Polynomial Curve Fitting with Excel

EAS 199A
Fall 2011

Overview

Practical motivation: fitting a pump curve

- Get data from the manufacturer.
- Use Excel's TRENDLINE function to fit polynomials to the data.
- Extract the polynomial coefficients for later use.

Note: This example uses pump data from a manufacturer. For the pump project assignment, use the measured data for your pump.

Sample pump data

A circulating pump from the Grainger Catalog

- http://www.grainger.com
- Select "pump" under Product Category
- Select "Centrifugal" under "Narrow your search by"

  (or click on the Centrifugal Pump panel in the center of the page)
- Select "Self priming pressure pumps"
- As an example, pick the first pump: Goulds GT10

Direct link (24 November 2010)
http://www.grainger.com/Grainger/GOULDS-Centrifugal-Pump-1N440

Pump, Centrifugal, 1 HP – Self Priming Pressure Pumps – Centrifugal – Pumps : Grainger Industrial Supply

http://www.grainger.com/Grainger/GOULDS-Centrifugal-Pump-1N440

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Pump, Centrifugal, 1 HP – Self Pri...

GOULDS Pump, Centrifugal, 1 HP

Centrifugal Pump, Power Rating 1 HP, Voltage @ 60 Hz 115/230 Volts, Phase Single, Full Load Amps 16.2/8.1, Motor Enclosure ODP, NPT Inlet 1 1/2 Inches, Outlet Port 1 1/2 Inches, Length 19 7/8 Inches, Height 9 1/4 Inches, Width 8 1/4 Inches, Self Priming

Grainger Item #	1N440
Price (ea.)	**$483.00**
Brand	GOULDS
Mfr. Model #	GT10
Ship Qty.	1
Sell Qty. (Will-Call)	1
Ship Weight (lbs.)	50.6
Usually Ships**	Today
Catalog Page No.	3573
Country of Origin **(Country of Origin is subject to change.)**	USA

Enlarge Image

See Notes & Restrictions for important safety information.

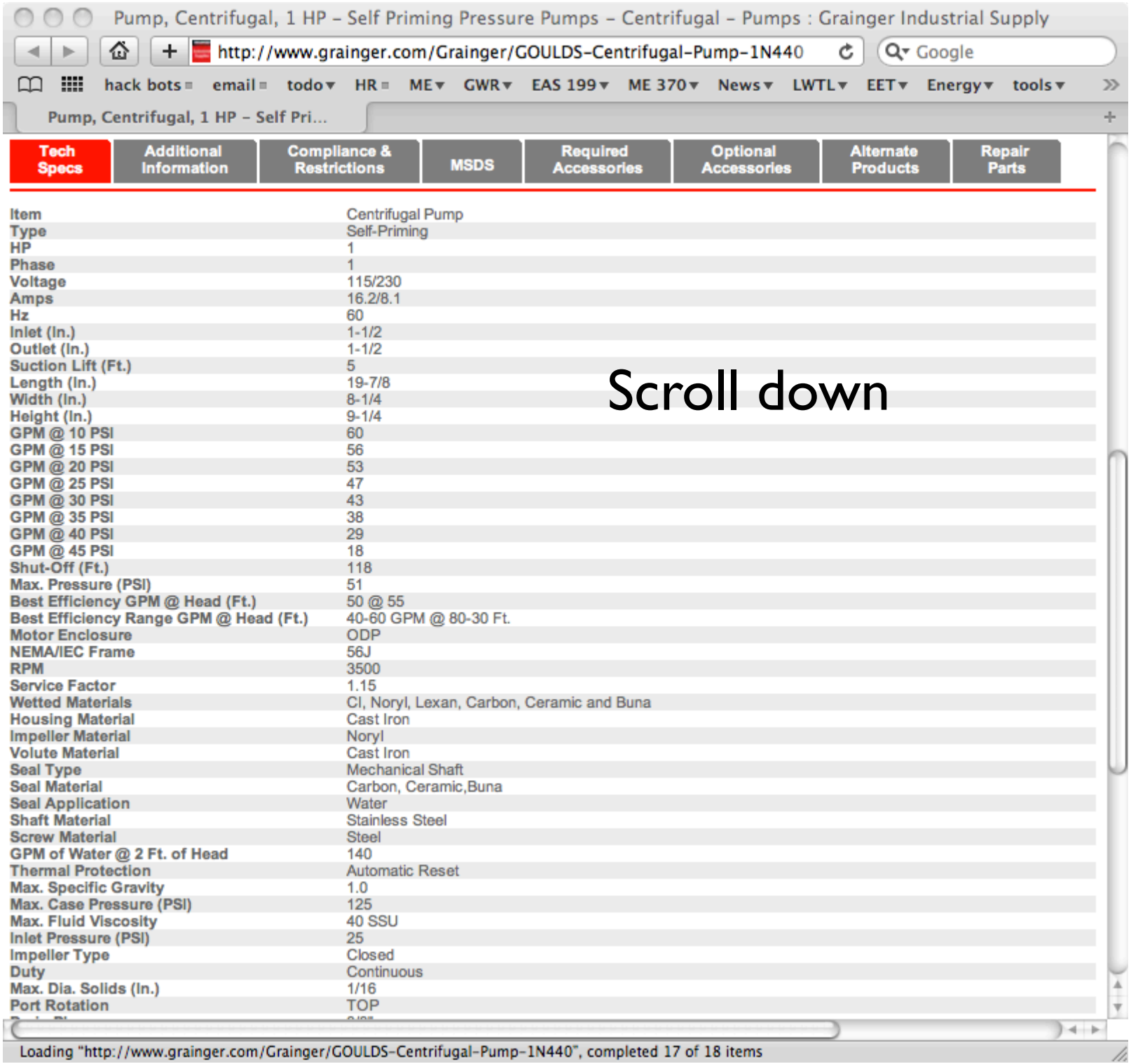
Qty.

Add Grainger TripleGuard® repair & replacement coverage for $89.95 each.

Add to Order | Add to Personal List | Compare Alternates

Price shown may not reflect your price. Sign in or register.

Tech Specs | Additional Information | Compliance & Restrictions | MSDS | Required Accessories | Optional Accessories | Alternate Products | Repair Parts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Pump, Centrifugal, 1 HP – Self Pri...
Tech Specs
Additional Information
Compliance & Restrictions
MSDS
Required Accessories
Optional Accessories
Alternate Products
Repair Parts
Item Centrifugal Pump
Type Self-Priming
HP 1
Phase 1
Voltage 115/230
Amps 16.2/8.1
Hz 60
Inlet (In.) 1-1/2
Outlet (In.) 1-1/2
Suction Lift (Ft.) 5
Length (In.) 19-7/8
Width (In.) 8-1/4
Height (In.) 9-1/4
GPM @ 10 PSI 60
GPM @ 15 PSI 56
GPM @ 20 PSI 53
GPM @ 25 PSI 47
GPM @ 30 PSI 43
GPM @ 35 PSI 38
GPM @ 40 PSI 29
GPM @ 45 PSI 18
Shut-Off (Ft.) 118
Max. Pressure (PSI) 51
Best Efficiency GPM @ Head (Ft.) 50 @ 55
Best Efficiency Range GPM @ Head (Ft.) 40-60 GPM @ 80-30 Ft.
Motor Enclosure ODP
NEMA/IEC Frame 56J
RPM 3500
Service Factor 1.15
Wetted Materials CI, Noryl, Lexan, Carbon, Ceramic and Buna
Housing Material Cast Iron
Impeller Material Noryl
Volute Material Cast Iron
Seal Type Mechanical Shaft
Seal Material Carbon, Ceramic,Buna
Seal Application Water
Shaft Material Stainless Steel
Screw Material Steel
GPM of Water @ 2 Ft. of Head 140
Thermal Protection Automatic Reset
Max. Specific Gravity 1.0
Max. Case Pressure (PSI) 125
Max. Fluid Viscosity 40 SSU
Inlet Pressure (PSI) 25
Impeller Type Closed
Duty Continuous
Max. Dia. Solids (In.) 1/16
Port Rotation TOP
Scroll down
Loading "http://www.grainger.com/Grainger/GOULDS-Centrifugal-Pump-1N440", completed 17 of 18 items

Pump, Centrifugal, 1 HP – Self Priming Pressure Pumps – Centrifugal – Pumps : Grainger Industrial Supply

http://www.grainger.com/Grainger/GOULDS-Centrifugal-Pump-1N440

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Pump, Centrifugal, 1 HP – Self Pri...

Tech Specs | Additional Information | Compliance & Restrictions | MSDS | Required Accessories | Optional Accessories | Alternate Products | Repair Parts

Item	Centrifugal Pump
Type	Self-Priming
HP	1
Phase	1
Voltage	115/230
Amps	16.2/8.1
Hz	60
Inlet (In.)	1-1/2
Outlet (In.)	1-1/2
Suction Lift (Ft.)	5
Length (In.)	19-7/8
Width (In.)	8-1/4
Height (In.)	9-1/4
GPM @ 10 PSI	60
GPM @ 15 PSI	56
GPM @ 20 PSI	53
GPM @ 25 PSI	47
GPM @ 30 PSI	43
GPM @ 35 PSI	38
GPM @ 40 PSI	29
GPM @ 45 PSI	18
Shut-Off (Ft.)	118
Max. Pressure (PSI)	51
Best Efficiency GPM @ Head (Ft.)	50 @ 55
Best Efficiency Range GPM @ Head (Ft.)	40-60 GPM @ 80-30 Ft.
Motor Enclosure	ODP
NEMA/IEC Frame	56J
RPM	3500
Service Factor	1.15
Wetted Materials	CI, Noryl, Lexan, Carbon, Ceramic and Buna
Housing Material	Cast Iron
Impeller Material	Noryl
Volute Material	Cast Iron
Seal Type	Mechanical Shaft
Seal Material	Carbon, Ceramic,Buna
Seal Application	Water
Shaft Material	Stainless Steel
Screw Material	Steel
GPM of Water @ 2 Ft. of Head	140
Thermal Protection	Automatic Reset
Max. Specific Gravity	1.0
Max. Case Pressure (PSI)	125
Max. Fluid Viscosity	40 SSU
Inlet Pressure (PSI)	25
Impeller Type	Closed
Duty	Continuous
Max. Dia. Solids (In.)	1/16
Port Rotation	TOP

Pump curve data

Loading "http://www.grainger.com/Grainger/GOULDS-Centrifugal-Pump-1N440", completed 17 of 18 items

Polynomial Curve Fit with Excel

1. Store the data
2. Make a scatter plot
3. Right-click on data, and "add a trendline"
   (a) Select Polynomial, dial-in the desired order
   (b) Check boxes to display equations and R2
   (c) Select "Options" in the list on the left, click the "Custom" radio button, and add "Cubit fit" in the text box for the custom label
   (d) Close dialog box
4. Right-click on the legend and select "format trendline label"
   (a) Select "Number" in the list on the left and "Scientific" and the Category for the number format
   (b) Change data to scientific notation with 3 or 4 decimal places
   (c) Select "Font" in the list on the left, and increase the font size to make the text legible

Manually extracting the curve fit coefficients

1. Suppose the data is in columns A and B, rows 7 through 15
2. Suppose you want a cubic fit
3. Enter these formulas in empty cells

```
=Index(LINEST(B7:B15,A7:A15^{1,2,3}),1,1)
=Index(LINEST(B7:B15,A7:A15^{1,2,3}),1,2)
=Index(LINEST(B7:B15,A7:A15^{1,2,3}),1,3)
=Index(LINEST(B7:B15,A7:A15^{1,2,3}),1,4)

=Index(LINEST(B7:B15,A7:A15^{1,2,3},1,0),1,3)
```

	A	B
1	**Pump curve for Goulds GT**	
2		Grainger Catalo
3		http://www.grain
4		
5		
6	**Q (GPM)**	**h (psi)**
7	60	10
8	56	15
9	53	20
10	47	25
11	43	30
12	38	35
13	29	40
14	18	45
15	0	51
16		

The first four lines give the coefficients of the cubit polynomial. The last line gives the value of R^2

Finished spreadsheet

	A	B	C	D	E	F	G	H	I	J	K
1	**Pump curve for Goulds GT10**										
2		Grainger Catalog, Part Number 1N440 (Catalog 401, November 2010)									
3		http://www.grainger.com/Grainger/GOULDS-Centrifugal-Pump-1N440									
4											
5											
6	**Q (GPM)**	**h (psi)**									
7	60	10									
8	56	15									
9	53	20									
10	47	25									
11	43	30									
12	38	35									
13	29	40									
14	18	45									
15	0	51									
16											
17											
18											
19											
20											
21											
22											
23											
24	Cubic polynomial coefficients										
25	1	-1.1495E-04									
26	2	1.9462E-04									
27	3	-2.8397E-01									
28	4	5.0946E+01									
29	R2	9.9822E-01									
30