

Hytran v 3.5.5 to v3.6.2 New Features

- 1.0 DRES, URES, VALD, VALI : % opening vs Coefficient added to Input
- 2.0 VALI: New algorithm and Optional inclusion of the additional headloss
- 3.0 SURG: Option to allow the tank to empty

Hytran v3.5.6

- 4.0 Pump/RUNS allows the user to input pump curve
- 5.0 Pump/STAR/CHEK and PUMP/SHUT/CHEK allow users to input pump curve
- 6.0 PUMP/STAR/VALI and PUMP/SHUT/VALI allow users to input pump curve
- 7.0 Text Boxes to label the drawing
- 8.0 Additional Dialog box for convenient editing of node and pipe data

Hytran v3.5.7

- 9.0 AIRV: Back Siphon Break Option
- 10.0 Help for VISTA

Hytranv 3.5.9

- 11.0 Drawing Parallell Curved Pipes
- 12.0 PUMP/VALI Input. Valve coefficients vs % Stem Movement as input
- 13.0 Composite Pipes added to the Pipe Input Dialog
- 14.0 Pipe Constraints added to Pipe Dialog box

Hytran 3.6.0

- 15 EPANET import now reads alpha names in the *.inp file
- 16 Place EPANET Flow BC's on upstream node of the EPANET definition
- 17 Where there is BC already on the Uspstream node or it is an Branch node, the pipe is split and the BC is located at split location
- 18 Curved pipes available for parallel pipes in EPANET
- 19 Pipes ++ can have the same features as EPANET

Hytran3.6.1

- 20 AIRC: MASSAL Air Chamber New algorithm to include air valve specification

Improvements

Hytran v3.5.6

- 1 **Vali:** The headloss through the in-line control valve have been recoded to provide more stability when the flow is reversing through the valve while it is closing

Hytran v3.5.7

- 2 **Pipe Selection indicator:**When selecting a pipe, a rectangular box appears enclosing the selected pipe
- 3 **DRES/VALVE Bug** removed for reverse flowout of Reservoir

Hytran v3.5.8

- 4 **Fluid properties** Hytran now requires the atmospheric pressure to be enters in bar or psi

Hytran v3.6.0

- 1 **EPANET** conversion of MLD to m³/s corrected

Hytran v3.6.1-2

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- 1 **Pump/Part/Shut/Check:** Corrected bug in Pump/Part/Shut/Check which prevented th edialog box closing when this option is selected
- 2 **STAN:** Stan Pipe at an end nodes did not read the run correctly as misreads the end node type

Hytran3.6.1-3

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- 1 **SURG** dialog did not record some charges to the Spill included and Tank Area options.
- 2 **SURG** Simple Branch did not stop at RL min corrected
- 3 **Surg Orifice** junction and branch can continue at RL Min
- 4 **Surg** Inflow to all surge tanks
- 5 **PIPE:** Additional Pipe Ratings available from 2.5 - 64 bar
- 6 Min pressure envelop availble

Hytran3.6.2-3

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- 1 Dummy Pipes now in RED colour

1.0 DRES, URES, VALD, VALI: % opening vs Coefficient added to Input

An additional row of table has been added to the above input dialog. Previously the coefficients of discharge have been spaced out at constant intervals for the valve % stem position. At small openings the coefficient can vary widely. The coefficients are now paired with the % stem opening position.

DRES: Downstream Reservoir

Downstream Reservoir Data

Node No: 28 Node RL[m]: 105 Wave Action (sine):
Reservoir Level RL[m]: 110 Reservoir Level Type: Constant Reservoir Level, Varying Reservoir Level, Sine Wave
Exit Coefficient (kv²/2g): 0 Amplitude (m): 0
Over Pressure (m): 0 Period (s): 0
No of Level Values: 2 *Wave Length (m): 0
*Displacement (m): 0
*Optional input

Start..... Reservoir Level RL[m]End
0 1 0 0 0 0 0 0 0 0 0 0

Start..... Time (s)End
0 0 0 0 0 0 0 0 0 0 0 0

Additional Valves
Main Valve: VALV Auxiliary Valve: NONE Auxiliary Valve Data
OK Cancel
Clear Help

Head Loss Discharge Coefficient (Cd)

What Coefficients? Type of Valve: NONE, Cone, Butterfly
Valve Database Kind of Coefficient: Cd, Kv, K, 1/K
No of Coefficients: 11 Valve Database: Edit Valve in DB, Add Valve to DB, Delete Valve from DB

Fully Closed..... Valve CoefficientFully Opened
0.0001 0.01 0.04 0.08 0.127 0.2 0.26 0.318 0.36 0.39 0.41

Fully Closed..... 0 ==Corresponding Valve Opening (0 - 1.0) ==>1Fully Opened
0 0.05 0.1 0.25 0.4 0.5 0.6 0.7 0.8 0.9 1

Valve Operation Data

Time of Operation (s): 30 Surge Relief Override Option: 1
Valve Operation Time Delay (s): 0 Wave Reflection Coefficient: 1
Valve Diameter (mm): 550 Rated Discharge (m3/s): 0.3831
No of Values in Closure curve: 2 Print Valve Data: What Operational Values?

Start..... Valve Opening (% Stem or % Area) Open = 1; Closed = 0End
0.324 0 0 0 0 0 0 0 0 0 0 0

Start..... Time (s)End
0 30 0 0 0 0 0 0 0 0 0 0

2.0 VALI: New algorithm and Optional inclusion of the additional headloss

A new algorithm is now used for the in line control valve. Previously the discharge coefficients were converted to 1/K. Now the Cd is used.

Previously if the incoming pipe diameter is smaller than the valve diameter, an additional head loss Was added to the discharge coefficients.

$$K_o^* = K_o + 1.5 \left(1 - \frac{D_{valve}^2}{D_{pipe}^2} \right)^2$$

VALI: In-Line Control Valve

Vali Data

Node No: 8

Node RL(m): 64

Valve Diameter (mm): 1814

Rated Discharge (m3/s): 66.45

Static Head (HGL[m]):

Wave Reflection Coefficient: 1

Calculate Ho: Enter Ho (m): 35.81

Calculate Diameter

Type of Valve: NONE

Print Valve Data:

Valve Initially Closed:

Include Pipe/Valve Dia Head loss:

Surge Relief Override Options

Values in Area/time Curve

Time of Operation (s): 8

Delay in Operation (s): 0

No of Values in Curve: 2

What Valve Opening?

Full Open (=1.0)

Full CLosed (=0.0)

Start..... Valve Opening (% Stem or % Area) Open = 1; Closed = 0)Finish

Time (s)

Head Loss Discharge Coefficient (Cd)

What Coefficients?

Valve Database

Kind of Coefficient

Cd Kv

K 1/K

Valve Database

Edit Valve in DB

Add Valve to DB

Delete Valve from DB

No of Coefficients: 11

Fully closed..... Valve Coefficient =====>Fully Opened

0.0001 0.01 0.067 0.11 0.164 0.22 0.31 0.47 0.65 0.87 0.97

Fully closed..... 0 ==Corresponding Valve Opening (0 - 1.0) ==>1Fully Opened

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

OK Cancel Clear Help

The additional headloss inclusion is now an option. For example, in using the valve to model turbine gate closure it is more appropriate to exclude this additional headloss. Aditioanl head loss can be added as a minor loss in the incoming pipe.

3.0 SURG: Option to allow the tank to empty

This is only available for simple surge tanks at junctions only. This option models a standpipe which empties and allows air into the pipeline. Used with an air valve in series (+ DUMMY pipe)

SURG: Surge Tank Data

Node No: 2
Node Level RL[m]: 57.4
Tank Diameter (m): 30
Minimum Water RL(m): 57

Select Surge Tank: Simple
Orifice
Differential

Allow Tank to Empty Print Surge Data
 Include Overflow Spillway
 Single Opening Double Opening Supply Tank Area

Additional Surge Tank Data

Inlet Diameter (m)	58.	Inflow Coefficient Cd	0.7
Outlet Diameter (m)		Outflow Coefficient Cd	0.7

Overflow Spillway Data

Spillway Width (m)	0.	Spillway Level RL(m)	0.
Max Tank Level RL(m)	0.	Spillway Coefficient, Cd	0.
Spillway Exponent	0.		

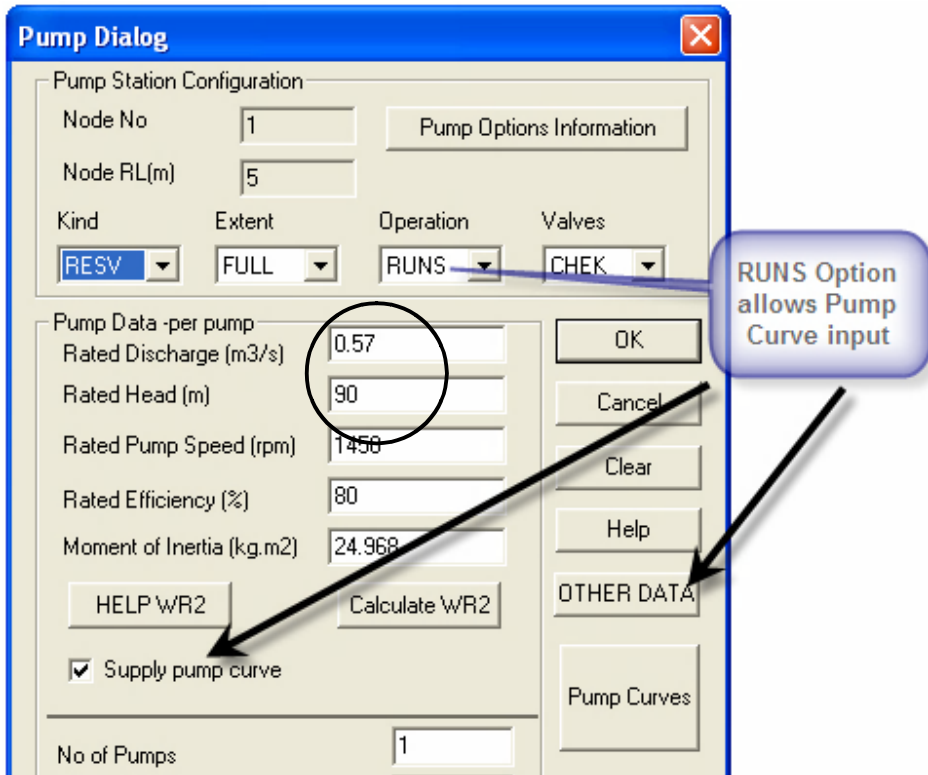
Supply Custom Tank Area Level RL vs Area

No of Values: 2

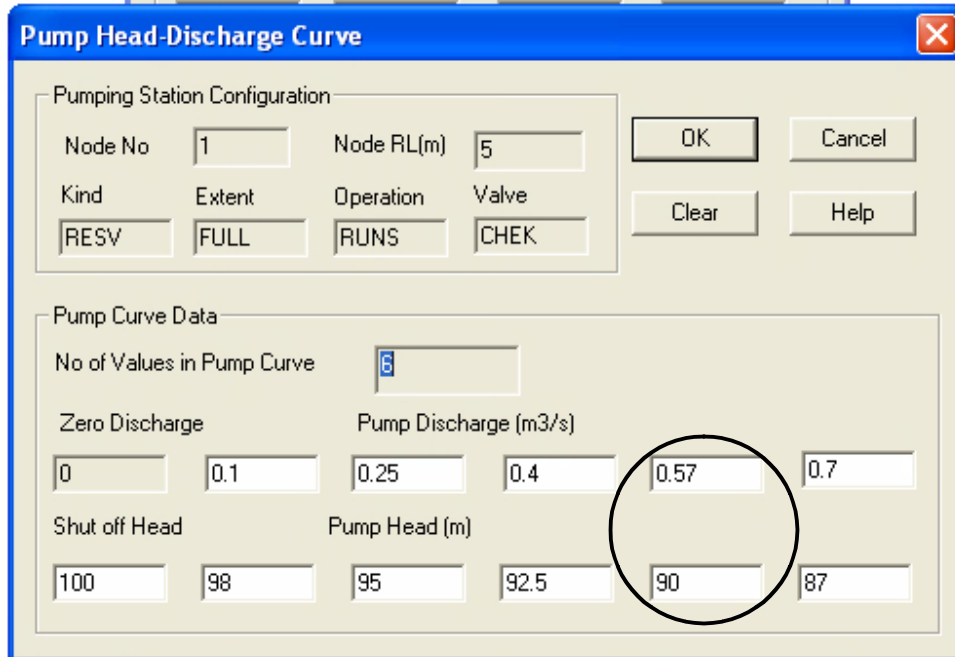
Tank Area Level RL(m)										
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Tank Area (m2)										
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Callout: Allow tank to reach minimum water level and continue processing

4.0 Pump/RUNS allows the user to input pump curve



Enter the pump head vs discharge curve.
Best to include the pump Duty point (H, Q) as a pair of values



5 Pump/STAR/CHEK and PUMP/SHUT/CHEK allows the user to input pump curve

Pump Dialog

Pump Station Configuration

Node No: 1 Pump Options Information

Node RL(m): 0.5

Kind: RESV Extent: FULL Operation: STAR Valves: CHEK

Pump Data - per pump

Rated Discharge (m3/s): 0.153

Rated Head (m): 120

Rated Pump Speed (rpm): 1450

Rated Efficiency (%): 90

Moment of Inertia (kg.m2): 3.455

HELP WR2 Calculate WR2

Supply pump curve

No of Pumps: 2

Buttons: Clear, Help, OTHER DATA, Pump Curves

SHUT/STAR with CHEK allows pump curve input

PUMP/CHEK: Pump Start Up/Shut Down Against Check Valve

Pumping Station Configuration

Node No: 1 OK

Kind: RESV Extent: FULL Operation: STAR Valve: CHEK Cancel

Start/ShutDown Operation

Static Head (HGL[m]): 107.21 For Startup operation only

Time of Operation (s): 10 Help - Start Up

No of Values in Operation Curve: 2 Help - Shut Down

Operation Curve (Full Speed = 1, Zero Speed = 0)

Start..... Individual pump shut down curve (% speed) vs time (s)Finish

0	1	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

Start..... Times (s)Finish

0	10	0	0	0	0	0	0	0	0	0	0
---	----	---	---	---	---	---	---	---	---	---	---

Pump Curve Data

No of Values in Pump Curve: 6

Zero Discharge Pump Discharge (m3/s)

0	0.05	0.1	0.153	0.16	0.17
---	------	-----	-------	------	------

Shut off Head Pump Head (m)

140	135	127	120	115	110
-----	-----	-----	-----	-----	-----

Include the pump duty point Q, H as a pair of values

6.0 PUMP/STAR/VALI and PUMP/SHUT/VALI allow users to input pump curve

Pump Dialog

Pump Station Configuration

Node No: 1

Node RL(m): 0.5

Kind: RESV Extent: FULL Operation: SHUT Valves: VALI

STAR OR SHUT with Pump Options Information

Pump Data - per pump

Rated Discharge (m3/s): 0.306

Rated Head (m): 42.15

Rated Pump Speed (rpm): 900

Rated Efficiency (%): 80

Moment of Inertia (kg.m2): 0.207

HELP WR2 Calculate WR2 OTHER DATA

Supply pump curve

OK Cancel Clear Help

Pump Curves

PUMP/VALI: Pump Start Up/Shut Down Against Control Valve

Pumping Station Configuration

Node No: 1

Kind: RESV Extent: FULL Operation: SHUT Valve: VALI

OK Cancel Help - Start Up Help - Shut Down

Start/ShutDown Valve Operation

Static Head (HGL)(m)

Time of Operation (s): 200

Wave Reflection Coefficient: 1

Valve Diameter (mm): 600

Pump Valve Operation Curve (% Stem or % Area)

No of Values in Operation Curve: 11 Full Open = 1 Full Closed = 0

Start.....	0.4	0.25	0.21	0.15	0.12	0.105	0.08	0.04	0.015	0	End	
Start.....	0	20	45	70	90	110	120	140	160	180	200	Finish
	Times (s)											

Head Loss Discharge Coefficient (Cd)

Help for Coefficients

Type of Valve: NONE

Kind of Coefficient: Cd K 1/K Kv

Valve Database: NONE

No of Values: 11

Valve Fully Closed Valve Fully Open

0.0001	0.01	0.08	0.15	0.221	0.3	0.381	0.46	0.59	0.63	0.8
--------	------	------	------	-------	-----	-------	------	------	------	-----

Pump Curve Data

No of Values in Pump Curve: 6

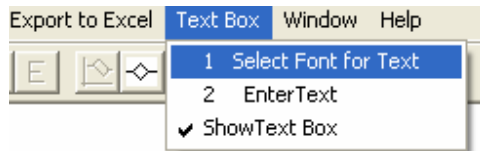
Zero Discharge	0	0.05	0.1	0.2	0.306	4
Pump Discharge (m3/s)						
Shut off Head	65	60	55	50	42.15	35
Pump Head (m)						

Include the pump duty point Q, H as a pair of values

7.0 Text Boxes to label the drawing

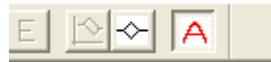
Text boxes may be added to label parts of the drawing

First select the the font



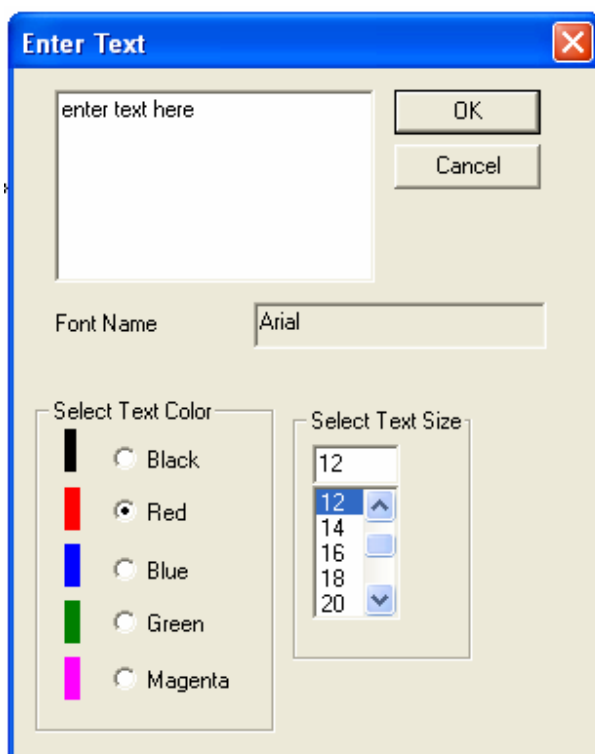
Only Regular fonts are used. The default font is the 12 point Arial black color.

To insert the text select the **A** icon




Place the cursor at the desired location and left click

To bring up the dialog box and enter text, select color or change font size



The Text box may be edited by clicking the A button and then palce the cursir on the text to be edited

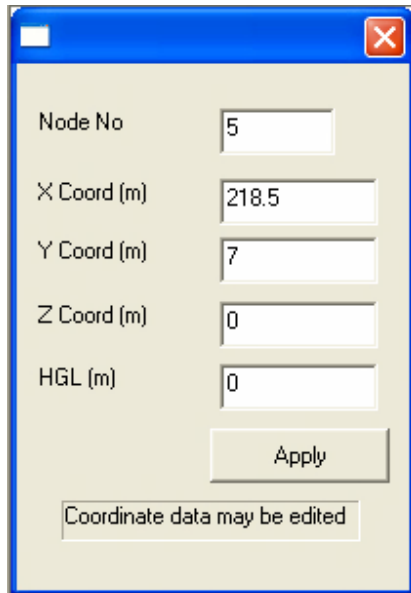
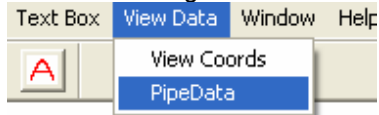
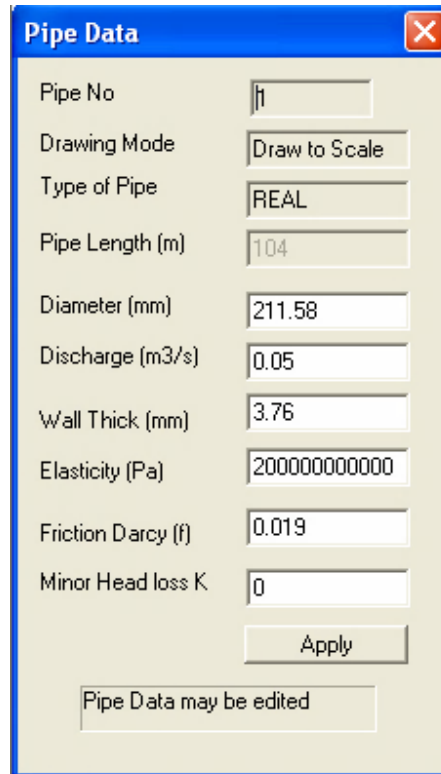
The Text box may be moved to a new location by selecting the  icon and then place the cursor on the text to be moved, left click and hold the button down and drag the text box to new location.

8.0 Additional Dialog box for convenient editing of node and pipe data

An additional dialog is available to edit and view node and pipe data.

The dialog stays open until it is shut.

Access the dialog via

A screenshot of a dialog box titled 'Coordinate Data'. It has a blue title bar with a close button (X) in the top right corner. The dialog contains five input fields: 'Node No' with the value '5', 'X Coord (m)' with '218.5', 'Y Coord (m)' with '7', 'Z Coord (m)' with '0', and 'HGL (m)' with '0'. Below the input fields is an 'Apply' button. At the bottom of the dialog, there is a text box containing the message 'Coordinate data may be edited'.A screenshot of a dialog box titled 'Pipe Data'. It has a blue title bar with a close button (X) in the top right corner. The dialog contains eight input fields: 'Pipe No' with '1', 'Drawing Mode' with 'Draw to Scale', 'Type of Pipe' with 'REAL', 'Pipe Length (m)' with '104', 'Diameter (mm)' with '211.58', 'Discharge (m3/s)' with '0.05', 'Wall Thick (mm)' with '3.76', 'Elasticity (Pa)' with '200000000000', 'Friction Darcy (f)' with '0.019', and 'Minor Head loss K' with '0'. Below the input fields is an 'Apply' button. At the bottom of the dialog, there is a text box containing the message 'Pipe Data may be edited'.

Once the dialog box is open move the cursor over a node (of the coordinate box is open) the node coordinates will be shown in the input boxes.

If the pipe dialog box is open, move the cursor on a pipe to show the pipe data.

The node coordinates and the pipe data may be edited

9 AIRV: Back Siphon Break

AIRV: Air Valve

Air Valve Data

Node No	<input type="text" value="2"/>	<input type="checkbox"/> Print Air Valve Data
Node RL(m)	<input type="text" value="71.9"/>	<input type="checkbox"/> Anti Surge Option (3 stage)
No of Valves	<input type="text" value="1"/>	<input checked="" type="checkbox"/> Back Siphon Breaking Valve
Valve Diameter IN (mm)	<input type="text" value="100"/>	Valve Diameter OUT (mm) <input type="text" value="100"/>
Inlet Coefficient, Cd	<input type="text" value="0.7"/>	Outlet Coefficient, Cd <input type="text" value="0.7"/>
Fluid Temperature (C)	<input type="text" value="20"/>	Atmospheric Temperature (C) <input type="text" value="30"/>
Gas Constant (N.m/kg.K)	<input type="text" value="287"/>	Vacuum Break Head (m gauge) <input type="text" value="-4"/>

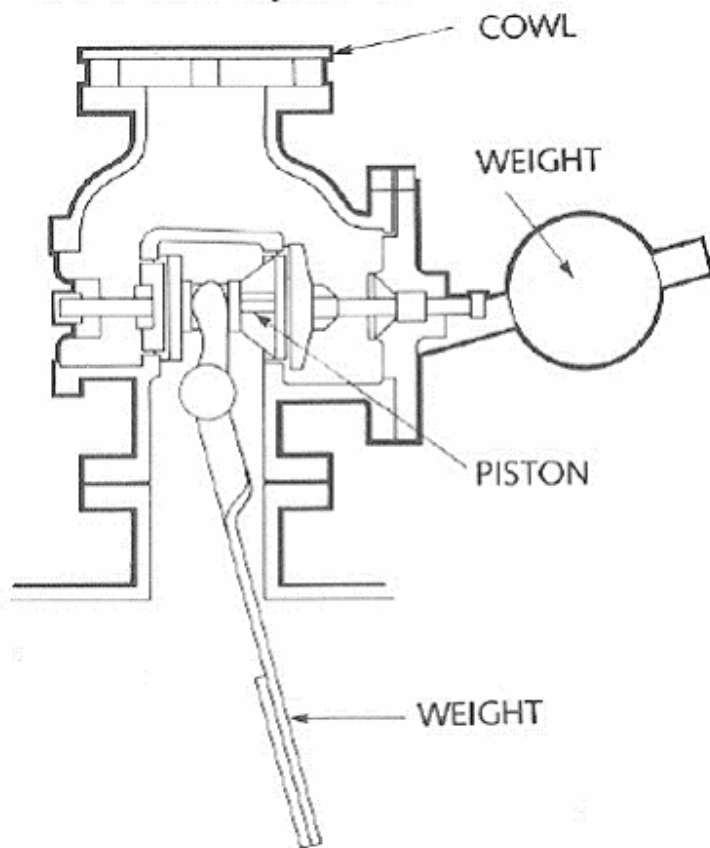
2 stage Anti Shock: Set the Outlet Diameter to smaller value to trap volume of air
Anti vacuum: Set the Outlet Diameter = 0.0 (traps all air in the pipe)

Notes

- Anti Surge Option and Back Siphon Breaking Valve options mutually exclusive.
- Back Siphon activated to admit air when the flow reverses to break the siphon.
- Vacuum break head may still be used for the forward flow to provide vacuum break protection
- To deactivate the vacuum break, select head less than vacuum so the valve does not open

To model this type valve see next page

1235 Paddle Operated



SYPHON AIR VALVE (MAKE AND BREAK)

SYPHON AIR VALVES are a unique type of Air/Vacuum Valve incorporating a paddle which hangs down into the main pipeline flow stream. The valve will allow a syphon flow to be developed and maintained. Subsequently should the syphon flow reverse, the paddle swings in reverse causing the float to drop and breaking the syphon. The APCO Syphon Air Valve requires no electrical connections or regular maintenance and is ideally suited for remote outdoor environments. In recent years with the emphasis on energy conservation, consulting engineers for water and waste water, often consider pumping by means of a syphon loop. APCO SYPHON AIR VALVES are ideally suited for this application. Solenoid valves for small diameter syphons, or pneumatically operated butterfly valves for large diameter syphons, may also be adapted for this application, but installation and maintenance is complicated and cumbersome. For example, power lines and air lines must be installed to operate these valves. An air compressor is also needed. APCO SYPHON AIR VALVES are mechanically operated, requiring no auxiliary power. They merely respond to flow, in either direction, to make the syphon or break it. Maintenance is virtually non-existent.

Series 5200 available in sizes 3"-16" for syphons up to 60" in diameter.



10 Help for Vista

It seems that the classic Windows Help is not currently supported in the Windows Vista OS.

In anticipation of Vista becoming more common Hytran now ships a Help file that is compatible with Vista

Classic Help files

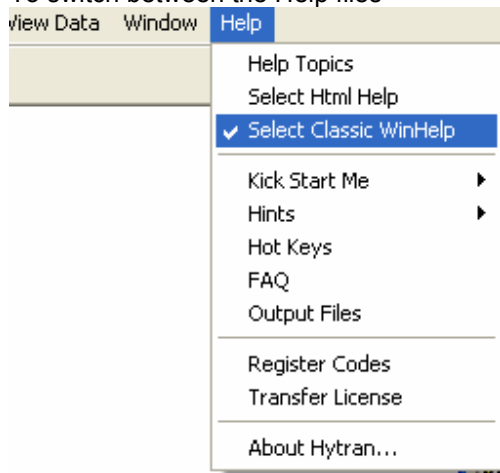
Hytran.cnt
Hytran.hlp

Vista Help

Hytran.chm

These file are all located in the c:\Program Files \Hytran Solutions folder

To switch between the Help files



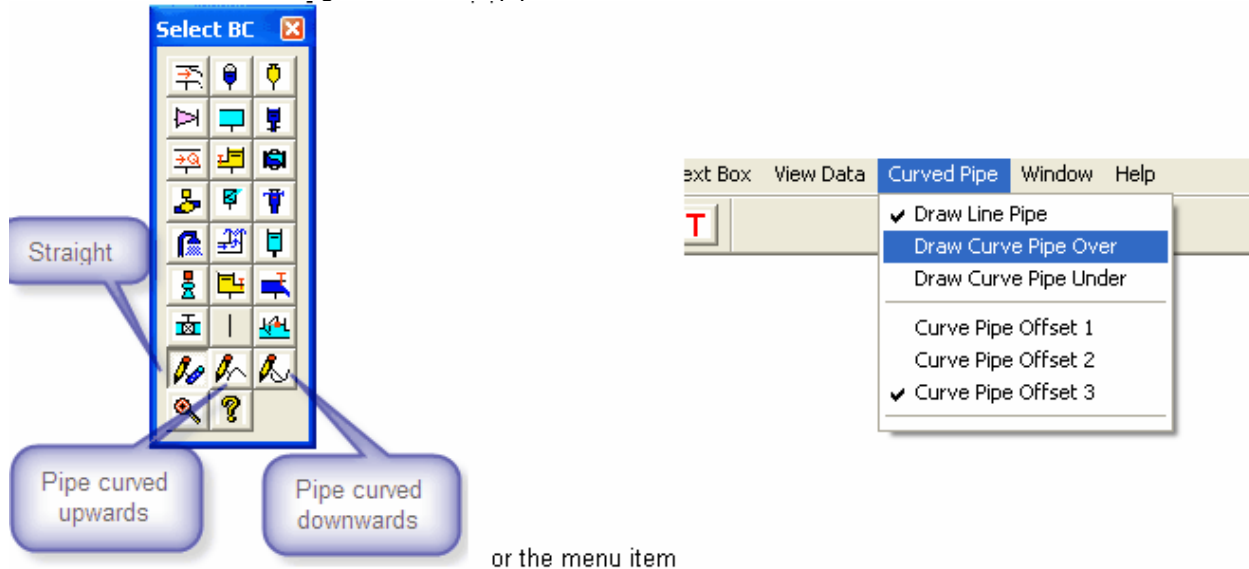
Important Note for Network License

A Windows security patch does not allow *.chm to be found over network drives. The Hytran.chm Help file must be installed on the local C Drive. (Special Instructions are available.)

11.0 Drawing Parallell Curved Pipes

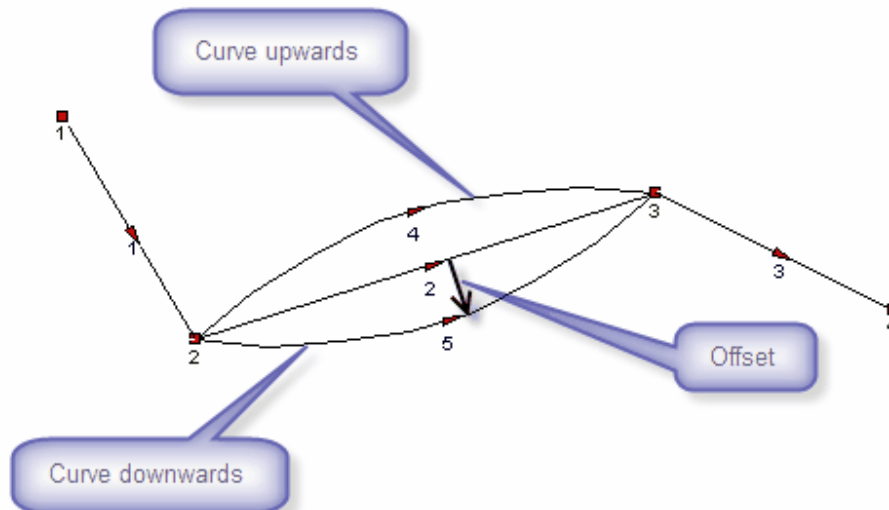
Pipes are by default drawn as a straight line joining 2 nodes. A parallel pipe may be drawn but would lie on the same line between the 2 nodes. To differentiate between the parallel pipes, they may be drawn as a curve with different curvature and over or above the initial straight pipe.

To select between the straight and curved pipes from the toolbar.



or the menu item

and draw the straight / curved pipe between the nodes.



Note:

In the Elevation or Plan View, a curved line is actually represents a straight pipe between the 2 nodes. To select a curved pipe, place the selection cursor on the pipe arrow.

12.0 PUMP/VALI Input. Valve coefficients vs % Stem Movement as input

PUMP/VALI: Pump Start Up/Shut Down Against Control Valve

Pumping Station Configuration

Node No:

Kind: Extent: Operation: Valve:

Start/ShutDown Valve Operation

Static Head (HGL[m]): For Startup operation only

Time of Operation (s): WaveReflection Coefficient:

Valve Diameter (mm):

Pump Valve Operation Curve (% Stem or % Area)

No of Values in Operation Curve: Full Open = 1
Full Closed = 0

Start.....End

1	0.4	0.25	0.21	0.15	0.12	0.105	0.08	0.04	0.015	0
---	-----	------	------	------	------	-------	------	------	-------	---

Start.....Times (s).....Finish

0	20	45	70	90	110	120	140	160	180	200
---	----	----	----	----	-----	-----	-----	-----	-----	-----

Head Loss Discharge Coefficient (Cd)

No of Values:

Valve Fully Closed Valve Fully Open

0.0001	0.01	0.08	0.15	0.221	0.3	0.381	0.46	0.54	0.63	0.8
--------	------	------	------	-------	-----	-------	------	------	------	-----

Fully closed... 0 == Corresponding Valve Opening (0 - 1.0) ==>1Fully Opened

0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
---	-----	-----	-----	-----	-----	-----	-----	-----	-----	---

Pump Curve Data

No of Values in Pump Curve:

Zero Discharge Pump Discharge (m3/s)

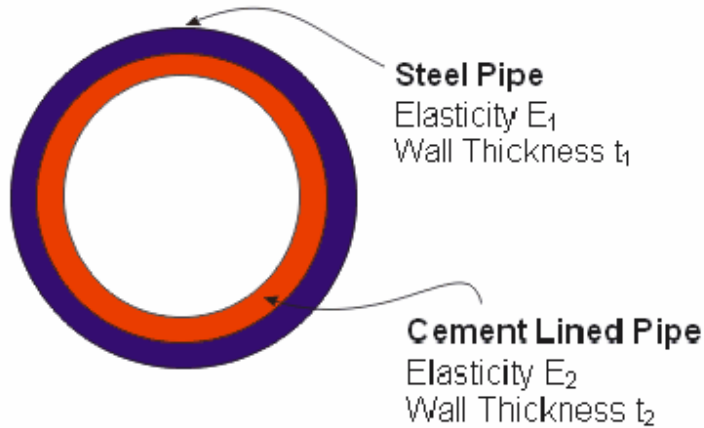
0	0	0	0	0	0
---	---	---	---	---	---

Shut off Head Pump Head (m)

0	0	0	0	0	0
---	---	---	---	---	---

13 Composite Pipes added to the Pipe Input Dialog

Composite pipes are made from materials of different wall thickness and elasticity which will affect the wave speed. Hytran uses the following procedure to calculate the equivalent pipe thickness for the pipe.



$$\text{Composite thickness } t = t_1 * (1 + (E_2 / E_1) * (t_2 / t_1))$$

Click on the "Composite Pipe Wall Thickness Calculator to open the dialog box

The screenshot shows a dialog box titled 'Composite Pipe Wall Thickness'. It has a blue title bar with a close button. The main area is light gray and contains the following elements:

- Two columns of input fields: 'Pipe Wall Thickness (mm)' and 'Pipe Elasticity (GPa)'.
- Row 1: 'Primary Pipe Material' with values 8 and 200.
- Row 2: 'Secondary Pipe Material' with values 12 and 30.
- A button labeled 'Calculate composite pipe wall thickness' with a dashed border.
- An output field labeled 'Composite Wall Thickness (mm)' with the value 9.8.
- Four buttons at the bottom: 'OK', 'Cancel', 'Clear', and 'Help'.

Input

- 1 Primary pipe wall thickness
- 2 Primary Pipe Elasticity
- 3 Secondary pipe wall thickness
- 4 Secondary Pipe Elasticity

14 Pipe Constraints Added to Pipe Input Dialog box

The screenshot shows the 'Pipe Dialog' window with the following sections and values:

- Pipe Coords:**
 - Pipe No: 3
 - Start: X-Distance (m) 1500, Elevation RL(m) 2, Z-Distance (m) 22
 - End: X-Distance (m) 3572.8, Elevation RL(m) 34, Z-Distance (m) 23
 - Pipe Length (m): 2073.04, DRAW to SCALE
 - Dummy Pipe (virtual zero length)
- Pipe Data:**
 - Diameter (mm): 750
 - Discharge (m³/s): 0.1
 - Wall Thickness (mm): 45.7
 - Composite Pipe Wall Thickness Calculator
 - Elasticity (Pa): 120000000000
 - Select Wave Speed (m/s) option
 - Calculate Wave Speed
 - Wave Speed Info
- Select Friction:**
 - Darcy, Hazen, Roughness (mm)
 - Friction Factor: 0.0183
 - Minor Head Loss K: 0, K Values
- Visco Elastic Option:** (Empty text area)
- Pipe Constraints:**
 - Expansion Joints, Anchored at upstream end, Fully Anchored
 - Poisson's Ratio: 0.23
- Type of Pipe:**
 - Thin Walled (D/e > 25), Thick Walled (D/e < 25)
 - Circular Tunnel (eg Rock), Other
- Optional:**
 - Specified Min Yield Strength (SMYS) (KPa): 0
- Pipe Input Options:**
 - Auto input EACH pipe, Auto input ALL pipes, Auto RESET ALL pipes

Buttons at the bottom: OK, Cancel, Clear, Help.

Pipe constraints and the type of Pipe added to dwfiwn the pipe
This requires the Poisson's ratio as required input.

The default is pipe line with expansion joints and thin walled (disregards Poissons ratio) .

Add the Poisson's ratio to pipe data base file "PipeDB.pdb"

Other factors affecting the wave speed include

- Whether the pipeline is constrained against longitudinal movement
- Type, shape and material of the conduit (thin walled, thick walled, Rock tunnels or composite materials)
- The wave speed varies with the passage of a pressure wave.
- Free gas entrained in the fluid affects the bulk modulus, K. Even a small amount of free gas can decrease the wave speed dramatically. Further, the amount of free gas in a fluid cannot be determined accurately. For a conservative analysis, use a low or zero free gas percentage.

1 For Thin and Thick Walled Pipes (from V C Streeter, "Fluid Transients")

Constraint Coefficients	Thin Walled (D/e > 25)	Thick Walled (D/e < 25)
The pipeline has expansion joints throughout its length	$C_1 = 1$	$C_1 = \frac{2e}{D}(1+\mu) + \frac{D}{D+e}$
The pipeline is anchored at upstream end only	$C_1 = 1 - \frac{\mu}{2}$	$C_1 = \frac{2e}{D}(1+\mu) + \frac{D}{D+e} \left(1 - \frac{\mu}{2}\right)$
The pipeline is anchored against longitudinal movement	$C_1 = 1 - \mu^2$	$C_1 = \frac{2e}{D}(1+\mu) + \frac{D}{D+e} (1 - \mu^2)$

Where μ is the Poisson Ratio for the pipe material.

2 Circular Tunnels (where the rock thickness is very large)

Formula quoted in V C Streeter, Fluid Transients	Formula quoted in M H Chaudhry, Applied Hydraulic Transients
<p>In this case $C_1 \rightarrow \frac{2e}{D}(1+\mu)$</p> $a = \sqrt{\frac{K/\rho}{\left(1 + \frac{2K(1+\mu)}{E}\right)}}$	$a = \sqrt{\frac{K/\rho}{\left(1 + \frac{K}{E}\right)}}$

Note: The wave speed calculated by formula in Streeter's book is less than value calculated from the formula quoted in Chaudhry's book.

3 Steel Line Rock Tunnels

Formula quoted in V C Streeter, Fluid Transients	Formula quoted in M H Chaudhry, Applied Hydraulic Transients
$a = \sqrt{\frac{K/\rho}{\left(1 + \frac{KD}{Ee}\right) * \left(\frac{2Ee}{E_R D + 2Ee}\right)}}$ <p>where $E_R = \text{Young's Modulus for rock}$ $e = \text{steel thickness}$ $E = \text{Young's Modulus for steel}$</p>	$a = \sqrt{\frac{K/\rho}{\left(1 + \frac{K}{E}\right) * \left(\frac{DE}{E_R D + Ee}\right)}}$ <p>where $E_R = \text{Young's Modulus for rock}$ $e = \text{steel thickness}$ $E = \text{Young's Modulus for steel}$</p>

Note: The wave speed calculated by formula in Streeter's book is less than value calculated from the formula quoted in M H Chaudhry's book

4 Reinforced Concrete Pipe (from M H Chaudhry, Applied Hydraulic Transients)

Replace the pipe with an equivalent steel pipe of equivalent thickness given by

$$e_e = E_R e_c + \frac{A_s}{l_s}$$

where

E_C = modulus of elasticity of concrete

E_S = modulus of elasticity of steel

E_R = ratio of E_C/E_S

e_C = thickness of concrete pipe

A_S = Reinforcing steel cross sectional area

l_S = spacing of the reinforcing steel

E_R may vary between 0.06 to 0.1. Chaudhry suggests a value of $E_R = 0.05$ to allow for cracks in the rock

Editing the Pipe Data base

Hytran supplies a text database file containing coefficients for typically a **Cone, Butterfly and Globe valve**. The file is listed below. The name is **ValveDB.dba** and is found in the **Hytran Solutions** folder.

```
6
OTHER
0. 0. 0.0
Steeler3
2.e+011 3.3e-002 0.28
mPVC2
600000000 25.39 0.35
Concrete
3.1e+010 5. 0.2
CLS
3.e+010 3. 0.2
Cast_Iron
23000000. 0.45 0.25
```

Format for the Text File PipeDB.dba

<Line 1> Number of pipes in database
<Line 2> Name of Pipe
<Line 3> Elasticity (Pa) Pipe Wall Roughness (mm) Poisson's Ratio
<Line 4> Name of Pipe
etc, etc

.

Repeat <lines 2-3> for each new pipe.

DO NOT use blank spaces for the pipe name and only 20 non blank characters allowed.

Editing the Pipe Data base File

Prior to Hytran Version 360, the Pipe Database only required the Elasticity and the Pipe Roughness

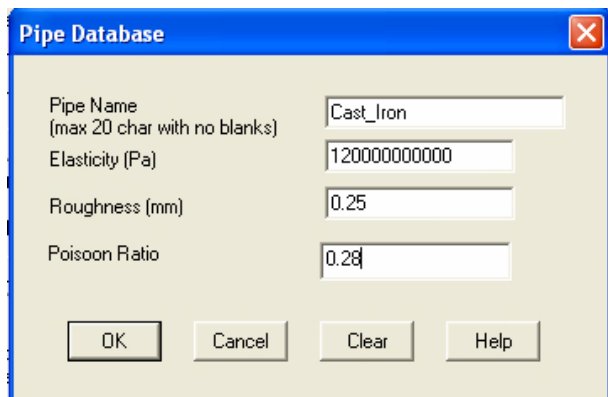
1 Manual Editing

Use any Text Editor (eg NotePad, Word) to edit the file and add the Poisson's Ratio to each line eg Line 3 above

```
Concrete
3.1e+010 5. 0.2
```

2 Pipe Input Data

Select the Edit Pipe Data base and enter the Poisson's Ratio for each pipe

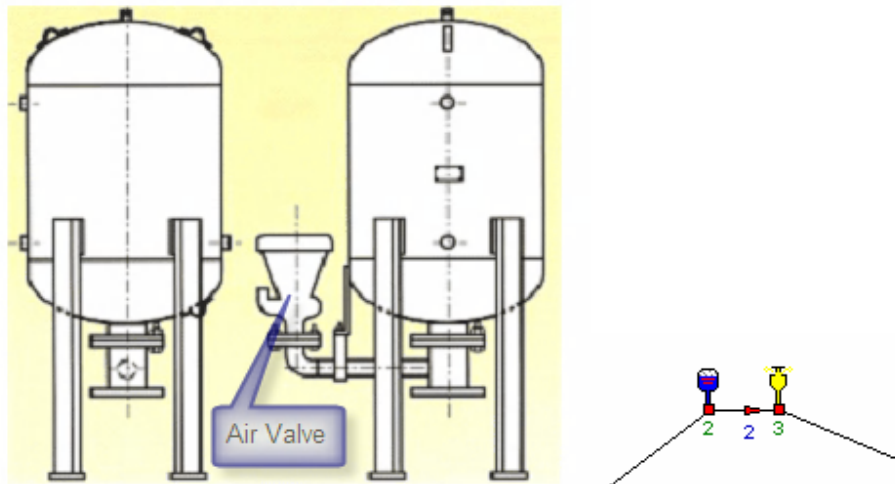


Pipe Name (max 20 char with no blanks)	Cast_Iron
Elasticity (Pa)	120000000000
Roughness (mm)	0.25
Poisson Ratio	0.28

OK Cancel Clear Help

20 AIRC: MASSAL Air Chamber New algorithm to include air valve specification

Previous the Massal Air chamber could be modelled by linking the air chamber with an air valve using a DUMMY Pipe.



The new algorithm no longer uses the external air valve but has additional input data to specify the air valve parameters. The new algorithm switches between the air valve and the air chamber

AIRC: Air Chamber [X]

Air Chamber Data

Node No: Use Horizontal Chamber

Node RL(m): Bladder Air Chamber

Print Air Chamber Data "Massal" Air Chamber

Nozzle Diameters

Nozzle Diameter OUT (mm): Coefficient Out, Cd:

Nozzle Diameter IN (mm): Coefficient In, Cd:

No of Identical Air Chambers: Pre-Charge Head (m):

Total Chamber Volume (m3): Calculate Start Conditions

Percentage Volume Air (%) Steady State: Volume of Air (m3):

Area of Chamber (m2): Water Start Level (m):

Maximum Air Volume (%) of Total Volume: Min Water Level (m):

Bottom of chamber (RL[m]): Estimate HGL (m) at Node:

Polytropic Index for Gas:

Maximum Working Head (m): <==== Optional input

Charlotte Type Air Chamber

Air valve input for the Massal Air Chamber

The additional data is

Air Valve for Massal Air Chamber [X]

Node No:

Node RL(m):

Valve Diameter IN (mm): Valve Diameter OUT (mm):

Inlet Coefficient, Cd: Outlet Coefficient, Cd:

Improvements

Fluid Properties (menu item Paramters. Fluid Proories)

Atmospheric pressure entered as an input as $P_o = 1.0132 \text{ bar} / 14.607 \text{ psi}$

Pipe Network Parameters

Network Data | Scale and Plotting Parameters | **Fluid Properties**

Fluid Properties

Fluid Density (kg/m ³)	1000	Gas Constant (N.m/kg.K)	287
Gravity (m/s ²)	9.81	Bulk Modulus of Fluid (Pa)	2000000000
Atmospheric Pressure (bar abs)	1.0132	Kinematic Viscosity (m ² /s)	1e-006
Atmospheric Pressure (m abs))	10.3282	Maximum Air Release Permitted (%)	0.00216
Vapour Pressure (m abs)	0.2	Air Release Gradient Constant	4e-005
Saturated Pressure (m abs)	9.8	Air Release Solubility Constant	3e-006
Fluid Temperature (C)	27		

Clear Help

Atmospheric head calculated by the
 $H_o = P_o / (\text{density} * \text{gravity})$

OK Cancel Apply Help

The atmospheric head $H_o = P_o / (\text{density} * \text{gravity})$