1900 Series In-Line Pumps

1900VFD
In-Line Pump with Variable Speed Drive

e-smart™
Resource Saving Products

Now available with
optional variable speed

Taco®
systems made easy®

©Taco Catalog #: 300-1.4
Supersedes: 03/15/05

Effective Date: 01/14/11
Printed in USA

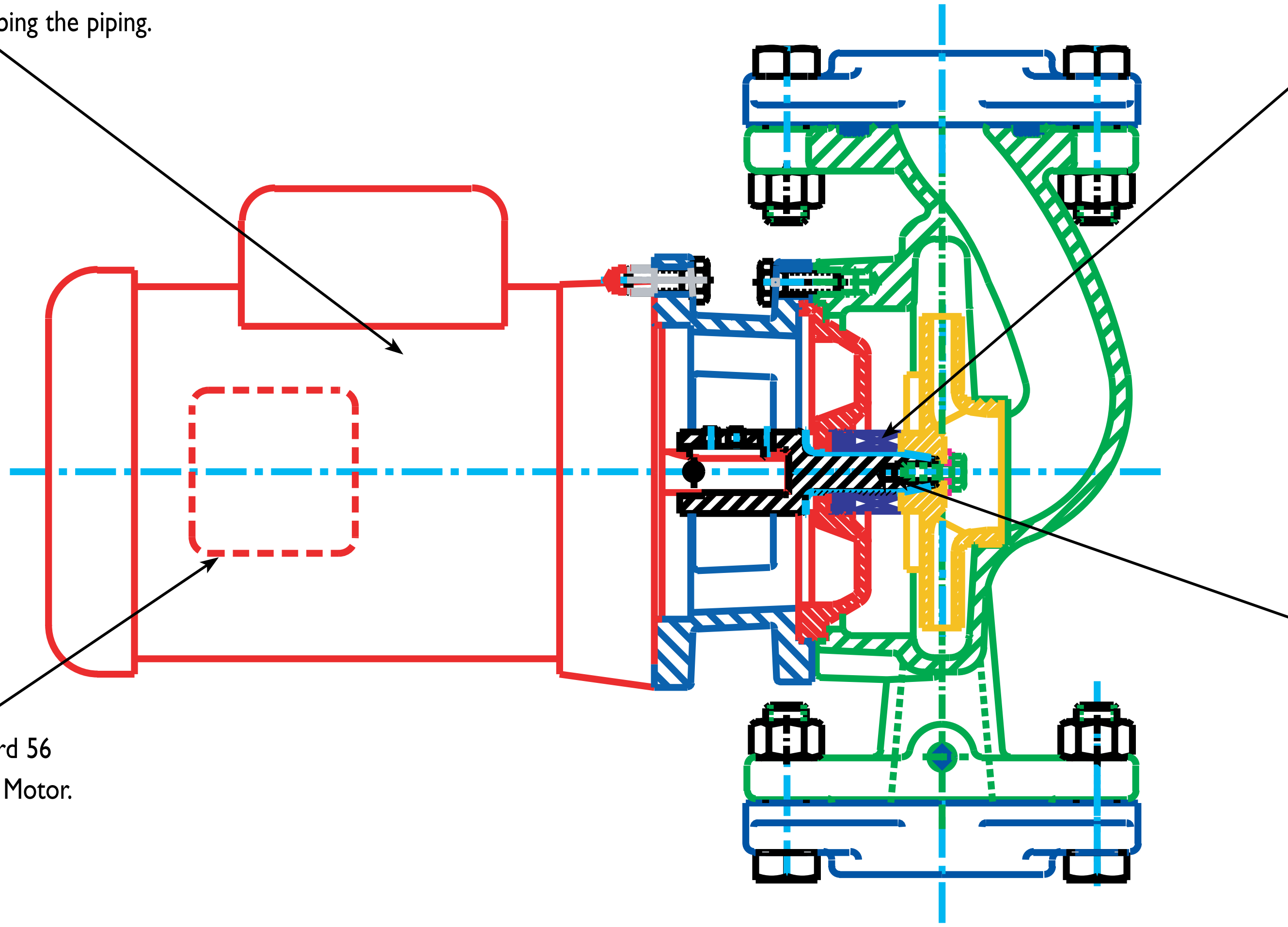
e-smart™ is our way of helping you quickly identify our most resource-saving products.

Features & Benefits

Quiet, dependable power and proven performance.

The 1900 Series close coupled in-line pumps meet the latest industry standards for hydraulic performance and reliability. Each is backed by Taco Inc. a worldwide leader in the design and manufacture of heating and cooling equipment for more than eight decades. Taco 1900 Series pumps are available in five basic models ranging in size from 1-1/2" x 1-1/2" to 2" x 2" with a flow range of 10 to 250 GPM and head capabilities to 160 feet.

Rear pull out design allows servicing of the pump without disturbing the piping.



NEMA Standard 56 Frame C Face Motor.

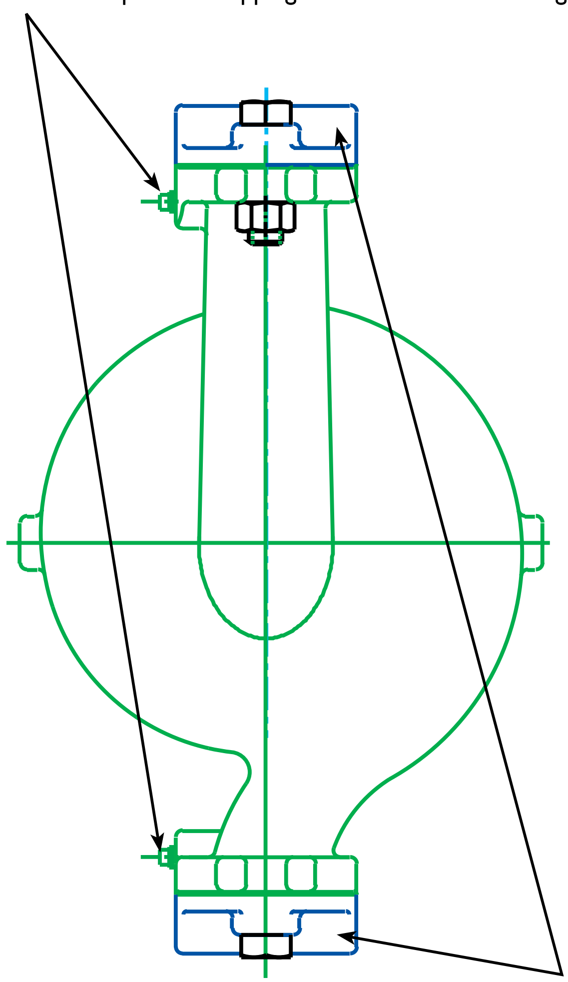
Features & Benefits

Taco 1900 Series In-Line pumps are compact, energy efficient and can be installed anywhere in the piping layout. The 1900 is designed to be self supported by the system piping (requiring no additional "strapping:" or external support) and can be mounted horizontally or vertically. Permanently sealed grease lubricated ball bearings in the motor make the 1900 Series pump virtually maintenance free. All 1900 Series pumps are furnished with ceramic seals (standard) in order to meet a wide range of application requirements. The mechanical seal is an innovative "unitized" design which combines all of the components of the rotating element (spring, retainer, bellows and carbon) into one assembly making seal replacement quick and easy, and one size seal fits all models.

Standard ceramic seal meets the demands of a wide range of application requirements, and the new **"unitized"** design facilitates quick and easy replacement simplifying maintenance.

Replaceable corrosion resistant shaft sleeve incorporates a "built in" slinger to deflect water away from the motor bearing in the event of a seal leak.

1/4 NPT pressure tappings on suction and discharge connections.



Companion flanges included.

Useful Definitions

Flow is a volume measure to establish pump capacity per unit of time, usually as GPM.

Head is a pressure measurement represented by how high the pump can lift a column of liquid, usually in feet. To convert the popular pressure expression P.S.I. to feet of water, multiply P.S.I. X 2.31.

Horsepower (H.P.) is the amount of power available to drive the pump.

Brake Horsepower (BHP) is the amount of power required to drive the pump.

Net Positive Suction Head Required (NPSHR) is a pressure measure – in absolute units – expressed in feet, and indicates the pressure required at the pump suction to prevent cavitation. Reducing the pressure at the pump flange below the vapor pressure of the liquid can cause formation of vapor pockets in the impeller passes. This condition (cavitation) will interfere with pump performance, and is usually accompanied by noise as the vapor pockets collapse. NPSHR can be thought of as the amount of pressure in excess of vapor pressure required to prevent the formation of vapor pockets.

Net Positive Suction Head Available (NPSHR) is the pressure available at the pump suction flange. If NPSHA is less the NPSHR, cavitation problems should be expected.

Pump efficiency represents the portion of brake horsepower converted into useful work. Pump efficiency, along with flow, head, and liquid specific gravity affect the power required to drive the pump. The more efficient the pump, the less power required to drive it.

Specific Gravity (S.G.) is the relative weight of a liquid when compared with water (water = 1.0 S.G.)

R.P.M. is the rotational speed of a pump.

Shut-Off Head is the head developed by a pump at zero flow.

Static Head is the pressure at the pump discharge which the pump must overcome before it can produce flow. Static head is a difference in elevation and can be computed for a variety of conditions surrounding a pump installation.

System Resistance is the pressure on the pump discharge resulting from the resistance to flow created by friction between the fluid and the piping system. This value will vary with flow rate.

Suction Pressure is the pressure observed at the pump suction connection. This may be a positive pressure or a negative pressure.

Discharge Pressure is the pressure at the discharge connection. This will always be a positive pressure.

Differential Pressure is the algebraic difference between the discharge and suction pressures. This value represents pump head.

Service Factor is the reserve power available from an electric motor when operating under normal conditions.

System Curve is a graphical representation of the hydraulic characteristics of a piping system. When the pump performance curve is laid over the system curve, the intersection indicates the flow and head pressure of the pump when coupled to the hydraulic system.

Constant Speed is the RPM of a pump upon which a published pump curve is based.

Part I – Fundamentals

A centrifugal pump operated at constant speed delivers any capacity from zero to maximum depending on the head, design and suction conditions. Pump performance is most commonly shown by means of plotted curves which are graphical representations of a pump's performance characteristics. Pump curves present the average results obtained from testing several pumps of the same design under standardized test conditions. For a single family residential application, considerations other than flow and head are of relatively little economic or functional importance, since the total load is small and the equipment used is relatively standardized. For many smaller circulators, only the flow and pressure produced are represented on the performance curve (Fig. 1-1).

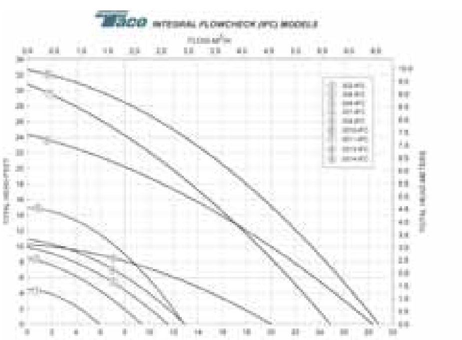


Fig. 1-1

For larger and more complex buildings and systems, economic and functional considerations are more critical, and performance curves must relate the hydraulic efficiency, the power required, the shaft speed, and the net positive suction head required in addition to the flow and pressure produced (Fig. 1-2).

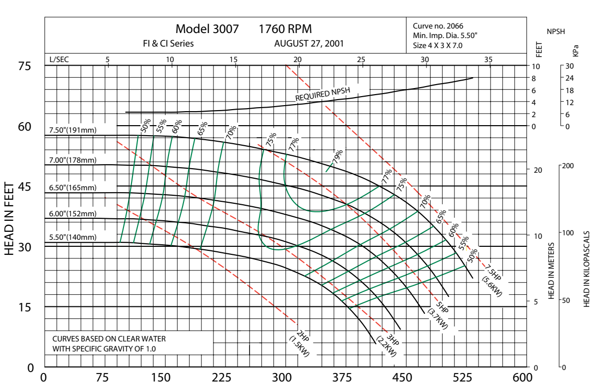


Fig. 1-2

Pump performance curves show this interrelation of pump head, flow and efficiency for a specific impeller diameter and casing size. Since impellers of more than one diameter can usually be fitted in a given pump casing, pump curves show the performance of a given pump with impellers of various diameters. Often, a complete line of pumps of one design is available and a plot called a composite or quick selection curve can be used, to give a complete picture of the available head and flow for a given pump line (Fig. 1-3).

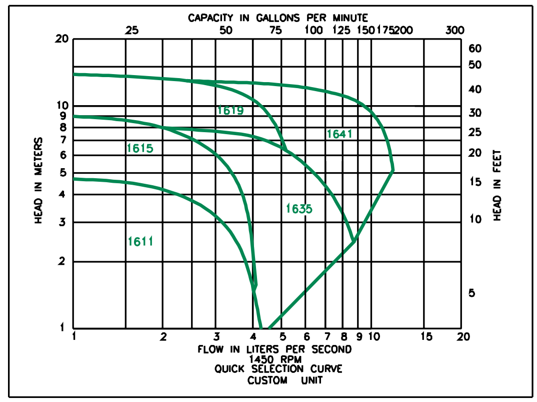


Fig. 1-3

Such charts normally give flow, head and pump size only, and the specific performance curve must then be referred to for impeller diameter, efficiency, and other details. For most applications in our industry, pump curves are based on clear water with a specific gravity of 1.0.

Part II – The System Curve

Understanding a system curve, sometimes called a system head curve, is important because conditions in larger, more complex piping systems vary as a result of either controllable or uncontrollable changes. A pump can operate at any point of rating on its performance curve, depending on the actual total head of a particular system. Partially closing a valve in the pump discharge or changing the size or length of pipes are changes in system conditions that will alter the shape of a system curve and, in turn, affect pump flow. Each pump model has a definite capacity curve for a given impeller diameter and speed. Developing a system curve provides the means to determine at what point on that curve a pump will operate when used in a particular piping system.

Pipes, valves and fittings create resistance to flow or friction head. Developing the data to plot a system curve for a closed Hydronic system under pressure requires calculation of the total of these friction head losses. Friction tables are readily available that provide friction loss data for pipe, valves and fittings. These tables usually express the losses in terms of the equivalent length of straight pipe of the same size as the valve or fitting. Once the total system friction is determined, a plot can be made because this friction varies roughly as the square of the liquid flow in the system. This plot represents the SYSTEM CURVE. By laying the system curve over the pump performance curve, the pump flow can be determined (Fig. 2–1).

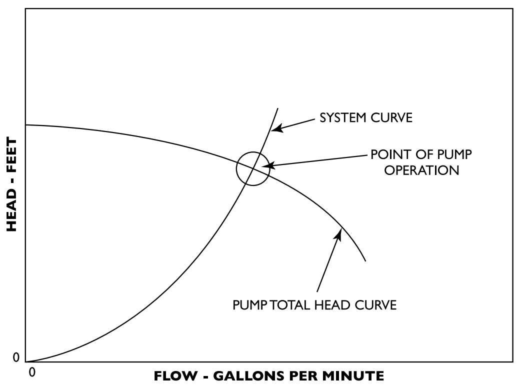


Fig. 2-1

Care must be taken that both pump head and friction are expressed in feet and that both are plotted on the same graph. The system curve will intersect the pump performance curve at the flow rate of the pump because this is the point at which the pump head is equal to the required system head for the same flow.

Fig. 2–2 illustrates the use of a discharge valve to change the system head to vary pump flow. Partially closing the valve shifts the operating point to a higher head or lower

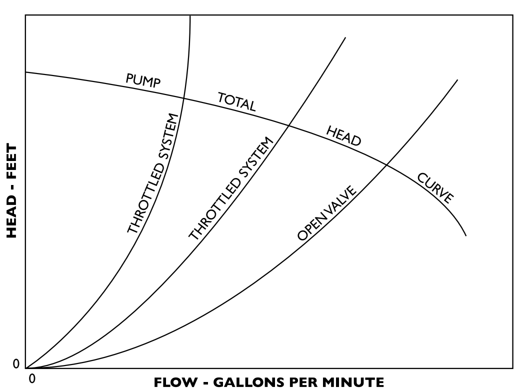


Fig. 2-2

flow capacity. Opening the valve has the opposite effect. Working the system curve against the pump performance curve for different total resistance possibilities provides the system designer important information with which to make pump and motor selection decisions for each system. A system curve is also an effective tool in analyzing system performance problems and choosing appropriate corrective action.

In an open Hydronic system, it may be necessary to add head to raise the liquid from a lower level to a higher level. Called static or elevation head, this amount is added to the friction head to determine the total system head curve. Fig. 2–3 illustrates a system curve developed by adding static head to the friction head resistance.

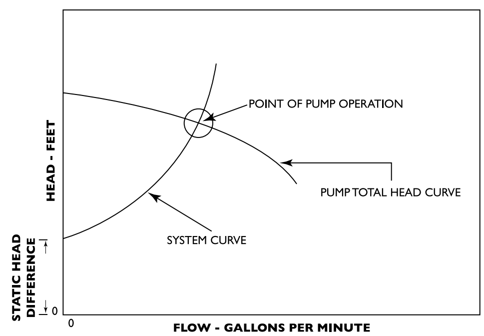


Fig. 2-3

Part III – Stable Curves, Unstable Curves And Parallel Pumping

One of the ways in which the multitude of possible performance curve shapes of centrifugal pumps can be subdivided is as stable and unstable. The head of a stable curve is highest at zero flow (shutoff) and decreases as the flow increases. This is illustrated by the curve of Pump 2 in Fig. 3 – 1.

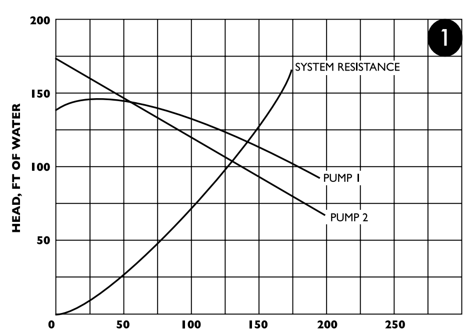


Fig. 3-1

So-called unstable curves are those with maximum head not at zero, but at 5 to 25 percent of maximum flow, as shown by the curve for Pump 1 in Fig. 3 – 1.

The term unstable, though commonly used, is rather unfortunate terminology in that it suggests unstable pump performance. Neither term refers to operating characteristic, however. Each is strictly a designation for a particular shape of curve. Both stable and unstable curves have advantages and disadvantages in design and application. It is left to the discretion of the designer to determine the shape of his curve.

In a vast majority of installations, whether the pump curve is stable or unstable is relatively unimportant, as the following examples of typical applications show.

Single Pump In Closed System

In a closed system, such as a Hydronic heating or cooling system, the function of the pump is to circulate the same quantity of fluid over and over again. Primary interest is in providing flow rate. No static head or lifting of fluid from one level to another takes place.

All system resistance curves originate at zero flow any head. Any pump, no matter how large or small, will produce some flow in a closed system.

For a given system resistance curve, the flow produced by any pump is determined by the intersection of the pump curve with the system resistance curve since only at this point is operating equilibrium possible. For each combination of system and pump, one and only one such intersection exists. Consequently, whether a pump curve is stable or unstable is of no consequence. This is illustrated in Fig. 3 –1.

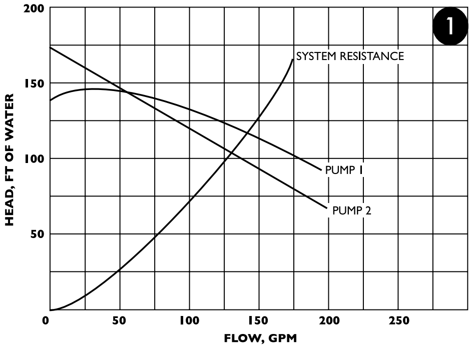


Fig. 3-1

Single Pump In Open System With Static Head

In an open system with static head, the resistance curve originates at zero flow and at the static head to be overcome. The flow is again given by the intersection of system resistance and pump curves as illustrated for a stable curve in Fig. 3–2.

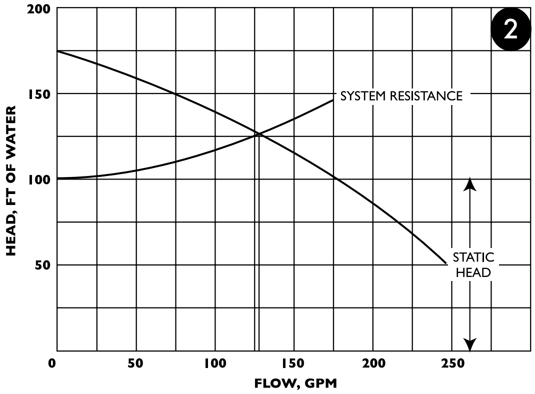


Fig. 3-2

It has been said that in an open system with static head a condition could exist where an unstable curve could cause the flow to "hunt" back and forth between two points since the system resistance curve intersects the pump curve twice, as shown in Fig. 3–3. The fallacy of this reasoning lies, in the fact that the pump used for the system in Fig. 3–3 already represents an improper selection in that it can never deliver any fluid at all. The shutoff head is lower than the static head. The explanation for this can be found in the manner in which a centrifugal pump develops its full pressure when the motor is started. The very important fact to remember here is that the shutoff head of the pump must theoretically always be at least equal to the static head.

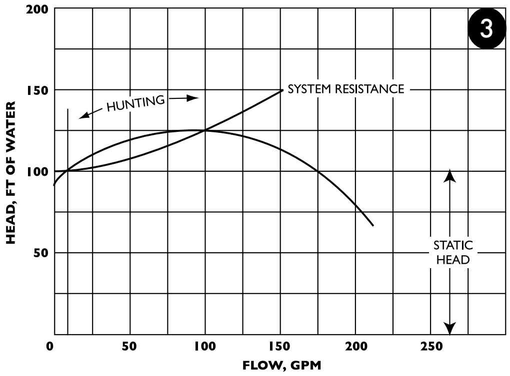


Fig. 3-3

Commercial Hydronic Application Information

From a practical point of view, the shutoff head should be 5 to 10 percent higher than the static head because the slightest reduction in pump head (such as that caused by possible impeller erosion or lower than anticipated motor speed or voltage) would again cause shutoff head to be lower than static head. If the pump is properly selected, there will be only one resistance curve intersection with the pump curve and definite, unchanging flow will be established, as shown in Fig. 3–4.

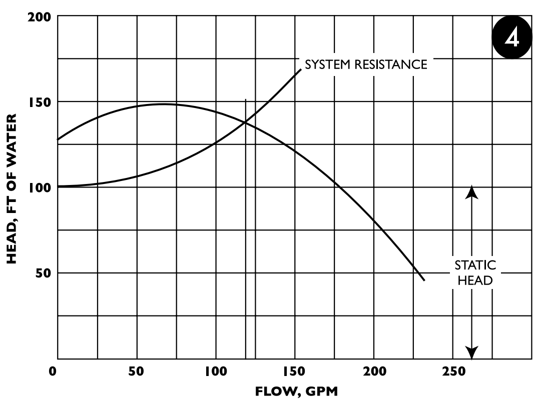


Fig. 3-4

Pumps Operating In Parallel

In more complex piping systems, two or more pumps may be arranged for parallel or series operation to meet a wide range of demand in the most economical manner. When demand drops, one or more pumps can be shut down, allowing the remaining pumps to operate at peak efficiency. Pumps operating in Parallel give multiple flow capacity against a common head. When pumps operate in series, performance is determined by adding heads at the same flow capacity. Pumps to be arranged in series or parallel require the use of a system curve in conjunction with the composite pump performance curves to evaluate their Performance under various conditions.

It is sometimes heard that for multiple pumping the individual pumps used must be stable performance curves. Correctly designed installations will give trouble-free service with either type of curve, however.

The important thing to remember is that additional pumps can be started up only when their shutoff heads are higher than the head developed by the pumps already running.

If a system with fixed resistance (no throttling devices such as modulating valves) is designed so that its head, with all pumps operating (maximum flow) is less than the shutoff head of any individual pump, the different pumps may be operated singly or in any combination, and any starting sequence will work. Fig. 3–5 shows and example consisting of two dissimilar unstable pumps operating on an open system with static head.

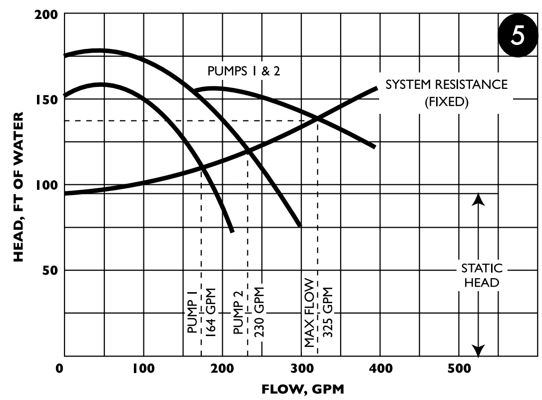


Fig. 3-5

It is also important to realize that stable curves do not guarantee successful parallel pumping by the mere fact that they are stable. Fig. 3–6 illustrates such a case. Two dissimilar pumps with stable curves are installed in a closed system with variable resistance (throttling may be affected by manually operated valves, for example).

With both pumps running, no benefit would be obtained from Pump 1 with the system resistance set to go through A, or any point between 0 and 100 GPM, for that matter. In fact, within that range, fluid from Pump 2 would flow backward through Pump 1 in spite of its running, because pressure available from Pump 2 would flow backward through Pump 1 in spite of its running, because pressure available from Pump 2 is greater than that developed by Pump 1.

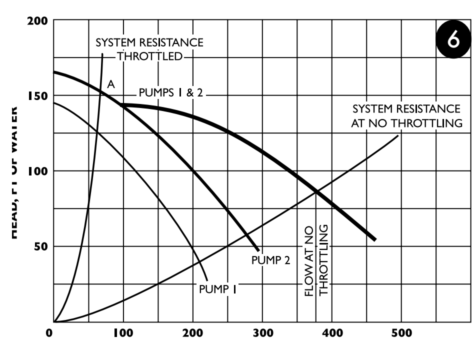


Fig. 3-6

Features / Benefits

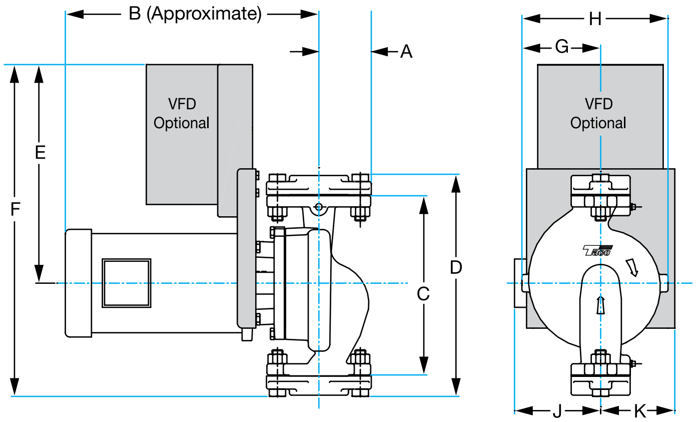
Features	Benefits
Rugged Casing Design	The 1900 Series In-Line pump has a maximum operating pressure of 175psi, and a maximum operating temperature of 300°F. The 1900 Series pump is available in cast iron bronze fitted construction or all bronze construction.
Pressure Tappings	Pressure tappings allow for differential pressure readings to be taken across the pump.
One Piece Enclosed Impeller	Dynamically balanced cast bronze impeller assures long life and higher pump efficiencies.
Cupro-Nickel Shaft Sleeve	Non corrosive shaft sleeve protects the shaft by preventing contact between the shaft and system fluid eliminating the need for more expensive corrosion shaft materials.
Standard Mechanical Seal	"1900" Series In-Line Pumps utilize a revolutionary new "unitized" seal design which facilitates quick and easy replacement. Available in ceramic (standard) or the new "Sealide C" (for more aggressive system fluids) ensures the flexibility to meet a wide range of application requirements. One size seal fits all models.
Motor	NEMA standard 56 frame C face motors*.
Parts Flexibility	Superior parts flexibility one seal, and one shaft extension fits all models.
Factory Tested	All "1900" Series In-Line pumps are factory tested, and are built in accordance with Hydraulic Institute Standards.

**3 HP 1750 rpm motors are TEFC, 5HP and 71/2 HP 3450 rpm motors are specially made OEM motors only available through authorized Taco distributors.*

Operating Specifications

Description	Standard	Optional
Pressure	175psi Maximum Operating Pressure (125psi Flanges Standard)	
Temperature Mechanical Seal	250°F	300°F
Motors	NEMA Standard 56 Frame C Face	
Metering Ports	Tapped Suction & Discharge Ports Provided as Standard	
Factory Tested	100% Factory Tested and built in Accordance with Hydraulic Standards	
Pump Flanges	Available with the Pump	

Commercial Hydronic Application Information



Materials of Construction

Description	Standard	Optional
Casing	Cast Iron	Bronze
Impeller	One Piece Cast Bronze	---
Shaft	Alloy Steel	---
Shaft Sleeve	Cupro-Nickel	---
Bracket	Cast Iron	Cast Iron with S/S Face Plate

Pump Dimensions & Weights

*English dimensions are in inches. Metric dimensions are in milimeters. Metric data is presented in ( ). Do not use for construction purposes unless certified. * 1/4 HP AVAILABLE IN 1 PHASE ONLY.*

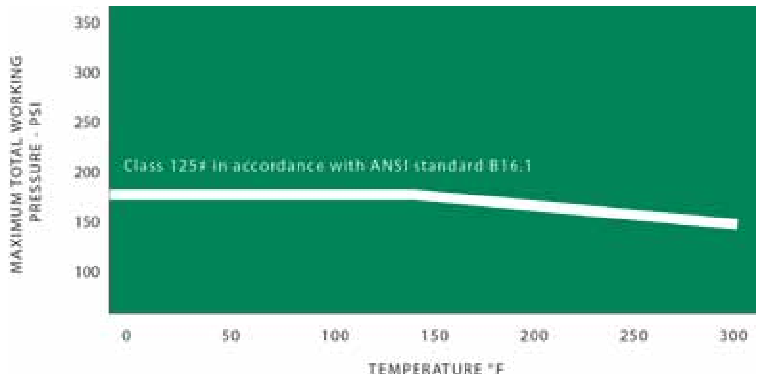
Model No.	Speed	Flange Size	H.P.	Dimensions (inches)									
				A	B	C	D	E	F	G	H	J	K
1911	1760	1-1/2" (38)	1/4* (.19)	3" (75)	14.0 (356)	10-1/4 (260)	12-7/8 (327)	14.8 (376)	21.24 (539)	4.52 (115)	8.38 (213)	5 (127)	4.25 (108)
			1/3 (.25)		14.0 (356)								
			1/2 (.37)		14.0 (356)								
			1 (.75)		15.0 (381)								
	3500		1-1/2 (1.1)		15.5 (393)								
			2 (1.5)		15.5 (393)								
			3 (2.25)		15.5 (393)								
			5 (3.75)		16.5 (420)							7 (175)	
1915	1760	1-1/2" (38)	1/3 (.25)	3-1/8" (80)	14.0 (356)	13-1/2 (368)	16-1/8 (410)	14.8 (376)	22.86 (580)	5.15 (131)	9.75 (248)	5 (127)	4.25 (108)
			1/2 (.37)		14.0 (356)								
			3/4 (.56)		15.0 (381)								
			1 (.75)		16.0 (406)								
			1-1/2 (1.1)		16.0 (406)								
	3500		2 (1.5)		16.0 (406)								
			3 (2.325)		16.0 (406)								
			5 (3.75)		17.0 (432)								
			7.5 (5.6)		17.0 (432)			19.2 (497)	28 (703)			7 (175)	
1919	1760	2" (51)	3/4 (.56)	3" (75)	14.75 (375)	14-1/2 (419)	17-3/8 (441)	14.8 (376)	23.49 (---)	5.74 (146)	11.19 (284)	5 (127)	4.25 (108)
			1 (.75)		15.75 (483)								
			1 1/2 (1.1)		15.75 (400)								
			2 (1.5)		17.5 (445)								
1935	1760	2" (51)	1/2 (.37)	3-1/2" (89)	13.75 (350)	13-1/2 (343)	16-1/8 (410)	14.8 (376)	22.86 (580)	5.39 (137)	9.90 (251)	5 (127)	4.25 (108)
			3/4 (.56)		14.75 (375)								
			1 (.75)		15.75 (483)								
			1-1/2 (1.1)		15.75 (400)								
	3500		2 (1.5)		15.75 (400)								
			3 (2.37)		16.0 (406)								
			5 (3.75)		17.0 (432)								
			7.5 (5.6)		17.0 (432)			19.2 (497)	28 (703)			7 (175)	
1941	1760	2" (51)	1-1/2 (1.1)	3-5/8" (92)	15.75 (400)	16-1/2 (419)	19-1/2 (495)	14.8 (376)	24.55 (623)	6.97 (177)	13.83 (326)	5 (127)	4.25 (108)
			2 (1.5)		17.5 (445)								
			3 (2.37)		24 (610)								

Commercial Hydronic Application Information

Applications

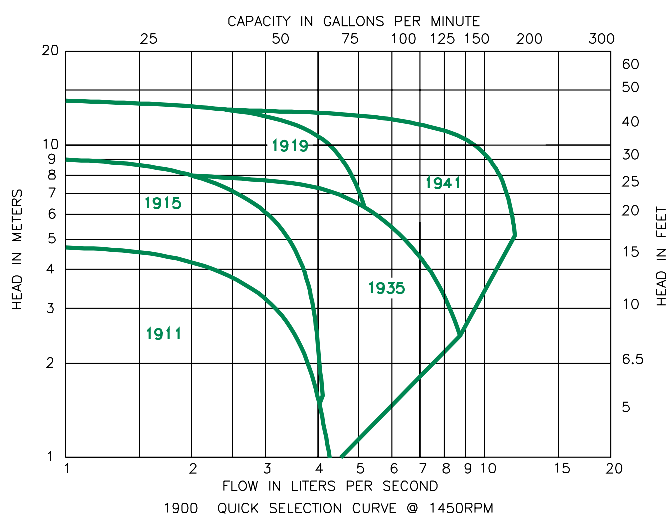
LoadMatch® Systems	Cooling Towers
Air Conditioning Systems	Golf Courses
Recirculation	Dry Cleaning Plants
Booster Service	Livestock Watering
Heating Systems	Bottle Washers
Laundry Equipment	Lawn Sprinklers

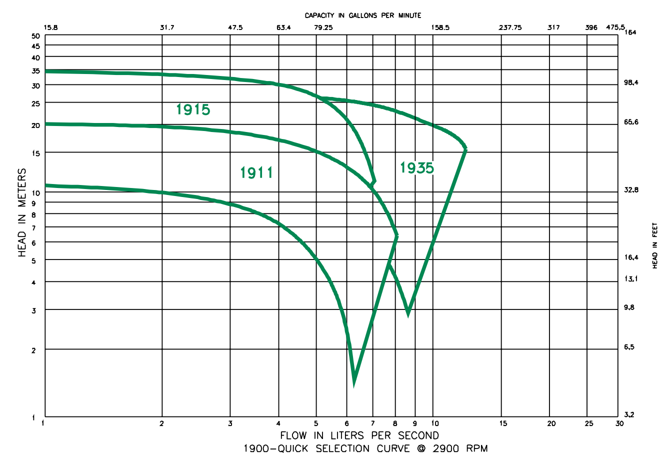
Pressure Temperature Ratings



1900 Series Performance Field 50 Hz

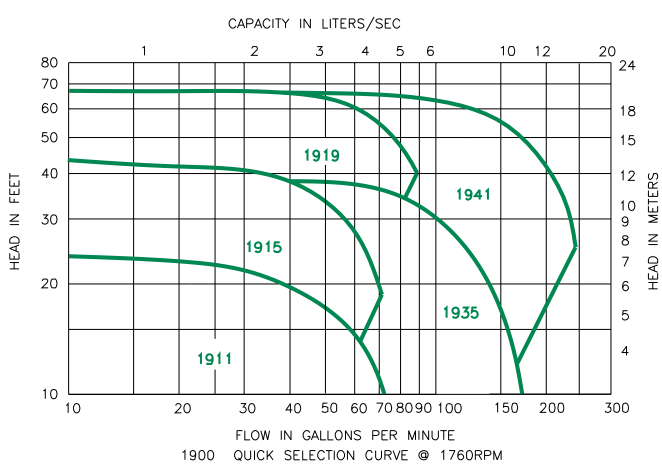
Curves also available on TacoNet®

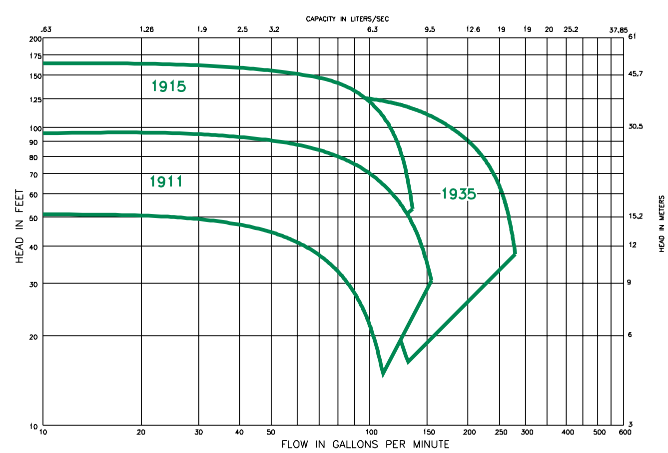




1900 Series Performance Field 60 Hz

Curves also available on TacoNet®





Go Green – 1900 VFD

1900 VFD

In-Line Pump with Variable Speed Drive

Let the 1900 VFD operate your buildings with greater efficiency; using them to control your pumps can significantly reduce energy costs.

In many instances, the payback period for installing adjustable frequency drives in place of other flow control methods is less than 12 months.

Most HVAC systems are designed to keep the building cool on the hottest days and warm on the coldest days. Therefore, the HVAC system only needs to work at full capacity on the 10 or so hottest days and the 10 or so coldest days of the year. On the other 345 days, the HVAC system may operate at a reduced capacity. This is where a system with variable frequency drives (VFDs) can be used to match system flow to actual heating and cooling demands. The VFD can reduce the motor speed when full flow is not required, thereby reducing the power required and the electrical energy used.

Three Phase

Single Phase

An HVAC system controlled by VFDs will go a long way in helping a new or existing building achieve greater energy efficiency. Not only will HVAC systems supplied by VFDs save money, but they also will increase the comfort of the building and reduce equipment maintenance costs and downtime. Plus, meeting the requirements of the Energy Policy Act of 2005 and achieving a more "green" system through LEED certification can offer more money-saving opportunities if the building is eligible for state and local government incentives. Ultimately, more efficient HVAC systems create more energy efficient buildings, which in turn conserves energy resources across the U.S. and the world.

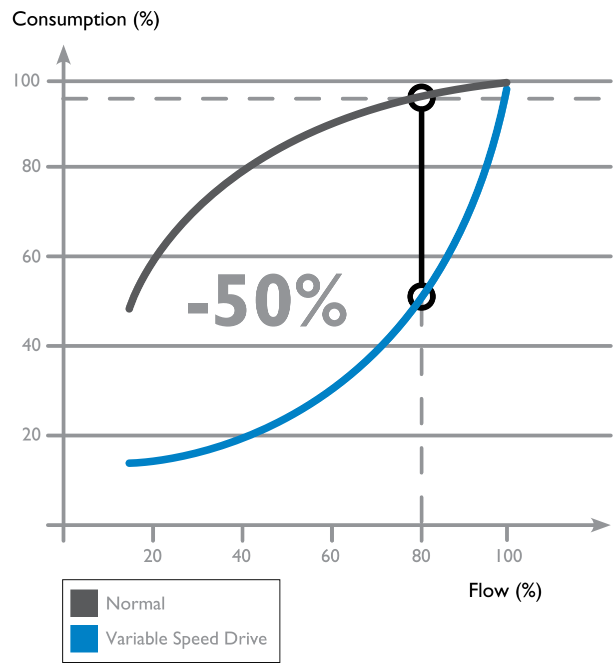
e-smart™

Resource Saving Products

Why Variable Speed Pumping?

- **Better Performance**
  - More efficient method of pump balancing
  - Better system balancing
  - Lower noise in piping
  - Better control prevents cavitation
  - Eliminates valve blow by
  - Allowance for expansion
  - Interim Performance at part load can be optimized
- **Longer equipment life**
  - Soft start/stop
  - Rotating Equipment: Life = 1/speed
  - Lower pressure on components
  - Valve actuators absorb less pressure
- **Lower "System" Life Cycle & Installed Cost**
  - Reduced maintenance
  - Lower "In Rush" current reduces wire and circuit breaker size
  - Smaller pipe (design 10-12 ft/sec)
  - Less tonnage required in chiller plant
- **Chiller plant optimization**
  - Less capacity goes further
  - Better Delta Ts

Reduced Energy Cost



World energy consumption has risen **45%** since 1980 and it's projected to be **70%** higher by 2030!

Pumps consume over **20%** of the world's energy.

The HVAC system accounts for up to **50%** of a commercial business's electric bill.

At **80%** of nominal flow, the power consumption is reduced by **50%** when using a Variable Speed Drive.

Features & Benefits for the 1900 VFD

- High efficiency premium motors
- Allow serial communication with pump
- Simple selection of drives
- Factory preset motor rotation
- Robust adjustable bracket design

FLEXIBLE MOUNTING POSITIONS

Single Phase Models

Three Phase Models

Drive Selection

Advantage
VARIABLE SPEED DRIVES

SELECTION GUIDE

Motor HP	Input Voltage				
	Single Phase		3 Phase		
	100V – 120V	200V – 240V	200V – 240V	380V – 480V	525V – 600V
¼					
⅓	ATV12H037F1	ATV12H037M2	ATV12H037M3		
½				ATV21H075N4	ATV312H075S6
¾	ATV12H075F1	ATV12H055M2	ATV21H075M3X		
1		ATV12H075M2			
1½		ATV12HU15M2	ATV21HU15M3X	ATV21HU15N4	ATV312HU15S6
2					
3	N/A	ATV12HU22M2	ATV21HU22M3X	ATV21HU22N4	ATV312HU22S6
5		N/A	ATV21HU40M3X	ATV21HU40N4	ATV312HU40S6
7½			ATV21HU55M3X	ATV21HU55N4	ATV312HU55S6

ADVANTAGE 12	ADVANTAGE 21	ADVANTAGE 312
For more information, See Taco Catalog #300-10	For more information, See Taco Catalog #300-11	For more information, See Taco Catalog #300-17
		

In order to provide the most efficient pump solution to our customers, Taco is now working with Schneider Electric.

This collaboration brings together Taco's pump technology with Schneider Electric Variable Frequency Drives and the drive packaging of Square D enclosures to offer the best overall pumping solution for our customers.

SQUARE D by Schneider Electric

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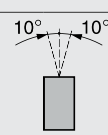
SINGLE PHASE APPLICATIONS
Advantage 12

Variable Speed Drive Specifications

Environmental characteristics

Conformity to standards			Advantage 12 drives have been developed to conform to the strictest international standards and the recommendations relating to electrical industrial control equipment (IEC, EN), in particular: IEC/EN 61800-5-1 (low voltage), IEC/EN 61800-3 (conducted and radiated EMC immunity and emissions).
EMC immunity			IEC/EN 61800-3, Environments 1 and 2 (EMC requirements and specific test methods) IEC/EN 61000-4-2 level 3 (electrostatic discharge immunity test) IEC/EN 61000-4-3 level 3 (radiated, radio-frequency, electromagnetic field immunity test) IEC/EN 61000-4-4 level 4 (electrical fast transient/burst immunity test) IEC/EN 61000-4-5 level 3 (surge immunity test) IEC/EN 61000-4-6 level 3 (immunity to conducted disturbances, induced by radio-frequency fields) IEC/EN 61000-4-11 (voltage dips, short interruptions and voltage variations immunity tests)
Conducted and radiated EMC emissions for drives	ATV 12 ●●●● F1 ATV 12H018M3 ATV 12● 037M3... ● U22M3		With additional EMC filter: ■ IEC/EN 61800-3, Environment 1 (public network) in restricted distribution: □ Category C1, at 2, 4, 8, 12 and 16 kHz for a shielded motor cable length ≤ 5 m □ Category C2, from 2 to 16 kHz for a shielded motor cable length ≤ 20 m ■ IEC/EN 61800-3, Environment 2 (industrial network): □ Category C3, from 2 to 16 kHz for a shielded motor cable length ≤ 20 m
	ATV 12●●●● M2		■ IEC/EN 61800-3, Environment 1 (public network) in restricted distribution: □ Category C1, at 2, 4, 8, 12 and 16 kHz for a shielded motor cable length ≤ 5 m □ Category C2: ATV 12H018M2... ● 075M2, from 2 to 12 kHz for a shielded motor cable length ≤ 5 m and at 2, 4, 16 kHz for a shielded motor cable length ≤ 10 m □ Category C2: ATV 12HU15M2...HU22M2, from 4 to 16 kHz for a shielded motor cable length ≤ 5 m and at 2, 4, 8, 12 and 16 kHz for a shielded motor cable length ≤ 10 m With additional EMC filter: ■ IEC/EN 61800-3, Environment 1 (public network) in restricted distribution: □ Category C1, at 2, 4, 8, 12 and 16 kHz for a shielded motor cable length ≤ 20 m □ Category C2, from 2 to 16 kHz for a shielded motor cable length ≤ 50 m ■ IEC/EN 61800-3, Environment 2 (industrial network): □ Category C3, from 2 to 16 kHz for a shielded motor cable length ≤ 50 m
CE marking			The drives are marked CE according to the European low voltage (2006/95/EC) and EMC (2004/108/EC) directives
Product certifications			UL, CSA, NOM, GOST and C-Tick
Degree of protection			IP 20
Vibration resistance	Drive not mounted on rail		According to IEC/EN 60068-2-6: □ 1.5 mm peak from 3 to 13 Hz □ 1 gn from 13 to 200 Hz
Shock resistance			15 gn for 11 ms according to IEC/EN 60068-2-27
Maximum ambient pollution Definition of insulation			Degree 2 according to IEC/EN 61800-5-1
Environmental conditions Use			IEC 60721-3-3 classes 3C3 and 3S2
Relative humidity		%	5…95 non condensing, no dripping water, according to IEC60068-2-3
Ambient air temperature around the device — Operation	ATV 12H018F1, H037F1 ATV 12H018M2…H075M2 ATV 12H018M3…H075M3 ATV 12P ●●●●●	°C	- 10…+ 40 without derating Up to + 60, with the protective blanking cover removed and current derating of 2.2% per additional degree
	ATV 12H075F1 ATV 12HU15M2, HU22M2 ATV 12HU15M3…HU40M3	°C	- 10…+ 50 without derating Up to + 60, with the protective blanking cover removed and current derating of 2.2% per additional degree
Storage	ATV 12 ●●●●●●	°C	- 25…+ 70
Maximum operating altitude	ATV 12 ●●●●●●	m	1000 without derating
	ATV 12●●●● F1 ATV 12●●●● M2	m	Up to 2000 for single-phase networks and corner grounded distribution networks, with current derating of 1% per additional 100 m
	ATV 12●●●● M3	m	Up to 3000 meters for three-phase networks, with current derating of 1% per additional 100 m
Operating position Maximum permanent angle in relation to the normal vertical mounting position			

Variable Speed Drive Specifications

SINGLE PHASE APPLICATIONS
Advantage 12

Drive characteristics

Output frequency range	Hz	0.5…400
Configurable switching frequency	kHz	Nominal switching frequency: 4 kHz without derating in continuous operation Adjustable during operation from 2 to 16 kHz Above 4 kHz in continuous operation, apply derating to the nominal drive current of: ■ 10% for 8 kHz ■ 20% for 12 kHz ■ 30% for 16 kHz Above 4 kHz, the drive will reduce the switching frequency automatically in the event of excessive temperature rise.
Speed range		1…20
Transient overtorque		150…170% of the nominal torque depending on the drive rating and the type of motor
Braking torque		■ Up to 70% of the nominal torque without resistor ■ Up to 150% of the nominal motor torque with braking unit (optional) at high inertia
Maximum transient current		150% of the nominal drive current for 60 seconds
Motor control profiles		■ Standard profile (voltage/frequency ratio) ■ Performance profile (sensorless flux vector control) ■ Pump/fan profile (Kn² quadratic ratio)

Electrical power characteristics

Power supply	Voltage	V	100 - 15% to 120 + 10% single-phase for ATV 12●●●● F1 200 - 15% to 240 + 10% single-phase for ATV 12●●●● M2 200 - 15% to 240 + 10% three-phase for ATV 12●●●● M3	
	Frequency	Hz	50…60 ± 5%	
	Isc (short-circuit current)	A	⩽1000 (Isc at the connection point) for single-phase power supply ⩽5000 (Isc at the connection point) for three-phase power supply	
Drive supply and output voltages			Drive supply voltage	Drive output voltage for motor
	ATV 12pppp F1	V	100…120 single-phase	200…240 three-phase
	ATV 12pppp M2	V	200…240 single-phase	
	ATV 12pppp M3	V	200…240 three-phase	
Maximum length of motor cable (including tap links)	Shielded cable	m	50	
	Unshielded cable	m	100	
Drive noise level	ATV 12H018F1, H037F1 ATV 12H018M2…H075M2 ATV 12H018M3…H075M3 ATV 12P ppppp	dBA	0	
	ATV 12H075F1 ATV 12HU15M2, HU22M2	dBA	45	
	ATV 12HU15M3…HU40M3	dBA	50	
Electrical isolation			Electrical isolation between power and control (inputs, outputs, power supplies)	

Connection characteristics
(drive terminals for the line supply, the motor output and the braking unit)

Drive terminals			R/L1, S/L2/N, T/L3, U/T1, V/T2, W/T3, PA/+, PC/–
Maximum wire size and tightening torque	ATV 12H018F1, H037F1 ATV 12H018M2…H075M2 ATV 12H018M3…H075M3 ATV 12P037F1 ATV 12P037M2…P075M2 ATV 12P037M3, P075M3		3.5 mm² (AWG 12) 0.8 Nm
	ATV 12H075F1 ATV 12HU15M2, HU22M2 ATV 12HU15M3…HU40M3 ATV 12PU15M3…PU40M3		5.5 mm² (AWG 10) 1.2 Nm

SINGLE PHASE APPLICATIONS
Advantage 12

Variable Speed Drive Specifications

Electrical characteristics (control)

Available internal supplies			Protected against short-circuits and overloads: ■ One 5 V ⎓ supply (± 5%) for the reference potentiometer (2.2 to 10 k Ω) maximum data rate 10 mA ■ One 24 V ⎓ supply (-15%/+20%) for the control inputs, maximum data rate 100 mA
Analog input	AI1		1 software-configurable voltage or current analog input: ■ Voltage analog input: 0…5 V ⎓ (internal power supply only) or 0…10 V ⎓, impedance 30 k Ω ■ Analog current input: X-Y mA by programming X and Y from 0…20 mA, impedance 250 Ω Sampling time: < 10 ms Resolution: 10 bits Accuracy: ± 1% at 25°C Linearity: ± 0.3% of the maximum scale value Factory setting: Input configured as voltage type
Analog output	AO1		1 software-configurable voltage or current analog output: ■ Analog voltage output: 0…10 V ⎓, minimum load impedance 470 Ω ■ Analog current output: 0 to 20 mA, maximum load impedance 800 Ω Update time: < 10 ms Resolution: 8 bits Accuracy: ± 1% at 25°C
Relay outputs	R1A, R1B, R1C		1 protected relay output, 1 N/O contact and 1 N/C contact with common point Response time: 30 ms maximum Minimum switching capacity: 5 mA for 24 V ⎓ Maximum switching capacity: ■ On resistive load (cos = 1 and L/R = 0 ms): 3 A at 250 V ~ or 4 A at 30 V ⎓ ■ On inductive load (cos = 0.4 and L/R = 7 ms): 2 A at 250 V ~ or 30 V ⎓
LI logic inputs	LI1…LI4		4 programmable logic inputs, compatible with PLC level 1, standard IEC/EN6 1131-2 24 V ⎓ internal power supply or 24 V ⎓ external power supply (min. 18 V, max. 30 V) Sampling time: < 20 ms Sampling time tolerance: ± 1 ms Factory-set with 2-wire control in "transition" mode for machine safety reasons: ■ LI1: forward ■ LI2…LI4: not assigned Multiple assignment makes it possible to configure several functions on one input (for example: LI1 assigned to forward and preset speed 2, LI3 assigned to reverse and preset speed 3) Impedance 3.5 k Ω
	Positive logic (Source)		Factory setting State 0 if < 5 V, state 1 if > 11 V
	Negative logic (Sink)		Software-configurable State 0 if > 16 V or logic input not wired, state 1 if < 10 V
Logic output	LO+		One 24 V ⎓ logic output assignable as positive logic (Source) or negative logic (Sink) open collector type, compatible with level 1 PLC, standard IEC/EN 61131-2 Maximum voltage: 30 V Linearity: ± 1% Maximum current: 10 mA (100 mA with external power supply) Impedance: 1k Ω Update time: < 20 ms Logic output common (LO-) to be connected to: ■ 24 V ⎓ in positive logic (Source) ■ 0 V in negative logic (Sink)
Maximum I/O wire size and tightening torque			1.5 mm^2 (AWG 14) 0.5 Nm
Acceleration and deceleration ramps			Ramp profile: ■ Linear from 0 to 999.9 s ■ S ramp ■ U ramp Automatic adaptation of deceleration ramp time if braking capacities exceeded, although this adaptation can be disabled (use of braking unit)
Emergency braking			By DC injection: automatically as soon as the estimated output frequency drops to < 0.2 Hz, period adjustable from 0.1 to 30 s or continuous, current adjustable from 0 to 1.2 In
Main drive protection features			Thermal protection against overheating Protection against short-circuits between motor phases Overcurrent protection between motor phases and earth Protection in the event of line overvoltage and undervoltage Input phase loss protection, in three-phase
Motor protection			Thermal protection integrated in the drive by continuous calculation of the I^2t
Frequency resolution			Display unit: 0.1 Hz Analog inputs: 10-bit A/D converter
Time constant on a change of setpoint		ms	20 ± 1 ms

Variable Speed Drive Specifications

THREE PHASE APPLICATIONS
Advantage 21

Electrical

Input Voltage	200 -15% to 240 +10%, 380 -15% to 480 +10%
Input Frequency	50 Hz -5% to 60 Hz +5%
Drive Input Section	Six pulse bridge rectifier
Drive Output Section	Three Phase, IGBT Inverter with Pulse Width Modulated (PWM) output Maximum voltage equal to input voltage
Galvanic Isolation	Galvanic isolation between power and control (inputs, outputs and power supplies)
Frequency Range of Power Converter	0.5 to 200 Hz
Torque/Overtorque	120% of nominal motor torque for 60 seconds
Current (transient)	110% of controller rated current for 60 seconds, 180% for 2 seconds
Switching Frequency	Selectable from 6 to 16 kHz, 12 kHz nominal rating for 1 HP to 20 HP @ 200/240 V, 380/480 V Selectable: 6 to 16 kHz, 8kHz nominal rating for 30 HP to 40 HP @ 200/240 V, 30 HP to 100 HP @ 380/480 V
Logic Inputs	3 logic inputs (F,R,RES) 24 Vdc, compatible with level 1 PLC, IEC 65A-68 standard Impedance: 3.5 kΩ, Maximum voltage: 30 Vdc, Max. sampling time: 2 ms ±0.5 milliseconds Multiple assignment makes it possible to configure several functions on one input
Speed Reference Inputs	VIA: Voltage analog input 0 to 10 Vdc, impedance 30 kΩ (max. safe voltage: 24 Vdc). Analog current input X–Y mA by programming X and Y from 0 to 20 mA, with impedance 242 Ω. Can also be configured as a logic input VIB: Voltage analog input, configurable as an analog input or as a PTC probe input. 0–10 Vdc, impedance 30 kΩ (max. safe voltage 24 Vdc)
Analog Reference Resolution	0.0048 Hz (11 bits)
Relay Outputs	FL (FLA,FLB,FLC) 1 N/C contact, and 1 N/O contact with common point R (RY,RC) 1 N/O contact Maximum switching capacity: • On resistive load (cos Ø = 1): 5 A for 250 Vac or 30 Vdc • On inductive load (cos Ø = 0.4 and L/R = 7 ms): 2 A for 250 Vac or 30 Vdc
I/O Sampling Time	2 milliseconds ±0.5 milliseconds on analog inputs & outputs, & logic inputs, 7 milliseconds ±0.5 milliseconds on relay outputs
Acceleration and Deceleration Ramps	0.1 to 3200 seconds (definition in 0.1 seconds increments)
Skip Frequencies	Three configurable skip frequency/jump frequency bands
Motor Control Profiles	Energy economizer (flux optimization) motor algorithm to maximize energy savings. (Automatically optimizes voltage based on load) or select volts/hertz profile or SLFV (sensorless flux vector)
Speed Range	1:10
Motor Protection	Class 10 electronic overload protection
Keypad/Display Terminal	4 segment, LED display with Run and Units LED indication. Run/ Stop, Local/ remote (with LED indication), and programming buttons. Quick Start, Fault History, I/O mapping, Last-used menus. Status Monitoring and self diagnostics with fault messages and status such as: Power on time, elapsed time, motor run time, line voltage, motor current, ready to run, running, motor speed, etc.
Compliance	RoHS
Codes and Standards	UL, CSA, NOM 117, DNV, CE, C-Tick, HPST, UL 1995 Plenum rated

Environmental

Temperature	Storage: -13 to +158 °F (-25 to +70 °C) Operation: +14 to +104 °F (-10 to +40 °C) without derating, +14 to +122 °F (-10 to +50 °C) with derating
Humidity	95% with no condensation or dripping water, conforming to IEC 600068-2-3.
Altitude	Up to 3,300 ft (1,000 m) without derating; derate by 1% for each additional 330 ft (100 m) up to 10,000 ft (3,000 m) Limit to 6,600 ft (2,000 m) if supplied by corner grounded distribution system
Enclosure Rating	• NEMA/UL open type (IP20) with top vent cover removed. • NEMA/UL Type 1 with the top vent cover in place and with the Conduit Entry Kit installed • IP21 and IP41 and on top of drive controller
Pollution Degree	1 HP to 25 HP @ 200/240 V, 1 HP to 5 HP @ 380/480 V: Pollution degree 2 per IEC/EN 61800-5-1, 30 HP to 40 HP @ 200/240 V, 30 HP to 100 HP @ 380/480 V: Pollution degree 3 per IEC/EN 61800-5-1
Vibration Resistance	1.5 mm peak to peak from 3 to 13 Hz, 1 gn from 13 to 150 Hz, conforming to IEC/EN 60068-2-6
Shock Resistance	15 gn for 11 ms conforming to IEC/EN 60068-2-27

THREE PHASE APPLICATIONS
Advantage 21

User Interface Kits

Description		Catalog Number
Remote Keypad Display Mounting Kit	Includes remote keypad, hardware and cable. IP65 rated	VW3A21101
PC Soft Test and Commissioning Software	Free for download on Telemecanique.com	VW3A2104
PC Connection Kit		VW3A8106

Communication Card Kits

Description	Catalog Number
LONWORKS	VW3A21312
METASYS N2	VW3A21313
APOGEE FLN P1	VW3A21314
BACnet	VW3A21315

Note: Only logic inputs F and R, analog input VIB, relay output FL, common and 24 V supply terminals and RJ45 Modbus connector are available when a communication option card is installed.

Field Installed Kits

RFI Input Filter For compliance with European (CE) conducted emissions standard 55022 Class B		
Three phase supply voltage: 200 to 240 V 50/60 Hz	ATV21H075M3X ATV21HU15M3X ATV21HU22M3X ATV21H075N4 ATV21HU15N4 ATV21HU22N4	VW3A31404
	ATV21HU30M3X ATV21HU40M3X ATV21HD22M3X	VW3A31406
	ATV21HU55M3X ATV21HU75M3X	VW3A31407
	ATV21HD11M3X ATV21HD15M3X ATV21HD18M3X ATV21HD30M3X	VW3A31408
Three phase supply voltage: 300 to 500 V 50/60 Hz	ATV21H075N4 ATV21HU15N4 ATV21HU22N4	VW3A31404
	ATV21HU30N4 ATV21HU40N4 ATV21HU55N4 ATV21HD22N4 ATV21HD30N4	VW3A31406
	ATV21HU75N4 ATV21HD11N4 ATV21HD37N4 ATV21HD45N4	VW3A31407
	ATV21HD55N4 ATV21HD75N4	VW3A31408
	ATV21HD15N4 ATV21HD18N4	VW3A31409

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