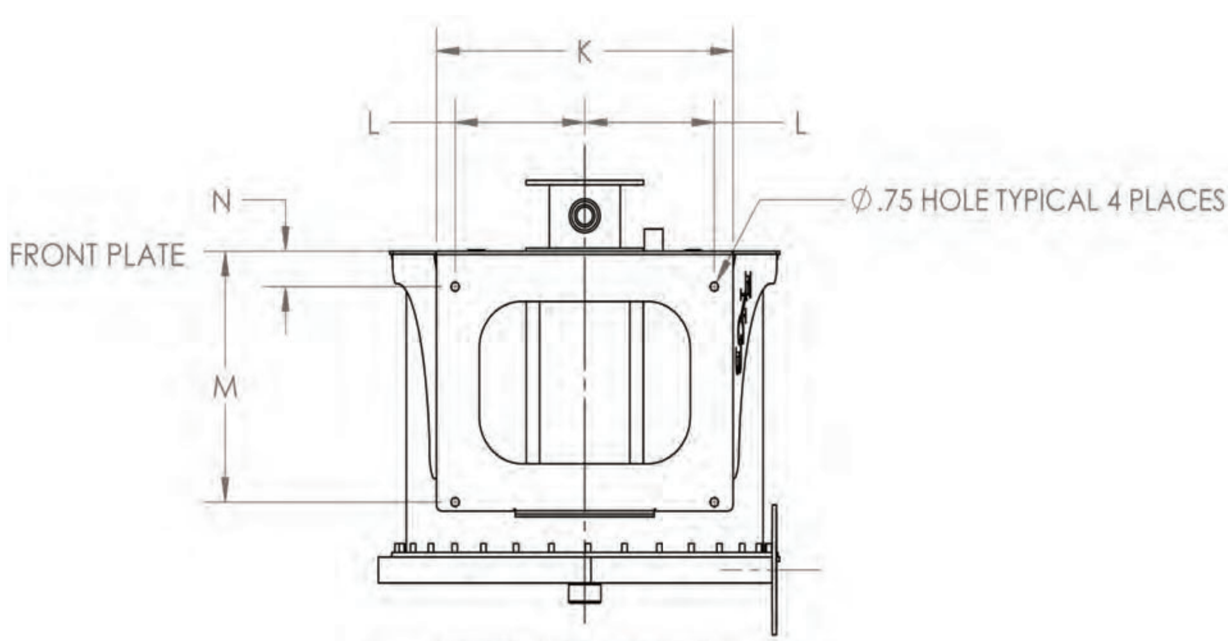
ENGB3 Dimensions

MODEL	INLET (INCHES)	OUTLET (INCHES)	WHEEL ID	MOTOR HP	OVERALL DIMENSIONS (INCHES)			PIPING RELATED DI		
					A	B	C	D	E	
ENGB-167	2	2	E1	1/2	36 7/8	32	27 3/4	18	8 3/8	32
ENGB-170	3	3	E1	1/2	35 3/8	32	27 3/4	18	8 3/8	31
ENGB-190	3	3	E2	1	36 1/8	32	27 3/4	18	8 3/8	32
ENGB-200	4	4	E2	1	36 7/8	32	27 3/4	18	8 3/8	32
ENGB-210	6	6	E2	1 1/2	38 1/4	32	27 3/4	18	8 3/8	32
ENGB-220	6	6	E2	2	38 1/4	32	27 3/4	18	8 3/8	32
ENGB-227	2	2	F1	1	36 7/8	32	27 3/4	18	8 3/8	32
ENGB-230	3	3	F1	1	35 3/8	32	27 3/4	18	7 1/4	31
ENGB-240	4	4	F1	1	36 1/8	32	27 3/4	18	7 1/4	31
ENGB-247	4	4	F2	1 1/2	36 1/8	32	27 3/4	18	7 1/4	31
ENGB-250	6	4	F2	1 1/2	36 5/8	32	27 3/4	18	7 1/4	32
ENGB-260	6	6	F2	2	37 5/8	32	27 3/4	18	7 1/4	32
ENGB-270	6	6	F3	3	38 5/8	32	27 3/4	18	7 1/4	33
ENGB-280	8	8	F3	5	39 7/8	32	27 3/4	18	7 1/4	33
ENGB-283	3	3	G1	1	35 3/8	32	27 3/4	18	7 1/4	31
ENGB-287	4	4	G1	1 1/2	36 1/8	32	27 3/4	18	7 1/4	31
ENGB-290	6	4	G1	1 1/2	36 3/8	32	27 3/4	18	6 1/8	31
ENGB-300	6	6	G1	2	37 3/8	32	27 3/4	18	6 1/8	31
ENGB-310	6	6	G2	2	38	32	27 3/4	18	6 1/8	32
ENGB-320	8	8	G2	3	39 1/4	32	27 3/4	18	6 1/8	32
ENGB-330	8	6	G3	5	38 5/8	32	27 3/4	18	6 1/8	33
ENGB-340	8	8	G3	7 1/2	39 7/8	32	27 3/4	18	6 1/8	33
ENGB-347	4	4	H1	2	36 1/8	32	27 3/4	18	7 1/4	31
ENGB-350	6	6	H1	2	37 3/8	32	27 3/4	18	5 3/4	31
ENGB-360	6	6	H1	3	37 3/8	32	27 3/4	18	5 3/4	31
ENGB-370	6	6	H2	5	37 3/8	32	27 3/4	18	5 3/4	33
ENGB-380	8	8	H2	5	38 5/8	32	27 3/4	18	5 3/4	33

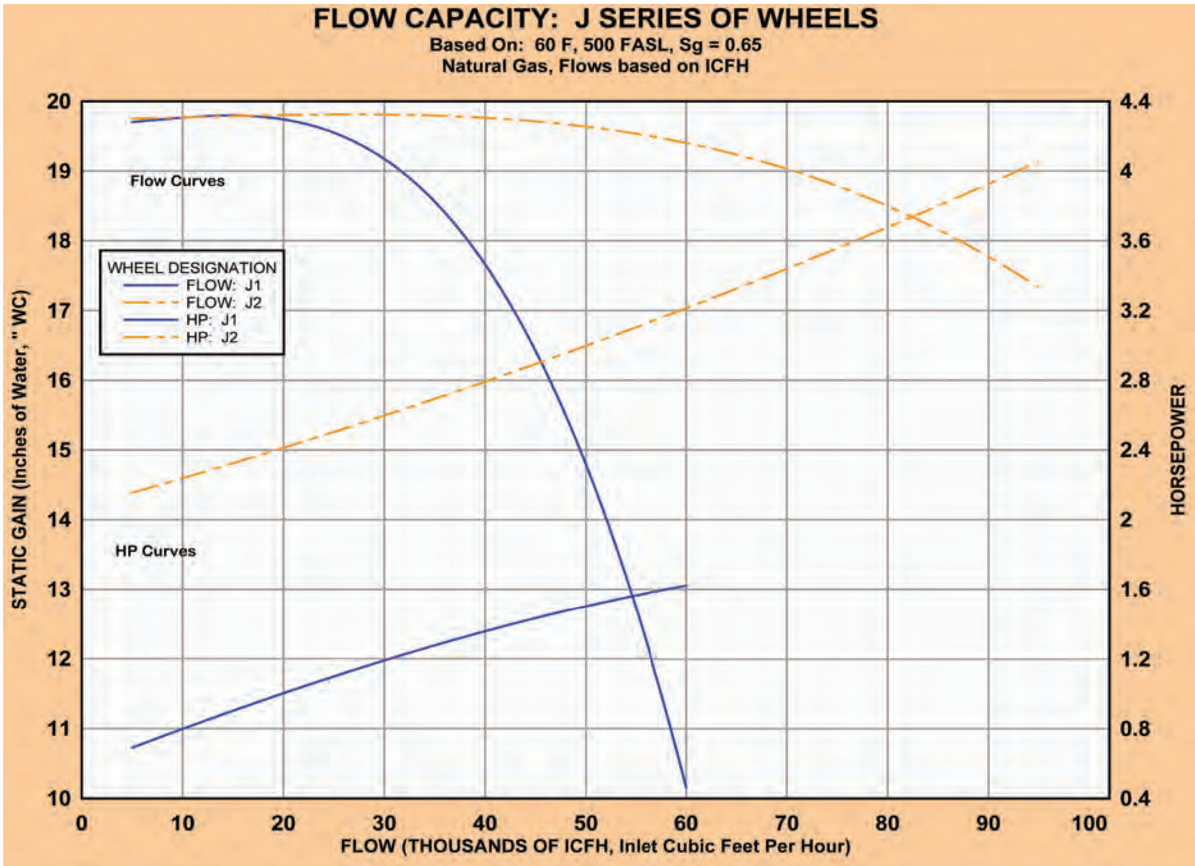


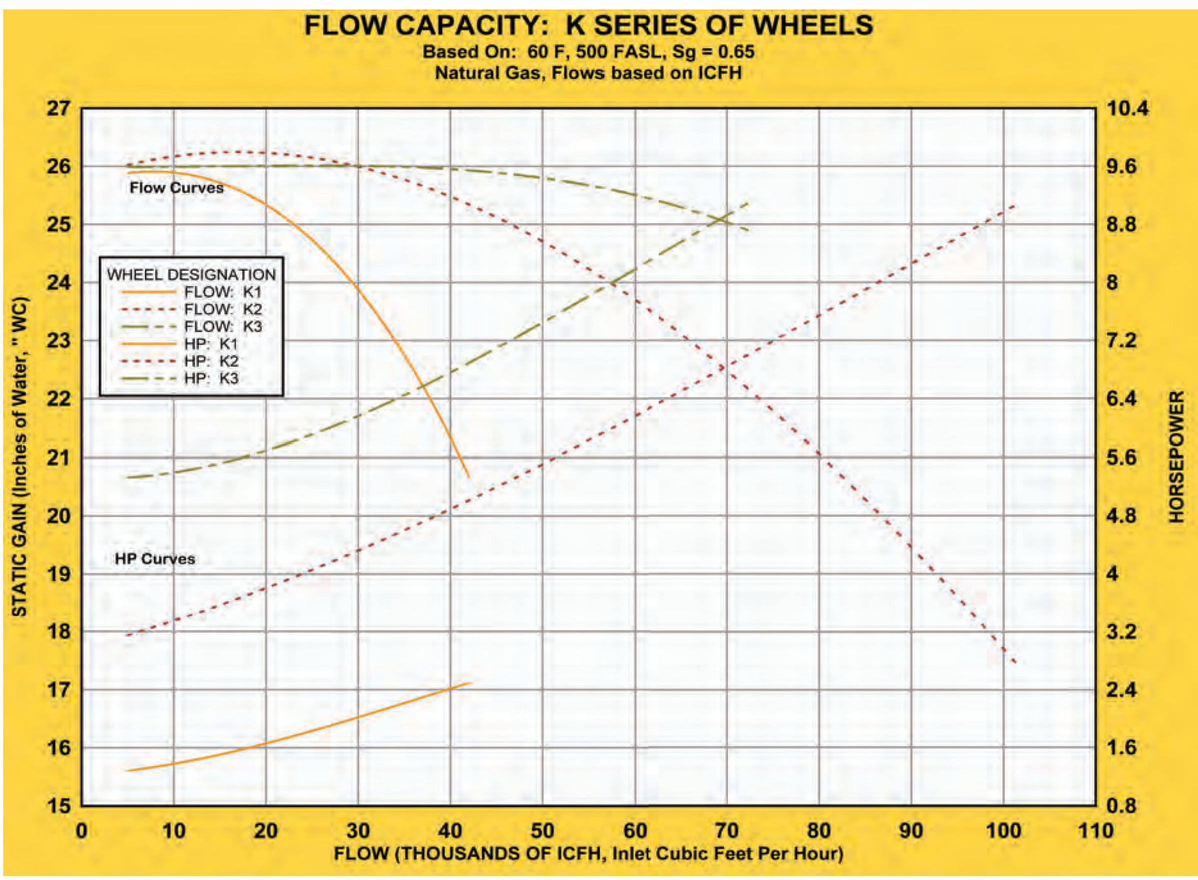
Natural gas booster design has gone unchanged for decades...*UNTIL NOW*.

IMENSIONS (INCHES)			GENERAL DIMENSIONS (INCHES)						WEIGHT
F	G	H	J	K	L	M	N	"O"	(LBS)
3/4	26 3/4	3	6	22 1/2	9 1/2	15	3	40	400
5/8	25 5/8	3	6	22 1/2	9 1/2	15	3	40	350
3/4	26 3/4	3	6	22 1/2	9 1/2	15	3	40	380
3/4	26 3/4	3	6	22 1/2	9 1/2	15	3	40	400
3/4	26 3/4	3	6	22 1/2	9 1/2	15	3	40	400
3/4	26 3/4	3	6	22 1/2	9 1/2	15	3	40	410
3/4	26 3/4	3	6	22 1/2	9 1/2	15	3	40	400
5/8	25 5/8	3	6	22 1/2	9 1/2	15	3	40	380
5/8	25 5/8	3	6	22 1/2	9 1/2	15	3	40	380
5/8	25 5/8	3	6	22 1/2	9 1/2	15	3	40	380
1/8	26 1/8	3	6	22 1/2	9 1/2	15	3	40	400
1/8	26 1/8	3	6	22 1/2	9 1/2	15	3	40	410
1/16	27 1/16	3	6	22 1/2	9 1/2	15	3	40	460
1/16	27 1/16	3	6	22 1/2	9 1/2	15	3	40	480
5/8	25 5/8	3	6	22 1/2	9 1/2	15	3	40	380
5/8	25 5/8	3	6	22 1/2	9 1/2	15	3	40	380
7/8	25 7/8	3	6	22 1/2	9 1/2	15	3	40	380
7/8	25 7/8	3	6	22 1/2	9 1/2	15	3	40	400
1/2	26 1/2	3	6	22 1/2	9 1/2	15	3	40	410
1/2	26 1/2	3	6	22 1/2	9 1/2	15	3	40	460
1/16	27 1/16	3	6	22 1/2	9 1/2	15	3	40	480
1/16	27 1/16	3	6	22 1/2	9 1/2	15	3	40	570
5/8	25 5/8	3	6	22 1/2	9 1/2	15	3	40	380
7/8	25 7/8	3	6	22 1/2	9 1/2	15	3	40	400
7/8	25 7/8	3	6	22 1/2	9 1/2	15	3	40	410
	27	3	6	22 1/2	9 1/2	15	3	40	460
	27	3	6	22 1/2	9 1/2	15	3	40	480

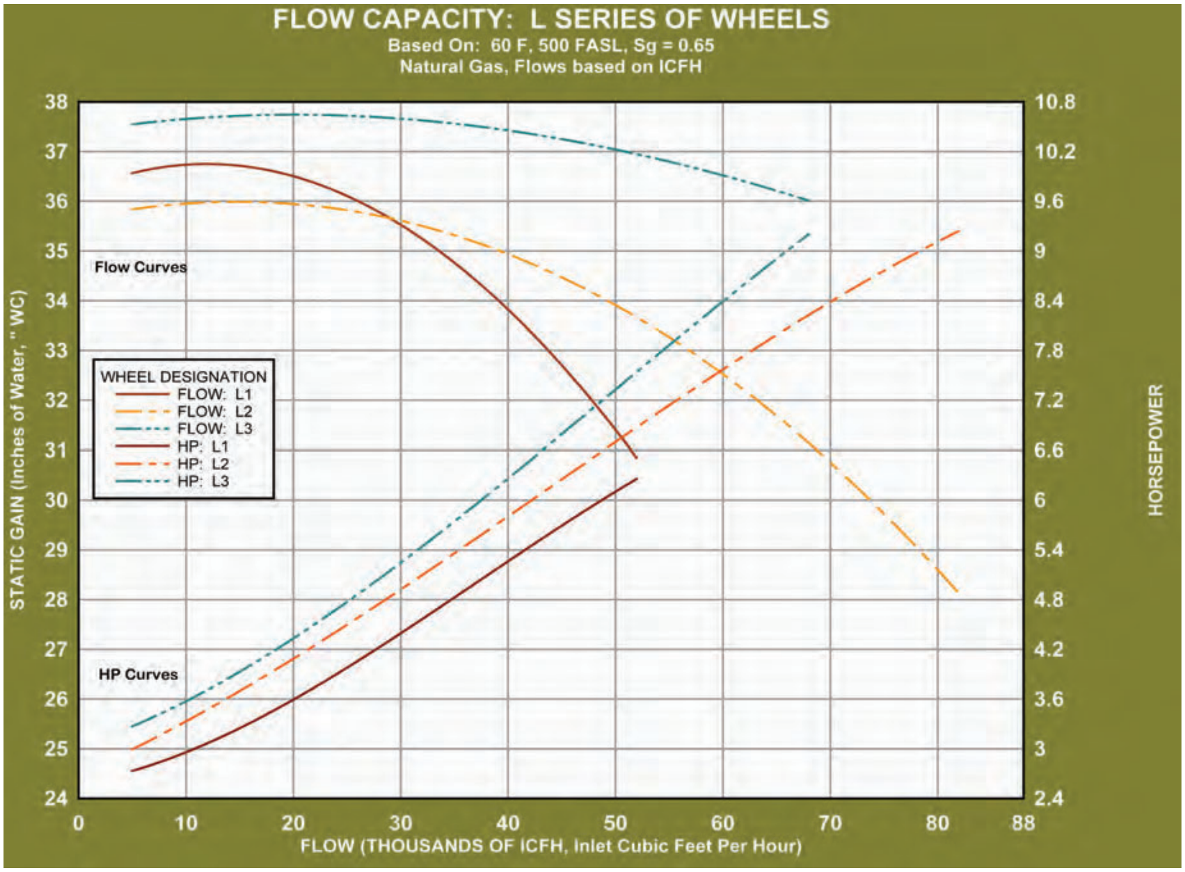


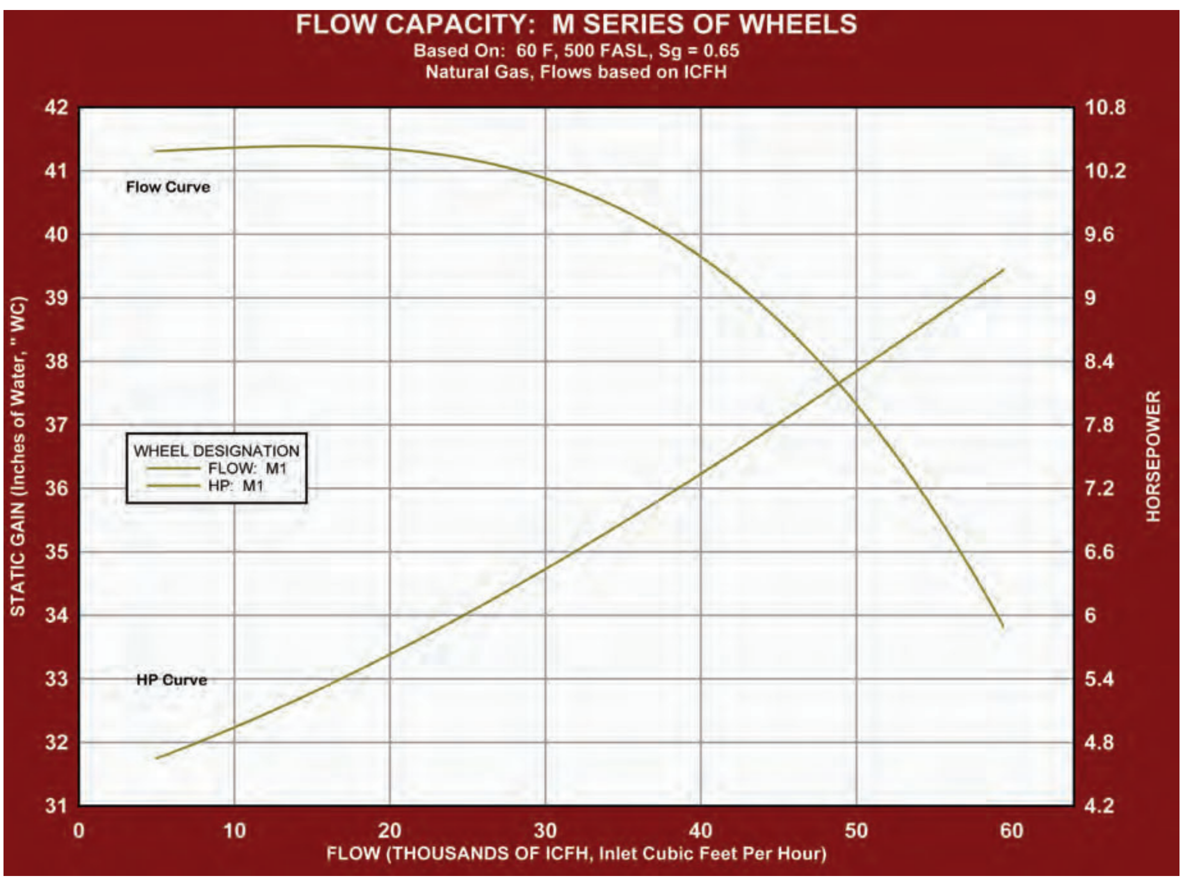
BOTTOM PROJECTION
(LOOKING UPWARD)





The curves depicted on the above plots are fan wheel performance curves and are for general reference. For more specific performance for each model size and wheel please refer to the table on Page 9 of this Technical Manual.



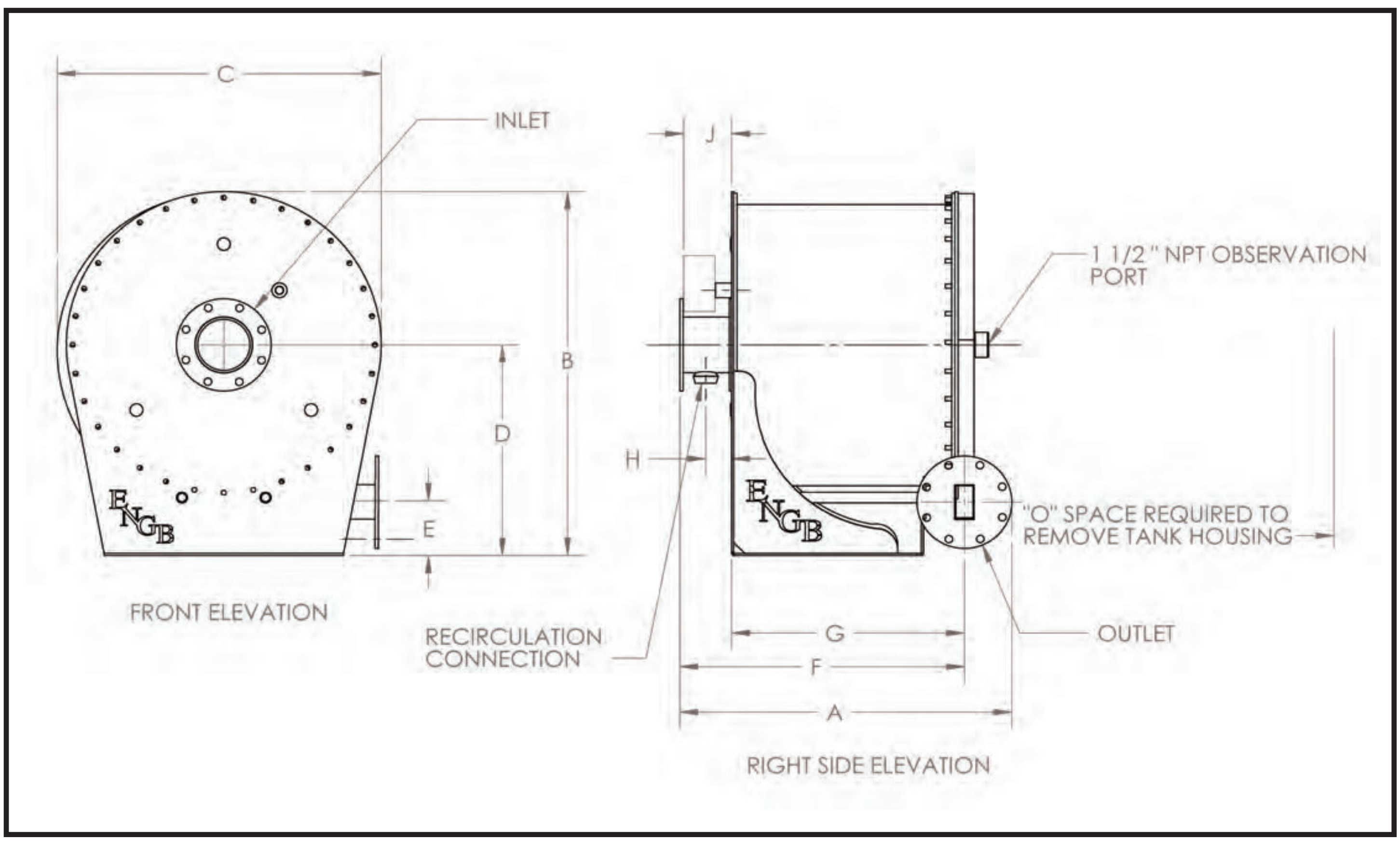


ENGB4 Performance Curves

The curves depicted on the above plots are fan wheel performance curves and are for general reference. For more specific performance for each model size and wheel please refer to the table on Page 9 of this Technical Manual.

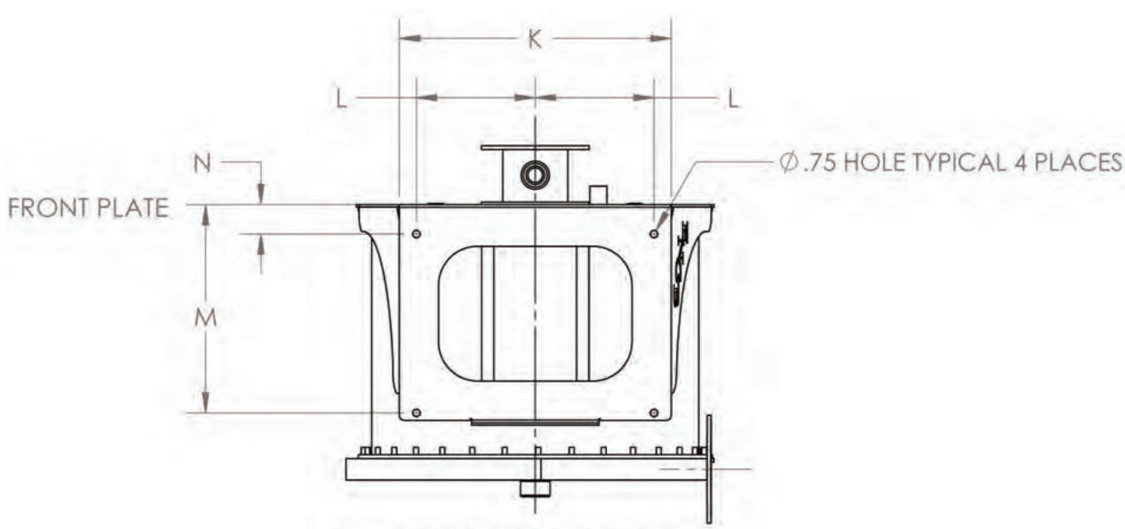
ENGB4 Dimensions

MODEL	INLET (INCHES)	OUTLET (INCHES)	WHEEL ID	MOTOR HP	OVERALL DIMENSIONS (INCHES)			PIPING RELATED DI		
					A	B	C	D	E	
ENGB-390	3	3	J1	2	37 1/2	43	36 1/2	24 3/4	10 1/4	33
ENGB-400	4	4	J1	3	38 1/4	43	36 1/2	24 3/4	10 1/4	33
ENGB-410	6	6	J1	3	39 1/4	43	36 1/2	24 3/4	10 1/4	33
ENGB-430	4	4	J2	3	39 1/8	43	36 1/2	24 3/4	10 1/4	34
ENGB-440	6	6	J2	5	40 1/8	43	36 1/2	24 3/4	10 1/4	34
ENGB-450	8	8	J2	5	41 3/8	43	36 1/2	24 3/4	10 1/4	34
ENGB-460	3	3	K1	2	37 1/4	43	36 1/2	24 3/4	8 1/2	33
ENGB-470	4	4	K1	3	38	43	36 1/2	24 3/4	8 1/2	33
ENGB-480	6	6	K1	5	39	43	36 1/2	24 3/4	8 1/2	33
ENGB-487	4	4	K2	5	38 1/2	43	36 1/2	24 3/4	8 1/2	33
ENGB-490	6	4	K2	5	38 1/2	43	36 1/2	24 3/4	8 1/2	34
ENGB-500	6	6	K2	7 1/2	39 1/2	43	36 1/2	24 3/4	8 1/2	34
ENGB-510	8	8	K2	10	40 3/4	43	36 1/2	24 3/4	8 1/2	34
ENGB-520	4	4	K3	7 1/2	38 7/8	43	36 1/2	24 3/4	8 1/2	34
ENGB-530	6	6	K3	7 1/2	39 7/8	43	36 1/2	24 3/4	8 1/2	34
ENGB-540	8	6	K3	10	39 7/8	43	36 1/2	24 3/4	8 1/2	34
ENGB-550	3	3	L1	5	36 7/8	43	36 1/2	24 3/4	6 1/4	34
ENGB-560	4	4	L1	5	38	43	36 1/2	24 3/4	6 1/4	33
ENGB-570	6	6	L1	5	39	43	36 1/2	24 3/4	6 1/4	33
ENGB-580	6	6	L1	7 1/2	39	43	36 1/2	24 3/4	6 1/4	33
ENGB-590	4	4	L2	7 1/2	38 1/4	43	36 1/2	24 3/4	6 1/4	33
ENGB-600	6	6	L2	7 1/2	39 1/4	43	36 1/2	24 3/4	6 1/4	33
ENGB-610	8	8	L2	10	40 1/2	43	36 1/2	24 3/4	6 1/4	33
ENGB-620	4	4	L3	5	38 1/2	43	36 1/2	24 3/4	6 1/4	34
ENGB-630	6	6	L3	7 1/2	39 1/2	43	36 1/2	24 3/4	6 1/4	34
ENGB-640	8	6	L3	10	39 1/2	43	36 1/2	24 3/4	6 1/4	34
ENGB-649	3	3	M1	10	37 1/2	43	36 1/2	24 3/4	10 1/4	33
ENGB-650	4	4	M1	10	38 1/8	43	36 1/2	24 3/4	5 1/8	33
ENGB-660	6	6	M1	10	39 1/8	43	36 1/2	24 3/4	5 1/8	33



Natural gas booster design has gone unchanged for decades...*UNTIL NOW*.

…IMENSIONS (INCHES)			GENERAL DIMENSIONS (INCHES)						WEIGHT (LBS)
F	G	H	J	K	L	M	N	"O"	
3/4	27 3/4	3	6	27 3/4	12 1/8	21 1/4	3	40	620
3/4	27 3/4	3	6	27 3/4	12 1/8	21 1/4	3	40	620
3/4	27 3/4	3	6	27 3/4	12 1/8	21 1/4	3	40	620
5/8	28 5/8	3	6	27 3/4	12 1/8	21 1/4	3	40	710
5/8	28 5/8	3	6	27 3/4	12 1/8	21 1/4	3	40	730
5/8	28 5/8	3	6	27 3/4	12 1/8	21 1/4	3	40	730
1/2	27 1/2	3	6	27 3/4	12 1/8	21 1/4	3	40	650
1/2	27 1/2	3	6	27 3/4	12 1/8	21 1/4	3	40	650
1/2	27 1/2	3	6	27 3/4	12 1/8	21 1/4	3	40	650
1/2	27 1/2	3	6	27 3/4	12 1/8	21 1/4	3	40	650
	28	3	6	27 3/4	12 1/8	21 1/4	3	40	710
	28	3	6	27 3/4	12 1/8	21 1/4	3	40	795
	28	3	6	27 3/4	12 1/8	21 1/4	3	40	825
3/8	28 3/8	3	6	27 3/4	12 1/8	21 1/4	3	40	795
3/8	28 3/8	3	6	27 3/4	12 1/8	21 1/4	3	40	795
3/8	28 3/8	3	6	27 3/4	12 1/8	21 1/4	3	40	825
1/2	27 1/2	3	6	27 3/4	12 1/8	21 1/4	3	40	710
1/2	27 1/2	3	6	27 3/4	12 1/8	21 1/4	3	40	710
1/2	27 1/2	3	6	27 3/4	12 1/8	21 1/4	3	40	710
1/2	27 1/2	3	6	27 3/4	12 1/8	21 1/4	3	40	795
3/4	27 3/4	3	6	27 3/4	12 1/8	21 1/4	3	40	795
3/4	27 3/4	3	6	27 3/4	12 1/8	21 1/4	3	40	795
3/4	27 3/4	3	6	27 3/4	12 1/8	21 1/4	3	40	825
	28	3	6	27 3/4	12 1/8	21 1/4	3	40	710
	28	3	6	27 3/4	12 1/8	21 1/4	3	40	795
	28	3	6	27 3/4	12 1/8	21 1/4	3	40	850
3/4	27 3/4	3	6	27 3/4	12 1/8	21 1/4	3	40	620
5/8	27 5/8	3	6	27 3/4	12 1/8	21 1/4	3	40	850
5/8	27 5/8	3	6	27 3/4	12 1/8	21 1/4	3	40	850



BOTTOM PROJECTION
(LOOKING UPWARD)

11.0 CONTROL MODES

When installing a gas booster there are numerous "control philosophies" or "operational modes" that are available. Due to its intricacies, a gas booster, unlike a simple pump, should have a mode of operation that is most closely matched to its real world application. For instance, the controls for a duplex gas booster system for a hospital would vary significantly from that which would be ideal for an emergency stand-by generator for a bank.

What is of real concern is answering the fundamental question of what is the desired mechanism that turns the booster ON, and then finally turns the booster OFF. In order to accomplish this effectively and efficiently ETTER has developed some basic Control Modes and the following should be considered when ordering your gas booster:

- **MODE M: MANUAL**

A very simplistic method of control that is rarely the best approach. The operator has ON-OFF control of the booster. The booster will remain OFF until the operator turns the switch powering the booster ON. The booster will run until the switch is turned OFF and the minimum run time has been met. Only the Emergency Stop Push Button, Low Gas Inlet Pressure Cut Off Switch, and the High Temperature Cut Off for the Motor will immediately shut off the booster, regardless of minimum run time.

- **MODE I: INTERLOCKED**

The preferred method of control, though not always practical. This method requires a pair of control wires running from each piece of equipment that the booster is servicing back to the Booster Control Panel. When applying a booster to three boilers with the booster located in the boileroom, this is ideal. When any of the three boilers turn on, the booster will be called to run. If ALL boilers are off, the booster will shut itself down automatically. This saves runtime and reduces wear and tear on the booster motor. Obviously this is not always practical due to conduit runs and wiring for equipment located a great distance from the booster, or for a building that has equipment spread out across the floor plan.

- **MODE R: REGULATOR MONITORING (PCFM)**

A sophisticated approach that is ideal in applications where a regulated outlet pressure is desirable with a lock-up requirement and there are numerous or remote pieces of equipment. **THIS APPROACH IS NOT AVAILABLE IN CLASSIFIED EXPLOSION PROOF AREAS**, unless the regulator monitor can be installed nearby in an unclassified area and piped to the booster located in the classified area. This approach is also limited in flow rate with a typical application being 18,000 CFH or less. Flows in excess of 40,000 CFH cannot be accommodated and flows between 18,000 and 40,000 CFH should be reviewed with ETTER Engineering.

This approach will consume some of the provided boost as a means of control, as the integral pressure regulator has an associated pressure loss. The controls monitor the position of the regulator and if it is satisfying set point and there is lack of flow, the regulator will close, telling the booster it may shut down. Should the load pick up, the regulator will sense the decay in pressure and open, once again telling the booster to run. It is considered a "pressure compensated flow monitoring" (PCFM) method.

- **Mode G: GENERATOR**

This approach is applied when supplying gas to an emergency backup-up or stand-by generator. Typically this booster and the associated controls would be done in 120V single phase power and an optional uniterrupted power supply (UPS) would be provided for the booster controls and motor; the controls would also include the necessary control relays to interface with the generator so that it will automatically turn on and run off the UPS when called for.

- **Mode V: VARIABLE FREQUENCY DRIVE**

The ENGB has been developed with the ability to operate in conjunction with a VFD, which is a more sophisticated approach that works well in applications where a regulated outlet pressure is desirable and there are numerous or remote pieces of equipment. The controls will monitor the outlet pressure of the booster and will increase the RPM of the motor within its limits when it senses a pressure below its set point. As the outlet pressure increases due to reduced load on the booster, the motor will automatically slow itself down, resulting in a regulated outlet pressure within the capabilities of the building's piping and the booster's performance.

NOTE: This does not have "lock-up" type capabilities that may be associated with the installation of a real regulator. This is pressure control via modulation of the booster's impeller speed. The booster will run until it hits both the minimum speed setting and satisfies the minimum run timer.

(CONTROL MODES CONT.)

• Mode F: FLOW MONITORING

A sophisticated approach that is ideal in applications where there are numerous pieces (too many to interlock) or several remote pieces (too far to be practical) of equipment. It is considered a "pressure compensated flow monitoring" (PCFM) method. **THIS APPROACH IS AVAILABLE IN CLASSIFIED EXPLOSION-PROOF AREAS**, and is also applicable to non-explosion proof projects. In this Mode the controls monitor an intrinsically safe flow sensor that is installed on the outlet of the booster. As the flow increases past the sensor, it turns the booster on. When the sensor determines the flow no longer exceeds a set point, a timer is started and if at the end of the timer the flow has not increased above set point the booster can either be shut down (in the case without a heat exchanger package) or be placed in a "heat exchanger mode" allowing recirculation and heat dissipation as required to protect larger horsepower motors. (For minimum flow requirements and heat exchanger information, please refer to that section of this manual for further details.) Once the booster is turned off due to lack of flow it is re-started by the fall in gas pressure below the adjustable set point.

IMPORTANT NOTE ABOUT CONTROLLING BOOSTERS: In all cases regardless of the selected mode, the ENGB is to satisfy the factory required minimum run time in order to maintain the warranty provided. Each motor has a limited number of starts per hour as specified by the motor manufacturer and the control system **MUST** ensure that parameter is followed in order for the warranty on the motor to remain in effect. All ETTER control modes insure that this minimum run time is satisfied. (For minimum flow requirements and heat exchanger information, please refer to that section of this manual for further details.)

Only the Emergency Stop push button provided on all ETTER booster control panels, or the Low Gas Inlet Pressure Cut Off Switch and the High Temperature Cut Off of the Motor will immediately shut off the booster regardless of minimum run time.

12.0 MAINTENANCE

Each ENGB is shipped with one or more tamper-proof security labels. **Before** servicing the booster, contact ETTER to request a new security label. Failure to do so will void the warranty for any booster with a label that is broken or shows evidence of tampering.

12.1 ASSEMBLY/DISASSEMBLY

Any disassembly of boosters by anyone other than ETTER Factory Authorized Service Representatives **will void all warranties**.

12.2 LUBRICATION

Motor bearings are pre-lubricated for the life of the motor.

12.3 BALANCING

All boosters are balanced before leaving our plant. However, rough handling - especially during transit and/or installation - can upset a booster's balance. If there is any excessive vibration due to an unbalanced condition, **IMMEDIATELY** shut down the unit and contact ETTER's Service Department.

CAUTION: Customers should NOT attempt to balance a hermetic gas booster.

13.0 TROUBLESHOOTING

If gas booster is not delivering the rated pressure, and motor **is not** overloaded check the following:

1. Reversed and correct rotation will produce two different pressures, the higher indicating proper rotation.
2. Interior parts clogged with dirt.
3. Piping too small, causing high frictional loss.
4. Lower specific gravity than specified on nameplate.
5. High inlet gas temperature.

If gas booster is not delivering rated pressure and motor **is** overloaded, check for the following:

1. Wrong voltage connections.
2. Unit handling more than rated volume.
3. Higher specific gravity than on nameplate.
4. Intake gas temperature too low.

If gas booster is vibrating, check for:

1. Material buildup on impeller blades.
2. Shaft bent.
3. Impeller failure.
4. Inlet and/or outlet piping connected to machine without flexible connector causing torque or stress on housing.
5. Piping not adequately supported.
6. Incorrect motor voltage, causing assembly to operate at improper speed.

14.0 HOW TO ORDER YOUR ENGB BOOSTER

ENGB BOOSTER DESIGNATION TO MODEL ORDERING REFERENCE

NOTE: ENGB1 SERIES HAS BEEN DISCONTINUED

ENGB Family	ENGB MODEL	INLET (INCHES)	OUTLET (INCHES)	WHEEL (ID)	MOTOR HP	BUYER TO SPECIFY AT TIME OF ORDER			
						Step 1 VOLTAGE	STEP 2 PHASE	STEP 3 POSITION	STEP 4 TYPE
	ENGB - 070	4	4	B2	1/2				
ENGB1	ENGB - 120	1 1/2	1 1/2	D1	1/2				
ENGB1	ENGB - 130	2	2	D1	1/2				
ENGB1	ENGB - 140	3	3	D1	1/2				
ENGB1	ENGB - 147	4	4	D1	1/2				
ENGB1	ENGB -150	6	4	D1	1/2				
ENGB1	ENGB - 157	4	4	D2	3/4				
ENGB1	ENGB - 160	6	6	D2	3/4				
ENGB2	ENGB - 167	2	2	E1	1/2				
ENGB2	ENGB - 170	3	3	E1	1/2				
ENGB2	ENGB - 190	3	3	E2	1				
ENGB2	ENGB - 200	4	4	E2	1				
ENGB2	ENGB - 210	6	6	E2	1 1/2				
ENGB2	ENGB - 220	6	6	E2	2				
ENGB2	ENGB - 227	2	2	F1	1				
ENGB2	ENGB - 230	3	3	F1	1				
ENGB2	ENGB - 240	4	4	F1	1				
ENGB2	ENGB - 247	4	4	F2	1 1/2				
ENGB2	ENGB - 250	6	4	F2	1 1/2				
ENGB2	ENGB - 260	6	6	F2	2				
ENGB2	ENGB - 270	6	6	F3	3				
ENGB2	ENGB - 280	8	8	F3	5				
ENGB2	ENGB - 283	3	3	G1	1				
ENGB2	ENGB - 287	4	4	G1	1				
ENGB2	ENGB - 290	6	4	G1	1 1/2				
ENGB2	ENGB - 300	6	6	G1	2				
ENGB2	ENGB - 310	6	6	G2	2				
ENGB2	ENGB - 320	8	8	G2	3				
ENGB2	ENGB - 330	8	6	G3	5				
ENGB2	ENGB - 340	8	8	G3	7 1/2				
ENGB2	ENGB - 347	4	4	H1	2				
ENGB2	ENGB - 350	6	6	H1	2				
ENGB2	ENGB - 360	6	6	H1	3				
ENGB2	ENGB - 370	6	6	H2	5				
ENGB2	ENGB - 380	8	8	H2	5				
ENGB4	ENGB - 390	3	3	J1	2				
ENGB4	ENGB - 400	4	4	J1	3				
ENGB4	ENGB - 410	6	6	J1	3				
ENGB4	ENGB - 430	4	4	J2	3				
ENGB4	ENGB - 440	6	6	J2	5				
ENGB4	ENGB - 450	8	8	J2	5				
ENGB4	ENGB - 460	3	3	K1	2				
ENGB4	ENGB - 470	4	4	K1	3				
ENGB4	ENGB - 480	6	6	K1	5				
ENGB4	ENGB - 487	4	4	K2	5				
ENGB4	ENGB - 490	6	4	K2	5				
ENGB4	ENGB - 500	6	6	K2	7 1/2				
ENGB4	ENGB - 510	8	8	K2	10				
ENGB4	ENGB - 520	4	4	K3	7 1/2				
ENGB4	ENGB - 530	6	6	K3	7 1/2				
ENGB4	ENGB - 540	8	6	K3	10				
ENGB4	ENGB - 550	3	3	L1	5				
ENGB4	ENGB - 560	4	4	L1	5				
ENGB4	ENGB - 570	6	6	L1	5				
ENGB4	ENGB - 580	6	6	L1	7 1/2				
ENGB4	ENGB - 590	4	4	L2	7 1/2				
ENGB4	ENGB - 600	6	6	L2	7 1/2				
ENGB4	ENGB - 610	8	8	L2	10				
ENGB4	ENGB - 620	4	4	L3	5				
ENGB4	ENGB - 630	6	6	L3	7 1/2				
ENGB4	ENGB - 640	8	6	L3	10				
ENGB4	ENGB - 649	3	3	M1	10				
ENGB4	ENGB - 650	4	4	M1	10				
ENGB4	ENGB - 660	6	6	M1	10				

THE STEPS TO FILLING OUT YOUR COMPLETE MODEL NUMBER

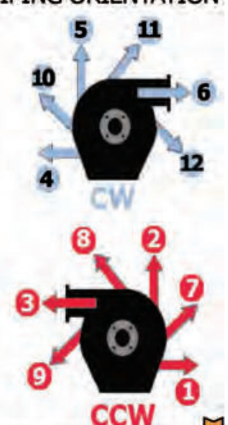
STEP 1:
SELECT YOUR VOLTAGE

- 115 V
- 208 V
- 230 V
- 460 V

STEP 2:
SELECT THE PHASE OF YOUR POWER SUPPLY

- 1 — Available for 115V and 208V only
- 3 — Available for 208V 230V & 460V only

STEP 3:
SELECT THE OUTLET PIPING ORIENTATION



STEP 4:
SELECT THE TYPE

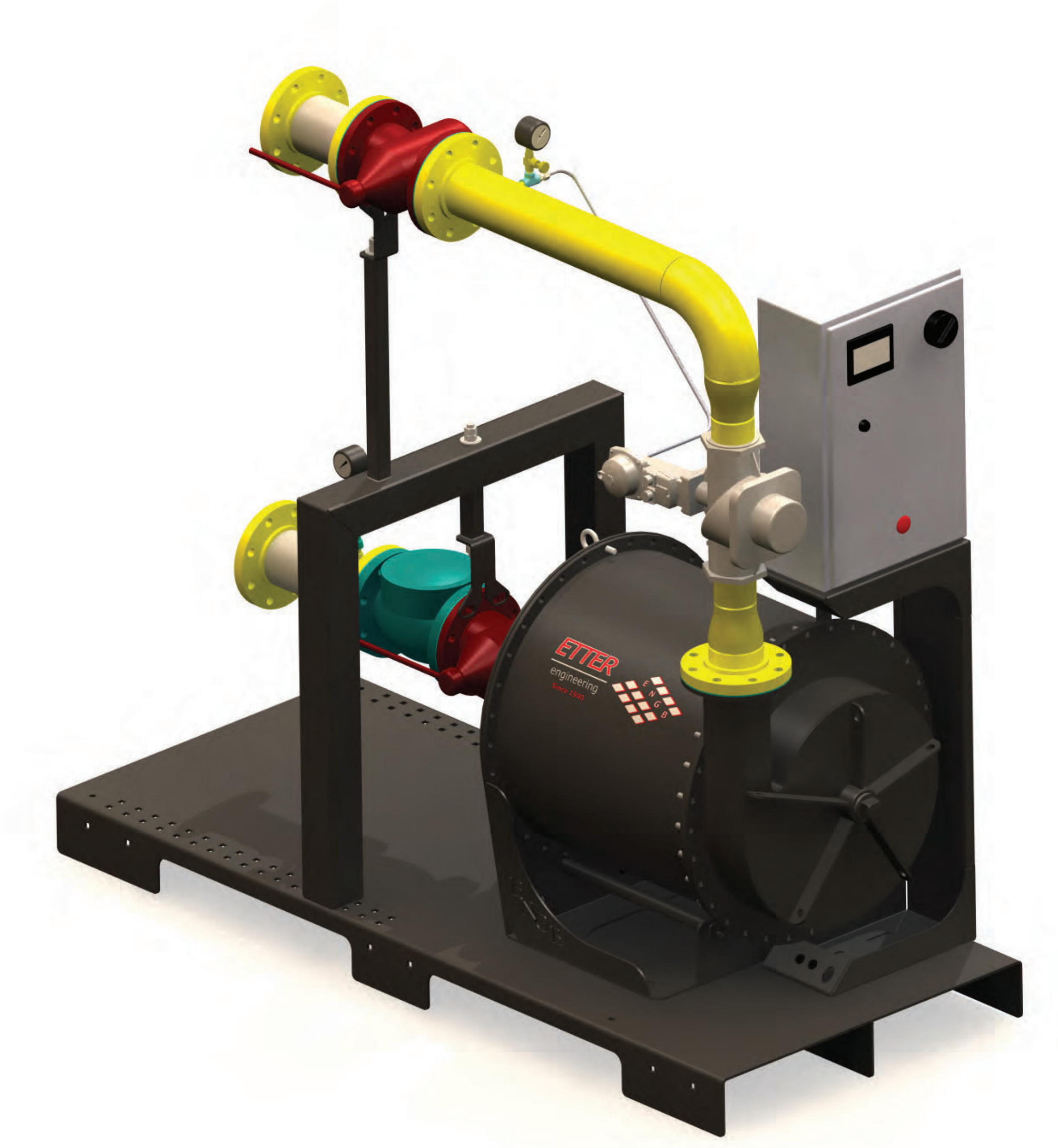
- N — Natural Gas
- L — Landfill-Digestor Gas
- P — Propane
- M — Propane-Air Mix

CONTACT ETTER REGARDING TYPES OTHER THAN NATURAL GAS

Natural gas booster design has gone unchanged for decades...*UNTIL NOW.*

NOTES

Natural gas booster design has gone unchanged for decades...*UNTIL NOW.*



210 CENTURY DRIVE • BRISTOL, CT • 06010 • TOLL FREE 1-800-444-1962 • FAX 860-584-8612 • www.etterengineering.com