CANUTE

FHC

Hydraulic calculation software for
water based fire protection systems

bafsa

Disclaimer

The information contained in this publication is subject to change without notice. Canute LLP makes no warranty of any kind with regards to this manual, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Canute LLP shall not be liable for errors contained herein or consequential damages in connection with the furnishing, performance, or use of this manual.

Copyright

Canute LLP
Flaxton House
Greenmount Terrace
Beeston
Leeds
LS11 6BX

Tel: +44 (0)113 394 4095
Fax: +44 (0)113 394 4041
Email info@canutesoft.com
Web www.canutesoft.com

1. Introduction to FHC

This manual describes a computer program called FHC to assist in the full hydraulic calculation of sprinkler and water spray protection pipe layouts suitable for the Windows 95, 98, ME, 2000, NT4.0 or XP operating systems.

Sprinkler systems can be Ordinary or High hazard terminal end-fed, looped or gridded pipework arrangements for the roof only or combined roof / rack protection for all process and storage risks within buildings. The program can also be applied to water spray, deluge, drencher, hosereel, hydrant, foam, fog etc. 'special risk' applications of up to 9000 pipes and 1500 operating nozzles. FHC can be used at the early design stage of a project where only limited information is known or for the production of the full results presentations for submission to insurance companies or fire authorities.

However the program does NOT design your system - the user must plan out the arrangement of the mains and range pipes feeding the required layout of sprinkler heads or nozzles and specifying the correct area of operation. Not all the heads in the building will normally be operating simultaneously. One starts by allocating 'node' numbers to the junctions of the pipes from the source outwards to the operating heads and then saying what happens between these numbers as a size in mm, length in m, direction and slope, its pipe type and if there is a head / nozzle at the end, its type and area of coverage. Additionally you can quote a valve type, hydrant, extra length, pressure drop, elbows, tees, victaulic joints or orifice plate.

Once this information has been prepared, it can either be typed in directly to the program or 'drawn' pipe by pipe on the screen of the computer so that you can see what is happening and amend the incorrect pipe data if any typing errors are made. Plans, elevations and isometric views of the partial or completed network can be given and several 'menu' options selected to add to, amend, copy, delete or inspect the list of pipes, to save, copy, printout etc. and to calculate the system. Once the hydraulic balancing of the flows and pressures around your system has been done you can display the results on the screen, print out the complete results presentation or amend one or more pipes / heads, design parameters etc. and repeat the calculations as often as required.

Q1) Project name: Write in the box provided, the name or reference of the job for identification using UPPER or lower case letters, numbers and spaces eg. F. BLOGGS LTD.

Q2) Address/location: As above but for the location of this job eg. Nowhere.
Q3) Project number: As above but for the order or contract numbers eg. 12345.

Q4) Designers reference : As above but for your or the Engineers name or initials eg. Alan Ashfield.

Q5) Design authority : Select one from this list :-

Loss Prevention Council
National Fire Protection Association
Factory Mutual
Dansk Brand-og Sikringstekniks Institut
CP52:1990 Rules in Singapore
Norwegian Sprinkler Rules
ANPI/NVBB Rules in Belgium
FOC 29th Edition Rules
LPC Tentative Spray Rules
Comite Europeen Des Assurances CEA4001
CEN 12845 Rules

Q6) Insurance company : As above but referring to the insurance company if involved eg. AAA Insurance Ltd.

Q7) Fluid : Enter WATER or CLEAN WATER as you prefer or DRY if a dry-pipe system or FOAM if a foam based system. The specific gravity will be taken as 1.0 unless you quote SG=0.9 or whatever in this line. For

Mist systems, you need to include the words MIST TO NFPA 750 DENS=xxx VISC=yyy where xxx is the density in kg/m3 (default is 998) and yyy is the absolute viscosity in centipoise (=0.95). For DRY systems, all the pipes will be taken as without water (and so any 'C' factors of 120 will be changed to 100 for NFPA/FM Rules) unless you add '#' and the sequence number of the first dry pipe, eg. Dry system starts at pipe #4.

Q8) Welded elbows : Enter the pipe size in mm to change from screwed to welded elbows if appropriate eg. 65. 999 will mean all screwed and 0 is all welded.

Q9) Pipe types data file : Enter FHCDATA.TXT to use the standard file supplied or FHCADDED.TXT if you want to use any of the specific types added or amended in this file. You can have other names but will then need to use NOTEPAD or similar word-processor to amend or print them out as they are not part of FHC.
Q10) Water supply / pump curve : Enter NONE if you want the program to tell you the source flow and pressure for the specified network of pipes and heads that follows. Enter one of the references of pump curve added to the program as 8 flow and pressure points (approx equal steps from 0 to say 20% above the maximum permitted flow), a reference and tank height in m - these will be shown by FHC for this question so you can either use one that has been added before or add one now for this job. A maximum of 50 pumps can be stored in the program.

Q11) Area reference : Enter the building being protected and area of operation eg. MAIN BUILDING MOST FAVOURABLE

Q12) Installation number : Enter the riser / control valve assembly reference eg. 1.

Q13) Hazard classification : Enter the hazard group or class concerned eg. HIGH HAZARD.

Q14) Density of coverage : Enter a number in the range of 2 to 100 mm/min (L/min per sq.m) for the hazard given eg. 7.5 but 0 is OK for deluge systems.

Q15) Design area : Enter the minimum area in sq.m to be protected for this hazard eg. 260. Don't forget to add at least 25% if it is a 'dry' system but 0 is also OK.

Q16) Drawing numbers : Enter the layout or detail drawing numbers for this system eg. 12345/A/1 and 2.

Q17) Issue no / date : Enter the matching latest revision numbers eg. A Jan 99.

Q18) Comments : Enter anything else you want to appear on the printout for identification eg. Existing system

All of the replies to these 18 questions are stored by the program so you only have to type in anything new or just select from the list of previous responses. Rather than leaving any specific question blank you should enter --- or NONE or similar just to remind you. There is an option in the program to remove items from the lists if they start to get too long.

Commas are not permitted (except to separate items in the pipe/fittings data files) so if you type in , then . will be given on the screen.

The program normally draws all sprinkler heads and nozzles as upright spray types - if you wish to use pendent heads then add the word 'pendent' to the reply for Question 12 eg 1 with pendent heads. The program also checks for correct fitting arrangements but you can prevent unwanted error messages if they are, in fact, in order by having -FC also in the Installation number. If you have head areas above 21 sq.m then you can add -AC also to Q12 to skip the warning messages. If you enter the 'exact' lengths of all pipes, then have -LC also in Q12. If you have "W" shaped ranges (where the first pipe from the main points down and then goes up to the apex of roof down the other side and then up to the backtrack), then enter +WR also in Q12 to get the right pipe lengths calculated - see page 9.

COMPLETION OF DATA FORM 2 - PIPES / HEADS

Each section of pipe in your system is specified by its :-

a) Start node number in range of 1 to 9999 eg. 100
b) End node number in the same range eg. 110
c) Nominal diameter or size in mm eg. 32
d) Length in m - usually horizontal eg. 2.78
e) Direction from North and slope in degrees eg. E@6
f) Pipe type from 1 to max in list eg. 1
g) Valve type from 0 to max in list eg. 0
h) Head code from 1 to max in list eg. 4 or 0 if none
i) Head area from 0 to 21 sq.m if head code given
There are also several optional items described later for special cases.

You may find it easier to prepare a small sketch, perhaps an isometric, of your pipework system for marking on the node numbers or add them to the layout drawing, if prepared. As the screen is wider than it is high you may wish to have the North sign pointing up the shorter length of your project.

You will need an identification 'node' number at :-

a) All elbows, tees and crosses where 2, 3 or 4 pipes meet
b) All operating sprinkler heads / nozzles
c) The source water supply or pump outlet
d) All changes of pipe type not at tees/crosses
e) All changes of pipe size not at tees/crosses
f) At each special valve, pressure drop or orifice plate

Each pipe will therefore have two node numbers - its START one assumed to be nearest the source in the direction of numbering (ie. where the water is assumed to be coming from) and its END node at the opposite end, which will be used once if terminating at a head or hydrant or used again as the start node for the next pipe section connecting to it.

These numbers can be in the range of 1 to 9999 and it is recommended that you always 'number away from the source' at the pipe junctions in set increments eg. 100 110 120 130 140 etc. You will find this procedure easier to follow and to pick up from if you break off and simpler to correct if you leave out some item ie. you would know that 135 in the above example was free to use without having to search the rest of the drawing or data form if 'random' numbers were being used.

End node numbers can be either higher or lower than the start node number eg. a pipe can be called 460 470 or 470 460 as you choose but in both cases the first node of the pair is assumed nearest the source and so is the start node.

The direction and slope that you give will be 'from' the start node 'to' the end node. Any sprinkler head is always positioned at the end node regardless of whether there is a head at the start node which would have been picked up by the end node of the previous pipe.
Each node number must be unique - eg. you cannot have two nodes 450 in different parts of the network. However each end node number might be used as a start node of another pipe eg. 100 110, 110 120, 120 130, 130 140, 120 260 etc.

The actual node numbers you use are not that important - the program will allow you to renumber any particular node, to change a group of node numbers or to resequence the whole numbering scheme if you so choose.

So it doesn't really matter that a specific point is called 110 or 8744 - it is just there for identification. However on multi-level schemes you may want to have nodes 100 to 199 for level 1, 200 to 299 for level 2,

300 to 399 (or 3000 to 3999) for level 3 and so on to make the identification easier on the drawing and on the printout.

Likewise, you may prefer to number the mains pipes feeding ranges as 200, 210, 220, 230 etc. and the heads along the range pipes related to those numbers eg. 201, 202, 203 & 204 connect to mains point 200 and 211, 212, 213 & 214 relate to mains point 210 rather than say 764, 765, 766 & 767 which could be anywhere.

If you have a roof and rack system, then you may want to number the mains from the source to the manifold using the numbers 100 to 200, then the roof system from 200 to 600 or whatever and then start again at 200 for the racking but continue with node numbers above 600 to say 900.

There is nothing to stop you numbering the operating heads 1, 2, 3, 4 and so on up to the total but then you would have pipes called 340 1, 1 2, 2 3, 3 350 which you may think is more confusing.

The order of entering the pipes is not too significant but to simplify matters you should ensure that the first pipe given is the one connecting to the water supply or pump at the source and (apart from this first pipe) that the start node you give MUST have been given previously as an end node. For example this list would be correct :-

100 110
110 120
120 130
130 140
120 260

but this list is wrong

100 110
110 120
130 140
120 130
120 260

(the start node 130 in the 3rd line has not been given as a previous end node ie. there is a break in the network even though the pipe 120 130 is given later).

Each pipe is therefore unique and only has to be given once in the list eg. 110 120 is OK and does not need repeating as 110 120 or as another pipe 120 110.

Only straight lengths of pipes can be given between two node numbers of one pipe size and type - any variation to this scheme will need another section of pipe in the data eg. a pipe rising vertically to an elbow to then run horizontally will need a node number at the elbow fitting so that the same pipe size can be given for both pipes but they have different directions, Up then North for example.

You do not need to enter heads or nozzles that are not deemed to be in operation in this particular calculation nor pipes that do not carry any water from the source to these operating heads, eg. drains or flushing connections. However you cannot miss out mains pipes forming any 'loops' in your network or in the underground site mains nor the 'backtracks' and non-operating ranges on gridded systems.

The program cannot check that you have the correct shape or extent of the design area of a sprinkler system - you will need to refer to the appropriate part of the design rules, especially for gridded pipe layouts, to determine the number of heads and ranges involved for the most unfavourable / favourable areas as well as the numbers of levels, adjacent racks and heads per level for racking systems.

Needless to say, the program cannot confirm that your entered system is 'correct' other than to accept what you enter as being in order (eg. a size of 32mm or a head area of 9 sq.m) or incorrect (eg. a size of 33mm

or a head area of 45.5 sq.m) both of which will cause a warning message to be given for you to amend the data accordingly.

So for each section of straight pipe on your job starting from the source and proceeding in sequential order out to the furthest sprinkler head / nozzle, you need to give :-

a) 'Start' node in the range of 1 to 9998 being the end of this pipe nearest the source following the order of specifying the previous pipes ie. apart from the first pipe, this must have been given as an 'end' node before eg. 150

b) 'End' node in the range of 2 to 9999 being the opposite end from the 'start' and having a different number from it, usually higher if you are numbering away from the source eg. 160 - where you want to connect to a previously given pipe (in looped, gridded or birdcage systems), then you quote that same number here.

c) Nominal diameter or size in mm - usually in the range of 25 to 300 mm but 2 to 900 mm would be acceptable if so defined in the two data files FHCDATA.TXT or FHCADDED.TXT where the actual internal bore of the pipe is quoted - see later. The actual numbers depend on the pipe type given in the same line ie. 25mm is available in MW but not in PVC so the program will always show you a list of ones from which to choose in the 'add' and 'edit' options. You can also enter 0 for an unsized pipe - when you come to select the 'calculate' option, the program will ask for a velocity or pressure drop/m design parameter to work out a suitable size for these pipes. This is only for terminal end-fed pipework layouts, not for looped, gridded or birdcage as there are pipes which are not sized just on flow rate.
d) Length in m - enter the nominal centre to centre horizontal length in metres from the 'start' node to the 'end' node to a maximum of 3 decimal places eg. 3.565 and in the range of 0.100 to 999.999 metres - the program will calculate the true length if sloping at an angle (see direction) so if the slope is over 45 deg from the horizontal, then the vertical length should be given instead.

e) Direction as a compass sign or an angle - enter the direction from the 'start' node to the 'end' node :-

N for North - vertically up the paper or screen in plan view
E for East - from left to right on the paper or the screen
S for South - vertically down the paper or screen in plan view
W for West - from right to left on the paper or the screen
U for Up - vertically upwards out of plane of drawing
D for Down - vertically downwards

You can also have NE, SE, SW or NW for the intermediate compass points or *angle for other angles in the range of 0 for North round clockwise to 359 degrees from North eg. *67.5 means midway between NE and E.

All pipes so specified are assumed to be running horizontally (except U and D of course) with no slope to drain as the convention in full hydraulic calculations for mains pipe runs. If this section of pipe goes up or down a roof or other slope by more than say, 2 degrees, then you will also need :-

f) Slope in degrees - an additional item to 'direction' being the angle of slope from zero for horizontal - positive if the 'end' node is above the 'start' node or negative if the 'end' node is below the 'start' node eg. E@6 means going east at 6 deg up a slope or E@-6 means going east but down a slope of 6 deg. You don't need to quote a slope of 90 deg for the U for up and D for down directions.

Please note that the program will check for incorrect slopes at tees and elbows so it will object if you specify a pipe slope of say 12 and the previous pipe ends at a sprinkler head with a slope of 6 - such changes can only take place at nodes not at tees / crosses where you can just 'bend' the pipe. Likewise, you cannot connect a vertical pipe to a tee containing a sprinkler head so you may need an extra section of pipe to have the head at its end.

Please also note that the program will check (and correct if necessary) the entered direction@slope if the end node specified for this pipe section has been given before - as might be the case in a looped, gridded or birdcage type of pipework layout. However, it can only do this at the second occurrence of the end node so if the first one comes at the 'wrong' place due to some typing or measuring error (node number, length, direction or slope), then FHC will 'connect' this pipe up to the same 'wrong' position and give a warning message. So the error may be with one or more of the previous pipes and not at the one highlighted as 'incorrect'.

g) Pipe type - can be left blank or 0 if MW pipe is required or you should enter a number of the required pipe type in the FHCDATA.TXT and/or FHCADDED.TXT data files - see later.
h) Valve type - can be left blank or 0 if not applicable or you should enter a number representing a special fitting as follows :-

1 = 90 deg screwed elbow
2 = 90 deg welded elbow
3 = 45 deg screwed elbow
4 = Screwed tee or cross
5 = Gate valve - straightway
6 = Alarm or non-return valve - swinging type
7 = Alarm or non-return valve - mushroom type
8 = Butterfly valve
9 = Globe valve

* The program can work out the positions
* of all elbows and tees so you do NOT
* need to enter these, just the numbers
* 5 to 9 as required

+ any further ones you have added yourselves.

i) Head Code - leave blank if there is not an operating sprinkler head or nozzle at the 'end' node of this pipe. If there is a head here, then enter one of the following code numbers (see AB later for added buildings if 'K' factor is over 999) :-

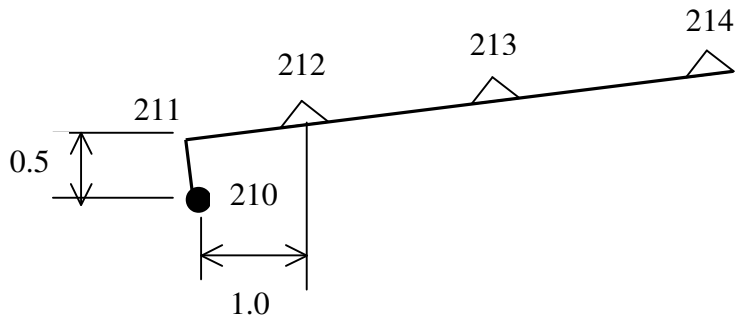
01 = 10mm k = 57 minimum pressure=0.35 bar Ordinary hazard
02 = 15mm k = 80 min press=0.35 Ordinary hazard
03 = 15mm k = 80 min press=0.5 High hazard
04 = 15mm k = 80 min press=2.0 Racks
05 = 15mm k = 115 min press=0.5 High hazard
06 = 20mm k = 115 min press=0.5 High hazard
07 = 20mm k = 143 min press=0.5 Large drop
08 = 20mm k = 204 min press=4.5 ESFR
09 = 12mm k = 48 min press=1.4 Deluge
10 = 12mm k = 41 min press=2.0 Spray

+ any others up to 99 that you have entered yourselves ie. if your ESFR system requires a 20mm orifice, k factor of 204 and a minimum pressure of 5.1 bars then you cannot use head code 8 but will have to use the next number in the list to represent it. Do not calculate the min pressure based on area covered.

j) Head area - only if you have a head code in this pipe, enter the area of coverage in sq.m of this sprinkler head at the 'end' node in the range of 0 (for in-rack or deluge heads where flow is based on minimum pressure) to 9 (for High hazard) to 12 (for Ordinary hazard) or 21 (for Light hazard) or up to 36 sq.m for extended coverage types. You must give the ACTUAL area covered by this head (but not that given in any manufacturers data sheet) which might be the same or different from all the other operating sprinkler heads or nozzles - do not enter any 'maximum' value specified in the design rules so if the head is in the middle of a space of 2.5 x 3m then the area is 7.5 sq.m, if it covers 3 x 3m then enter 9 (it is rectangular not circular) and so on. The calculation of this area is generally :-

$$\frac{\text{Distance to both adjacent ranges added together and divided by 2}}{\text{Distance to both adjacent heads added together and divided by 2}}$$

FHC will calculate the correct lengths of pipes rising from a main to an elbow on a range pipe connecting to the first head on that range (ie not "w" shaped) :-



Pipe 210 211 would be given as 32 0.5 W@84 and pipe 211 212 might be 32 1.0 E@6 - note the 84 and 6 come to 90 deg for the correct elbow shape and that the West direction is opposite to East and the sizes could be the same or different as needed. The program would determine the first length as 0.503 m with a vertical static change of 0.5 m and the second pipe becoming 1.058 m with a static change of 0.111 m. If this was a gridded range then you will have the opposite at the other end as say, 217 218 as 32 1.0 E@-6 and 218 219 (down to the main on the backtrack) as 32 0.5 W@-84 - noting again the opposite directions and slopes. You must enter all the ranges on a gridded system in this fashion before giving the back-tracks linking all the ranges together. Do not enter overhangs or overriders in between the first (or last) 2 pipes and you may prefer to enter any riser pipes (candlesticks) separately after the range - see +WR on page 3.

This completes the set of information needed for most pipe sections but the program has the following additional 'options' for special cases :-

Options for Special Cases

DD - different density
If a particular sprinkler head needs say 5 mm/min density when you have specified 7.5 mm/min density in question 14 of the project data, then give DD 5.0 ie. anything different from the default should be given as DD.

HY – hydrant
If there is an operating hydrant of a constant flow rate at the end of a separate stand-pipe (and there is not a sprinkler head / nozzle already there) then give the required flow rate as HY 456 or whatever from 10 to 30000 L/min.

AB - added building
If you want to add another type of outlet (eg. a monitor where the flow rate varies with the pressure) or another system / building / area previously calculated, then you can add the AB flow pressure area values on that line eg. AB 2150 3.45 260 which will add 260 sq.m to the total area protected in this calculation and at least 2150 L/min at 3.45 bars (actually FHC will determine the 'k' factor of 1157 and call it a 'very big sprinkler head'). The area can be zero if required but all three numbers must be quoted after the AB.

AL - added length
If this section of pipe is very long eg. 500m, then you can enter it as a length of 500 and the program will draw it to scale. However, this might make the rest of the scheme very congested as most pipes might be only 3m long! You can therefore enter its length as say 50m to show it as a reasonably long pipe on the drawing and then AL450 to add the remaining length for the correct pressure drop calculation. This option is only applicable to horizontal pipes and can be used to add the equivalent length of any special valves or other items of equipment (where k factors or pressure drop are not applicable - see later) to this section of pipe eg. AL 16 will add 16m to the specified pipe length.

AE - added elbows
These are normally determined by the program based on the orientation of the 'start' node but if you have to step around a column, for example, and don't want to give the extra 3 pipes, then you can have AL2 (for the extra length) and AE4 for the additional 4 elbows due to the change of directions.

AT - Added tees
These are normally determined by the program based on the orientation of the 'start' node but if you have a long length of underground site main, for example, and don't want to go to the trouble of entering all the pipes involved, then you can have AT3 for an additional 3 tees (or whatever) included in the pressure drop calculations. If you have a range at the end of a run of mains pipes, then its start fitting will be taken as an 'elbow' not a 'tee' so you may need to add AE-1 AT1 to the first range pipe.

VJ - Victaulic joints
Only really for NFPA and FM requirements on long lengths of site mains, then the program will add 0.3m for each joint specified eg. VJ4

PD - Pressure drop
If you have an item of equipment in this section of pipe that cannot be specified as an equivalent length or a 'k' factor (see OP next) and stays constant regardless of flow, then enter its pressure drop in bars here eg. PD 0.65 will always add 0.65 bar to this pipe.

OP - orifice plate
If you have a orifice plate to balance roof and rack systems (they should not be needed in other systems as all hydraulic balancing should normally be done by adjustment of pipe sizes) or a multiple junction control or item of equipment that cannot be included as an equivalent length or pressure drop, then enter the 'k' factor of the item here eg. OP 567. The 'k' factor can be calculated from the formula k = Q (flow in L/min) divided by the square root of the pressure P in bars eg. for Q=1200 and P=4.0, then k=600.

You may have several 'options' if necessary on one line separated by spaces and the order is not important eg. AE3 AT2 OP777 but only HY and AB are permitted if there is no head code given as you can only have one 'outlet' per pipe, but you can easily add another pipe to the hydrant or added building if necessary.

This completes the description of all the input data needed by the program - it may seem confusing to start with but all will become clear when you begin using FHC on your first job. It doesn't really matter if you make any coding or typing mistakes as you will normally be entering the majority of this data pipe by pipe on the screen and so any errors will be picked up immediately - the program just won't let you enter an incorrect size (eg. 33!) or node number (125 you thought was free has been used over the other side of the drawing!) or a obviously wrong direction (you can't have S after a N!).

There are several worked examples supplied with the program which show the general procedure and typical ways of numbering or entering information - you can either follow these for your particular schemes or use your own ideas for the coding / order of pipes. In most cases, the noding and sequences are not critical and different people in your office can have their own way of completing the forms - the only real numbering problem will come from quoting a 'start' node that has not previously been quoted further up the list as an 'end' node.

2. OPERATION OF COMPUTER PROGRAM FHC

Where there are buttons or menu items shown in black on the screen, a single click with the left hand mouse button will activate them. Where a button is shown with its title surrounded by a dotted line, you can press the ENTER or SPACE BAR keys to actuate it and in most cases, the ESCAPE key is the same as clicking on CANCEL. Use the TAB key to move between input boxes or items (the same as 'enter' in MS.DOS programs) or click your mouse when its cursor is over that item. The DELETE key either cancels the current character or erases the whole line of text in an input box and, of course, you must still use the keyboard to enter numbers or alphabetical characters in UPPER or lower case where these need to be typed in - the current position is shown by a flashing black bar. Most dialog boxes have a title which can be clicked on to move that box around the screen if it obscures the underlying picture. Where scroll bars are shown to the right of a list or text display, you can click on the top / bottom 'arrow' symbols to move in that direction, move the mouse over the grey bar and click and slide it up or down or click somewhere in the display and use the PGUP or PGDN keys to move up or down by a screenfull at a time. In most cases there is either a single 'status' line at the bottom of the screen describing the current option or suggesting what can be done next or a box with black text on a yellow background giving a brief description of what that dialog box is about and what you can do within it. There is also the 'Help' option to show all of this user manual on the screen and allowing a 'keyword' search of the full text to look up any items on which you seek further clarification.

The FHC is best viewed at 800 x 600 resolution so you may want to change from 640 x 480 if you currently have this screen size. Higher resolutions are only applicable to 17" and larger screen sizes otherwise the text is far too small to read. You should also have correctly installed your printer and set it to the 'default' one and ensured it supports the 'Courier New' and 'Arial' fonts before using FHC.

Once the program has been activated, a screen will be given showing your company name and address in the centre, the developers name and address in the lower left and the current date and time in the bottom right. Click on 'OK' to continue or 'EXIT' if you want to stop.

The main picture screen will be initially blank with only the 'File', 'Options' and 'Help' menu headings given on the top line and the status line at the bottom indicating 'Click on 'File' to start'. If you do not want the program taking up all the screen you can click on the 'double box' icon on the top right to see a smaller version of the display where the 4 borders can be resized to suit your needs - don't make it too small though.
It now depends on what you want to do as to what menu options and sequence you follow - I therefore cannot give step by step instructions for a complete task but can only describe what option does in turn for you to select this at the appropriate time in running your particular project through the program. This is the main point of a graphical 'Windows' based computer program in presenting the user with the valid choices he / she can make at any specific time and ensuring the program follows that step. For example if you click on an 'Exit' command then the program will stop - if you didn't want the program to stop, then you shouldn't have selected 'Exit' should you?! If you select the right option then that operation will take place, if you choose 'Add' when you meant 'Amend' then the program will present you with the 'Add' display which you will have to cancel if you don't want to do that. Do not just turn off the computer if it does something you do not want!

MENU DISPLAY OPTIONS

Across the top of the screen will be 9 menu items, either visible meaning that they can be selected or 'greyed out' to show they are not yet applicable ie. you can't select 'Printout' until the calculations have been done. These main menu items are 'File', 'Edit', 'Drawing', 'Calculate', 'Results', 'Printout', 'Options', 'View' and 'Help'.

'File' - 'New'
To start a brand new set of project and pipe data. It will prompt you to save or cancel the current set of data if applicable and then present you with the main Project Data Entry dialog box - see under 'Edit'.

'File' - 'Last job'
Will allow you to skip the 'Old' part described next and read in the last file added or amended and show its plan on the screen.

'File' - 'Browse'
If you cannot remember the file names given to your jobs or wish to delete some, this dialog box will show the current jobs stored and the first 19 lines of data. You can change between files by clicking on their names or 'double-clicking' on the drive or directory titles. Click on 'Cancel' if not required, 'Open' to read in that job and show it on the screen or 'Delete' if you don't need it any more - the program will need confirmation before it will be erased.

'File' - 'Open'
To read in the data for a previously prepared project. It will prompt you to save or cancel the current set of data if applicable and then present you with a standard 'Open File' dialog box. You may select any of the options and type in or click on the name of the file, with its full path, and then on 'Open' to read in that file and show its plan on the screen. You don't have to enter the suffix '.FHC' as this is automatically done by the program which also keeps a '.BAK' backup copy just in case the main one fails. You can enter any combination of letters and numbers for the name you want to use so JOB001, TESTMR, BloggsMF2 are all acceptable. If you click on 'Cancel', the dialog box will disappear.

'File' - 'Save'
Can be selected at any time to save the current set of data on your job safely to the hard or floppy disk if it has changed since the last save command. Please do this regularly just in case Windows or the program or the power supply fails.

'File' - 'Save As'
This option will prompt you to save or cancel the current set of data if applicable and allows you to rename the current data to make a copy in another place on the hard or floppy disk or to make another version of this data file with say, different head or pipe sizes. A 'Save As' dialog box is given so you can select the drive / path required and type in a new name (or reuse an existing file name) as required - again the .FHC part is not needed. Thereafter the original job would have been stored on disk and all options you select now will refer to the file name just given.

'File' - 'Printout of data for last job'
Will immediately printout the data for the current job (or the last one if none yet read in) on the printer for record purposes - just for a quick check and not as comprehensive as the 'Printout' option in the 'Edit' part described next.

'File' - 'Quickest'
If you have a reasonably symmetrical building where a simple gridded system may be the most economical, then this option will present you with a dialog box showing the last set of data stored. Most of the items are self-explanatory so you should orientate your building such that the riser is somewhere along the left hand side so that the ranges are always left to right and the front and back tracks are from top to bottom in plan view. You can have the single bay roof going from left to right or top to bottom and select either the 'most favourable' or 'most unfavourable' design area along with the dimensions, head codes, density and pipe sizes. If you have an ESFR system, then add the letters [ESFR] to the title. Once all the data is on the screen click on 'OK' to get the program to generate the FHC data file called 'QUICKEST.FHC' - which will take a few seconds to read in and then its plan shown on the screen. If it doesn't come out as you intended, then simply select this option again and correct the item(s) required and redo the file.

'File' - 'Printer Setup'
Will allow you to see what the current printer / paper size etc. is and to change the details if required (you need to click on 'Apply' to save the amendment).

'File' - 'Exit'
Will close the program after prompting you to save or cancel the current set of data - the only way to finish with FHC and do something else or switch off the computer. The normal 'Windows' screen will be shown with the task bar.
'Edit'

When selected, this will show a 5 page dialog box allowing you to enter (after a 'New') or amend the set of project, water supply, design area, head codes and pipes information. You move between these pages in whatever order you want by clicking on the header description to see that page displayed but may have to press the TAB key or click on an item with your mouse to highlight that particular option on the page.

'Edit' - 'Project data'
Here the first 9 questions are shown and you can either type in that answer into the space provide or click on the little 'arrow' symbol on the right to see a list of the previous replies to that question, just in case one of these might be appropriate this time. Not all the questions need a reply as the program will supply a suitable default value but this may not be what you want.

'Edit' - 'Water supply'
Here the top display shows the current water supply / pump curve references and the 2 rows of 8 boxes underneath show the current flow and pressure values for each as you highlight the various headings. To add another set of values, click on 'Add another pump' button and then enter the flow, pressure, flow, pressure etc. values to complete the 16 boxes and then the reference and tank height ones, pressing TAB to advance after typing in each response. After 'tank height', click on 'Save' to store these numbers. To amend one or more of the current values, click on 'Edit these values' and then amending or retyping any ones you want to change and then click on 'Save' to store the revised information.

'Edit' - 'Design area'
Similar to the first page and showing the questions 11 to 18 on data form 1 - again a new reply can be typed in or a selection made from the previous replies to that question. You can press SHIFT-TAB to move up the screen.

'Edit' - 'Head codes'
On this page, you may inspect, amend or add to the list of head codes available for selection on your projects. The top display shows the current choices, so you may need to click on the scroll bars to see more of the full list with the 4 text boxes showing each of the items in turn. You may use any of these heads codes on your project just by quoting its reference number eg. 4 but may only edit them if it has not already been amended by another project which may be described in red alongside. You can add another head code by clicking on the 'Add another head / nozzle type' button and filling in the 4 text boxes, pressing TAB each time, with the appropriate values.

'Edit' - 'Nodes / pipes'
This will be blank if coming from 'New' or show all or the top part of the data form 2 about your pipes and operating heads / nozzles. This can be regarded as a full-screen editor if you want to enter one or more pipes already written on the data form more rapidly than can be 'drawn' by the 'Drawing' options described next. You can skip this part if you want to use these drawing options though.

Briefly you type in the start node, end node, size in mm, length in m, direction@slope, pipe type, valve type, head code, area in sq.m and the various 'options' separated by one or more spaces - there is no need to line up the items under their headings, just so long as a space separates the different values.

So 110 120 32 4.5 N 1 0 4 9.000 is the same as 110 120 32 4.500 N 1 0 4 9. Note there is no space between the direction and optional slope so E@6 is correct but E @ 6 is not. If no PT or VT is shown on the form but a head code / area is given then two zeroes are needed to keep the head code in the right column. If any 'options' are shown, then spaces are also needed to separate them in that line eg. AE4 AT1 AL56. When each line is entered, press 'enter' to return the cursor bar to the start of the next line for the next pipe and so on. Type in END as the last line to finish this data. For large jobs, there will be 2 more pages N/P2 and N/P3.

If you want to insert another pipe in the middle of a list, just click the mouse on the first character of the next line and press 'enter', the 'up' key and then type in the new line of data in the blank space created but you don't press 'enter' at the end of the line. Any line that starts with a ' is a comment eg. 'front track.

If you want to just amend one item on a line, say the size, then move the mouse cursor to that point and click, the cursor bar will stay in the position selected so you can use the DELETE key to remove unwanted numbers and type in the correct ones, with the left and right cursor keys moving the bar along the line.

If you wish to search through the list for a given node number or size, then press the 'F2' function key to get a small dialog box up and type in the required set of numbers and press 'enter' or click on 'Find' to remove the box and the text, if found, will be highlighted on the screen. Pressing 'F3' will search for the next occurrence of the same characters or give a message saying that there are no more occasions in the list. Press 'F2' to search the list again, from the beginning, for the same or another set of numbers / characters. Press 'F4' for the similar search and replace function and you can 'highlight' part of the text first to restrict the changes made eg. change 150 to 100 might change node nos as well as sizes.

The usual 'highlight' and 'copy/paste' commands work within this text display, so to copy one group of lines to another place, move the mouse cursor to the start point, hold down the 'SHIFT' key while sliding the mouse or using the 'down' arrow cursor key to the end point where the selected text will be shown highlighted. Now press CTRL-INS together to 'capture' the text and unselect the text, move the mouse cursor to the required insertion point and press SHIFT-INS to duplicate the set of lines chosen - perhaps making a blank line first - don't forget to change the node numbers though otherwise you will end up with lots of duplicated pipes.

'Edit' - 'Apply changes made'
Click on this button when all changes have been made to your set of project data to carry out the full checking process and, if there aren't any error messages, the plan view of your scheme will be shown on the screen after a few seconds delay. If you have come from the 'New' menu option then the program will show the 'Start node' dialog box and expects you to type in the first node number of the water supply / pump outlet before going automatically to the 'Drawing' - 'Add a pipe' option asking for details of the first pipe in your project before there is anything to 'draw' on the screen.

'Edit' - 'Printout of data'
Click on this button to obtain a printout of your current set of input data for checking or record purposes - see worked example pages further in this manual. The 3 buttons along the bottom of the screen will disappear to signal this process has started but you may have to wait 10 to 30 seconds before the first page comes out of the printer and then the 3 buttons will come back.

'Edit' - 'Cancel'
Click on this button either if no changes have been made to the set of data or if the amendments you have made are not required and should be cancelled. The drawing that you left will again be shown on the screen. If coming from the 'New' menu option, then this will cancel all of the input data entered (if any) and revert back as if 'New' had not been selected.

'Drawing' - 'Add another pipe'
Select this option when you want to add another pipe to a previously drawn 'end' node - you can either do this on a plan or preferably, an isometric view if there are several nodes close together. The status line will confirm this option so move the mouse cursor to the end of a the pipe where you want to join on a new, additional pipe and click its left button. If valid, a 5 page dialog box will be given showing the 'start' node of this pipe, the data for the previous upstream pipe and expecting you to type in the required 'end' node.

This value is checked and will be shown as a 'new node number' or as an 'existing node number' if you are connecting to a previously given end node number somewhere else in your network. If existing, the program will calculate the length and direction/slope for you to click on 'Yes' if correct or 'No' if you want to enter your own data or to change the 'end' node number. If a new node number, then the blue message will say 'is a new number'.

'Add another pipe' - 'Pipe data'
You can now move the mouse or press TAB to get to the pipe size, length, direction, slope and pipe type questions on that page - if there is no head code at the end nor any other 'options', click on the 'Add this pipe' button to recheck and redisplay the new pipework scheme. Note that if you miss out the end node or pipe length, then the program will give you a warning message and wait until a valid number is typed in for both questions. Note you may also get some warning messages about invalid directions or slopes based on the direction, slope and tee/elbow arrangement of the previous pipe.

'Add a pipe' - 'Head code'
Here you may select which head code to use and its area of coverage and density (if different from the value given in the project data). Also on this page are the options about hydrant and added buildings. Note that you can only have a head code, a hydrant or an added building at the 'end' node.

'Add a pipe' - 'Optional items'
Here you may type in any of the optional items in this pipe section such as added length, etc and can press TAB to move between the 7 boxes or move directly there with the mouse and click. Note that 0 is the normal response to all these questions and you only need to enter a value if applicable.

'Add a pipe' - 'Upstream pipe'
This page just shows the data on the previous upstream pipe that you choose to connect this pipe to for reference purposes.

'Add a pipe' - 'Copy another'
This page shows the previous set of data for all the pipes so far on your job with the upstream one 'highlighted' (it will be blank if you have come from 'New' on your first pipe). If you want to copy the information given on any previous pipe to the new additional pipe (apart from the node numbers of course), you can move the highlighted bar with the mouse on the scroll bars in the normal way and 'double click' when the right pipe is shown to transfer its information about size, length, direction etc. to this pipe to save you having to type it in again.

'Add a pipe ' - 'Add this pipe'
Click on this button to add the pipe so defined to your scheme to recheck and redraw the plan or isometric - the 'Add' option stays in effect so you can click on another 'end' node (perhaps the one you just drew) to add another pipe and so on until another drawing or menu option is selected. Don't forget to click on 'File' then 'Save' occasionally to save the information to the hard or floppy disk.
'Add a pipe' - 'Add a head code'

Click on this button if you wish to use a head code at the end of this pipe not previously specified in the 'Edit' part - a dialog box will be given where you may enter the size, k-factor, minimum pressure and reference and then click on 'OK' or just click on 'Cancel' if not needed.

'Add a pipe' - 'Cancel'
Click on this button to cancel any data entered or copied about the pipe 'start' and 'end' node and reshow the drawing you just came from - useful if the wrong option or 'start' node selected or if there is something wrong with the previous pipe that you want to correct before adding any further pipes.

'Drawing' - 'Break a pipe in two'
This option is used to insert an extra node number somewhere along a previously specified pipe, to add another pipe or a head / nozzle for example. You cannot just delete a pipe and type in two pipes in its place without causing routing errors.

Once chosen, the status line will request that you move the mouse cursor on the screen to the pipe in question (in plan or isometric view) and then click its left hand button. A small dialog box will show the details about that pipe with its 'start' and 'end' node numbers, size and type, length, direction and slope with two text boxes currently empty. You can now type in the new, unused node number in the centre of

the pipe (remember what I said about numbering away from the source in set increments so you 'know' if any intermediate node numbers have been used or not) and press TAB to get to the length from start box.

Type in the pipe dimension from the 'start' node to the new one (more than 0.1 m but less than the length of this pipe minus 0.1 m). You can now click on 'Add this pipe' to store this new pipe or 'Cancel' if this option is not required or if you just have the wrong pipe. You may not notice much has changed on the diagram - you have only added a node number of course, but there are now two pipes where there was one before so the data on one, or either, or both pipes can now be amended as required. You can turn on the node number display from 'View'.

'Drawing' - 'Copy group of pipes'
You should use this option to repeat a group of range or mains pipes already specified but at another position in the network and you might prefer to have the node numbers shown on the screen to help in choosing the right numbers. Simply type in the 'start' node of the first pipe that you want to copy from, then the TAB key and the 'end' node of the last pipe that you want to copy from. If acceptable, the program will display the group of pipes so specified or the box will remain blank if either the start or end nodes are not found or not in sequence. Now type in the end node number of the pipe where you wish to duplicate all the pipes displayed and click on 'Copy' to carry out that action and redisplay the extra pipes on the screen. These are not yet saved so you can always exit or delete them if wrong. Alternatively, click on 'Cancel' if you don't want to proceed.

'Drawing ' - 'Delete one or more pipes'
This option is used to remove pipes currently on your drawing if no longer required. The status line will prompt you to select a pipe with the mouse cursor. You should click near the centre of the most upstream pipe if you want to delete a group together and its best not to click on the first pipe from the water supply unless you want your whole system to disappear! The program will search through your network for all pipes that are supplied via the one selected and redraw the plan / isometric with these pipes shown in red and a narrow dialog box will be shown telling you how many pipes will be erased and how to move the display to view those pipes. When you are satisfied that the 'right' pipes are shown, click on 'Yes' to delete them or on 'No' if you don't want to go ahead. Even if you delete more pipes than you subsequently find you should have, then remember that any changes have not been saved to your project data file on the hard or floppy disks so only by selecting 'Save' from the 'File' menu will these pipes disappear forever.

'Drawing' - 'Edit information on a pipe'
Don't confuse this with the main 'Edit' menu option which deals with your project data, water supply, head codes etc. Once selected, the status line will prompt you to click your mouse button when the cursor is over the pipe you wish to inspect / amend. When done, a large dialog box will be shown in the centre of the screen showing all the current items of data relating to this pipe section.

You may now change the pipe size, length, direction, slope, pipe type, valve type, head code, area, density or 'options' as shown - you cannot change the 'start' and 'end' nodes in this display - see the 'Global', 'Renumber' or 'Resequence' options described later if you do.

Changes can be made by pressing the TAB key to highlight the reply you want to edit or clicking the mouse directly when its cursor is over that item. Some boxes are simply text displays where you have to type in a number / value or list boxes where previous or other valid selections can be made.

When the one or more alterations have been completed in whatever order you choose, click on the 'Apply changes made' button to recheck/redraw the picture with those new items in effect or click on the 'Cancel' button to revert back to the original set of data and redisplay the drawing as if nothing had changed. The 'Edit' option stays in effect so you can just move the mouse to another pipe to amend its information and click or select another drawing option.

'Drawing' - Form no 2 data entry / amendment
This can be used to type in the 9 columns of data for each pipe in turn if completed on data form no 2, together with the various options just by pressing 'TAB' between each one. One can move forwards or backwards through all the pipes, changing specific items as required or add extra pipes onto the current end

of the list. Note that no checking takes place so you may only want to enter, say, 20 pipes at a time before pressing 'Cancel' to recheck and redraw the 'picture' just in case some errors have been made and you will know the problem was just in the last set of data entered.

Global changes on all pipes

This option will permit you to change all common items such as pipe size, type or lengths on the complete drawing in one go. If you don't want this or are afraid that you might inadvertently change something you don't mean to, then there is the next option 'Global changes on selected pipes' which may be better. A 4 page dialog box is given showing the main titles of what can be changed.

Node numbers
Here is shown the lowest and highest node numbers found in the list and inviting you to amend the minimum or maximum node numbers and renumber the intermediate ones in whatever increments you type in. There is an example given in the 'help' display.

Sizes / types
Here is shown the list of pipe sizes and types used so far on your job and requesting what changes you want to make. You could change all the 32mm MW pipes to 40mm MW or 150mm MW to 150mm PVC for example, just by arranging the 4 display boxes to the required values before clicking on the 'Apply changes made' button. However, please bear in mind that these amendments take place immediately so if you want to change the 32mm pipes to 40mm and the 40mm ones to 50mm then you should make the largest change (the 40 to 50 one) first and then the 32 to 40 change next. If you don't, then the 32mm pipes will get changed to 40s which will then get changed again to 50s!. Likewise if reducing the pipe sizes on your job eg. 100 to 80 and then 80 to 65mm, start with the smaller pipe sizes first.

Lengths/slopes
On this page there are 3 groups of 2 display boxes - the top one shows the list of current pipe lengths, in ascending order, that you may select and a box where you can type in the new length eg. select 1.0 m pipe length and type in 1.4 or whatever to have the program increase all the matching pipes from 1 to 1.4 m by clicking on the 'Apply changes made' button.

You may also change any of the current pipe slopes shown, say 6, to another value, say 7 degrees. Only those pipes currently with a slope of 6 will change to 7 - those with zero will stay at zero, -6 will stay at -6 and so on.

If you have a gridded system where the range pipes go up and over the roof of say 6 degrees, then the bottom two boxes will allow these, and corresponding slopes to be automatically changed to another slope, say 7. Now the pipes of 6 deg slope will be revised to 7, -6 will change to -7, 84 will change to 83 and -84 will change to -83 to keep the correct elbow shapes at the risers from the front and back tracks. If you make a mistake, you can always change the 7s (and 83s) back to 6s (and 84s).

Heads / areas
This page will permit you to turn off existing sprinkler heads (by setting their head codes to zero) or to change head code 3 to head code 6 or to revise all the common head areas to another value.

Simply select the list box selections from what is shown to what you require and click on the 'Apply changes made' button. The head areas will be those used so far on your job, so if 6.75 sq.m is not shown, then you haven't used that value but you can change the 6.75 to 7.75 by typing 7.75 in the 4th box and again clicking on the 'Apply changes made' button

Global changes - 'Apply' button
When any of the 4 pages is shown and you have made an amendment to the data shown, then clicking on this button will immediately revise all the matching pipes with the new information and present a little dialog box showing what changes have been made and the numbers of pipes affected. Press 'enter' or click on 'OK' to get back to the display you just left with the various boxes updated.

Global changes - 'OK' button
Click on this button to remove the whole box from the screen, either without making any changes or when all the changes you have actioned are complete. The set of input data will be rechecked and the new drawing (if amended) reshown as a plan or isometric on the screen.

Global changes on selected pipes

This is exactly the same as just described except that the screen display will be changed to a plan and the status line will give you instructions on how to select part of your scheme to amend the node numbers, pipe sizes, types, head codes etc. as above.

Move your mouse cursor to the bottom left hand corner of the group of pipes that you want to operate on and hold the left hand button down (don't click it), now slide the mouse upwards and to the right, still holding the button down, to draw out a red rectangle on the screen, getting bigger or smaller as you move the mouse. When the red rectangle encloses all the centres of the pipes you want to 'grab', release the mouse button.

The same dialog box as for the 'Global changes on all pipes' will be shown but this time its title will only say something like '6 pipes and 4 heads' rather than the whole system. Any changes you now make will only apply to those pipes / nozzles selected - this is quite useful for amending just the roof or rack only parts of a combined roof + rack system as you won't get the roof sizes, lengths etc. mixed up with the rack ones.

'Drawing' - 'Interactive edit'

This option will permit you to quickly change common items on one or more pipes eg. pipe sizes, lengths etc. to a common value. When selected, a dialog box will show the various options that can be changed and the new value that you want eg. pipe size and then type 25 in the white box and click on 'Select'. Your system will then be redrawn with all the pipe sizes shown so just click near the centre of the required pipes to change their size to 25mm. Select this or any other option to continue but remember that any changes made have not been saved in your data file until you select the 'save' or 'save as' options or exit or select another job.

'Drawing' - 'Locate a node number'

When selected, a small display will be given in the centre of the screen with a box showing the last node number used and two buttons. Select the node number you seek or just type it in and click on 'OK' for the plan to be redrawn centred about that node number and the 8 'pan' buttons (see 'View' - 'Zoom in on plan' later) or click on 'Cancel' to remove the dialog box.

'Drawing' - 'Move a pipe to another position'

If the start node of a pipe connects to the wrong end node of a previous pipe, then you can either just retype it in the 'Edit' - 'Nodes / pipes' option or select the pipe that you want to change by clicking near its centre with the mouse to get a small display in the centre of the screen showing this start node and two buttons. Either select the correct node number or just type it in and click on 'OK' to get the screen redrawn with the pipe (and any pipes it fed) shown in the new position.

'Drawing' - 'Renumber a node'

This option allows to renumber an existing node number on the screen and ensure all other pipes referring to it are likewise renumbered. The status line will prompt you to move the mouse cursor to the end of the pipe whose node number you want to change and then click. You can use the 'View' option to show all the node numbers on the plan or isometric on the screen.

A small dialog box will come up confirming which node number you have selected and the pipes currently using it as a 'start' or an 'end' node. If you don't want to proceed, just click on 'Cancel' to reshow the drawing. If you type in a number in the range of 1 to 9999 not previously used in the box provided and click on 'OK' then that node will change to the new number and the box will disappear so the picture can again be seen.

'Drawing' - 'Resequence all node numbers'

This option is especially useful if you have not been too careful in your selection of node numbers used so far on your project as it permits you to completely renumber them afresh. When selected, a dialog box will confirm the minimum and maximum node numbers allocated so far and how many have been used and inviting you to enter the new start node number and an increment. For example, you could have used numbers 56, 100, 110, 120, 135, 176 and 543 on your job. If you enter a new start node number of 100 and a step of 10 then these will change to 100, 110, 120, 130, 140, 150 and 160. Click on 'OK' to proceed. A start node of 350 and increment of 47 will give a new list of 350, 397, 444, 491, 538, 585 and 632. You can even number backwards if you want ie. a start node of 7654 and step of -832 will give a new list of nodes of 7654, 6822, 5990, 5158, 4326, 3494 and 2662! Please remember that these numbers must be in the range of 1 to 9999 so you can't have a start node of 9000 and an increment of 2000 nor a start node of 100 and a step of -456 so the program will give a warning to this effect if your two numbers cause such a problem.

'Drawing' - 'Tree planter' (or terminal range/main creator)

This option will show a little plan on the screen to permit you to specify :-

Start node of mains pipe - must already exist
Direction of main - 0 for north, 90 = east, 180 = south etc. (400=down for racks)
Length of first run of main - from the above start node to the first range
Number of ranges - from 1 to 90
Spacing of ranges - distance in m between ranges from 2 to 5m
First node - must be a new number and all subsequent nodes will be in steps of 1
Number of heads per range on side 1 - from 1 to 10
Direction of side 1 - 0 for north, 90 for east etc usually at 90 deg to main
Head code number - from 1 to maximum given so far
Spacing of heads - distance in m between heads from 2 to 5m
Slope in degrees for side 1 - 0 for horizontal, 6 for plus six degrees etc
Vertical height from main to range - for riser pipe from 0 (=none) to 3m
Distance to first head - usually less than half of spacing or 0 for head on tee
Rise or drop pipe to each head in m or 0 if heads on range
Number of heads per range on side 2 - 0 for end fed or up to 10 at opposite direction and slope

Once all of these items have been selected or typed in, just click on 'OK' to get the program to draw out the mains and range pipes as specified and see the resulting plan or isometric view - all the pipes will be unsized so you can prefix them if needed or let the program size them. If the set of end or centre-fed ranges does not come out as intended, them just select 'Delete' and erase the first run of mains pipe to the array, so deleting all the ranges and then just try again.

'Drawing' - 'Type a pipe'

Like the 'ADD' option, click on the end node where you want to add another pipe and a small dialog box opens adjacent to that node - just type in the end node, size, length, direction etc. as on the data form separating each number with a 'space' and then press ENTER or click on OK to check and reshow the scheme.

'Drawing' - 'View details on a pipe'
This is the default selection if no other drawing options are shown and is characterised by a 'cross-hair' cursor on the screen which follows the mouse movement. Simply click the mouse button when over or near

the centre of any pipe you wish to look at is shown in the plan or isometric views. A small dialog box will be shown on the top left of the screen (and can be moved in the normal by dragging the title around to another part of the screen where it will stay until moved again) giving full details about the pipe identified in yellow on the screen.

This will be a description of the input data on that pipe and the flow rates, pressures etc. in the pipe and at the head / nozzle if applicable if the calculations have been completed. Underneath will be 4 buttons - click on 'Upstream' to see the details about the pipe feeding the selected pipe or 'Previous' to see the details about the pipe immediately before the selected pipe in the list of data or 'Next' to see the details about the next pipe in the list or 'Return to drawing' when complete.

Calculate the FHC hydraulic model

Up to now we have just read in the already prepared data file or used 'New' to start and enter a new project. To calculate your system, you should normally select the 3rd option - 'All heads given to be operating' but if you have specified more heads or nozzles than are required, you can select the 1st option and either :-

a) Individually select the operating heads by clicking your mouse when its pointer is over a head / nozzle in plan or isometric view to turn it blue (equals 'on') or again to turn it white (equals 'off').

b) Within squares or rectangles by holding down your mouse button in the bottom left hand corner of the group of heads you want, keeping the button down and sliding the mouse (to draw out a red box) and then release the button when all those heads should turn blue. You can repeat the box drawing part as often as required.

When finished with either of these, click on 'Calculate' icon of the menu bar or press the F12 Key.at the far top right and the 2nd option simply allows you to increase or decrease the number of heads AFTER the 1st option has been used and then click 'GO' again. You can save this if needed.

In all these cases, the program will quickly check your set of data again and give one or more error messages (see later) if anything is amiss and then offer a small dialog box with 4 text boxes and 'OK' and 'Cancel' buttons.

You should click on 'Cancel' if this option has been wrongly selected or if the density / areas shown are not right of if the total of the area covered by the operating heads does not yet add up to the value quoted in the project data.

Here you may get the program to prompt you if any pipes are below the minimum water velocity indicated, if any pipes are above the maximum velocity quoted in the second box and if any pipes have pressure drops greater than the value specified.

Note that these do not govern the sizing of your pipes - you have prefixed those - but simply to draw your attention to possible missing head codes (so having no flow in one or more pipes) or undersized pipes, incorrect head 'k' factors, too large a pump curve etc. giving too high a flow and hence, water velocity and pressure drop in the associated pipes. If you do not have any other design criteria, then leave the 3 boxes as 0.00, 6.00 and 1.00 and click on 'OK' to start the calculations. You only need to enter the most remotest head node number for exceptional cases as the program will normally find it automatically.

If you have any unsized pipes, a slightly different screen will be given asking for the velocity or pressure drop/m sizing parameters and the minimum pipe size. Choose the required option and value and click on 'OK' or 'cancel' if not needed.

Depending on the size of your job, the amount of imbalance between the nearest and farthest heads and the speed of your computer you may or may not see a 'One Moment Please ...' message and the progress of

the hydraulic calculations performed by the program taking about 0.1 to 20 or more seconds until they are complete, when a 'Calculations Summary' will normally be given.

You may also see some helpful warning messages about your system if your heads are at the same level as the source, very high above the start node or a considerable distance below it, all possibly indicating some errors in slopes or directions. If something is obviously wrong with your pipe sizing or other design parameters and you have a huge flow rate, pressure or maximum velocity then more messages may be displayed - just press 'enter' or click on 'OK' to continue.

You may also see one or more displays of pipe and head details if

a) You have any pipes equal to or below the minimum velocity specified
b) You have any pipes above the maximum velocity specified
c) You have any pipes where its pressure drop is greater than the max value given
d) You have some pipes where the start / end pressure is negative
e) You have any heads where the density is below the minimum specified - perhaps due to insufficient pump pressure

f) You have any heads where the pressure is below the minimum value specified for that head code - again can only really come up when a pump curve is given.

g) You have heads where the flow is over 3 times to minimum necessary to satisfy the density and/or minimum pressure - just to show there is too much water here, perhaps you can install smaller heads or pipes in these locations.

h) The program cannot solve the network as might be the case when you have heads at say 10m high and the pump only gives 0.5 bar!

i) When balancing to a specified pump curve, the flow rate is higher than the maximum value given so the last pressure point as been taken as the source duty - please increase the last flow value or enter / select another pump curve.

The 'Calculations Summary' dialog box will tell you the source flow and pressure and many more useful statistics about the flow rates, velocities, pressure drops, 4 most remotest heads (if applicable), balancing of gridded systems, different units, calculation accuracies etc. You can view this data or get a printout if required and can click on 'Save data' to update the floppy or hard disk for the latest changes. The 'Optimise' button allows you to interactively increase or decrease any pipe sizes to immediately see the resulting source duty and you will return to this screen at after 'Apply revised sizes' or 'Cancel'. Click on 'OK' to see that the two menus 'Results' and 'Printout' are now available.

Results and Reports

Heads summary
This will display the calculated flows, pressures and densities for all your operating heads / nozzles underneath various headings. If you click on one of the buttons forming the heading line, then that column will be sorted into ascending order with the lowest first so you may have to scroll down to see the rest or 'OK' when done.

Pipes Summary
This will display the calculated flows, pressures, velocities etc. for all your pipes underneath various headings. If you click on one of the buttons forming the heading line, then that column will be sorted into ascending order with the lowest first so you may have to scroll down to see the rest or 'OK' when done.

Check Summary
If you have not seen this before on your job, then that is because there weren't any errors in it. This display gives various lines of statistics about your job for checking or reference finishing with a list of quantities.

You may click on the 'Print' button if a hard copy is wanted or 'Save data' if any changes or additions have been made or on 'OK' to clear it.

Calculations summary
This will again display the same information as given at the end of the calculations just in case you want to review it again or to get a printout.

3D DXF file
If you have a CAD program that can accept three dimensional DXF files then this option will quickly produce such a file of pipes, node numbers, sizes, flows and pressures on various layers in different colours. The summary at the end will confirm these items so you can subsequently run your CAD program and read in the file name quoted. However the drawing does get a bit cramped around short length pipes so you may need to turn off some 'layers' to make the drawing easier to follow or erase / move some text items to obviate overprinting.

Printout
This menu option is only applicable after the calculations have been completed and will present a dialog box offering the choice of the full results printout or can be skipped, what view if any is wanted and how many copies (1, 2 or 3) to generate. If you have now sized any previous 'unsized' pipes, click on the 'Save Sizes' button. Ensure that your printer is on with sufficient paper in it and click on the 'Start Printout' button or on 'Cancel' if not required.

Depending on the size of your system, the speed of your printer and how many copies are needed, you will have to wait until the printout, usually giving a 'One moment please ...' message is complete when another dialog box is shown requesting that you click on its 'OK' button to redisplay your drawing. You may still have to wait 1 to 5 or more minutes for all the pages to be finished. Note that you cannot click on 'Calculate' again as the sums have already been done until one or more items of data are changed, so hiding the 'Results' and 'Printout' options.

'Options' - 'Delete all .BAK files'

FHC makes a .BAK file of each job as changes are made so if you have lots of these and have never used them, just click on this option to free up the disk space.

'Options' - 'Edit FHCDATA.TXT'

This is where the information on the pipe types, sizes and valves is stored and will display the first set of lines, indicating when it was last amended and offering 'Print' and 'Cancel' buttons. If you make one or more changes, a new button 'Save / Continue' will come up and which should be selected to retain these amendments.

'Options' - 'Edit FHCADDED.TXT'

Exactly the same as the above option but for the FHCADDED.TXT file, the one set aside for your own additions and amendments to the pipe types, sizes and valves.

'Options' - 'Reset stored lists'

Obviously the previous replies to the project data questions have to be stored somewhere so after you have entered lots of jobs then you may find you are presented with too many valid replies to make any sense of. In such a case, this option will show you the 15 different headings and the list of responses to each. Just click on any of the circles to see the description change - if you want to get rid of all but the most recent one, please click on the 'Delete all but last reference' button and try some more of the circles and 'Delete' button. When finished, click on 'OK' to return to the picture display.

'Undo'

This allows you to go back up to 20 steps in adding or amending data since reading it in from disk or starting a new job. Just select the line BEFORE the option that you want to correct and click on 'OK' or on 'Cancel' if not needed.

'View' - 'Zoom in on plan'

You can now select 'All pipes' or 'Specify min/max heights' - only choose the latter to restrict the depth of view in any subsequent isometrics and is quite useful on multi-layer projects. You can then follow the status prompts to move your mouse cursor to the bottom left hand corner of the group of pipes that you want to see and hold the left hand button down (don't click it), now slide the mouse upwards and to the right, still holding the button down, to draw out a red rectangle on the screen, getting larger or smaller as you move the mouse. When the red rectangle encloses all the centres of the pipes you want to see, release the mouse button. The display will now show just the pipes selected and 8 'pan' buttons at the 4 corners and edges of the screen will now become visible. If you click on any of these small buttons labelled 'N', 'NE', 'E', 'SE', 'S', 'SW', 'W' or 'NW' then the drawing will keep the same dimensions but will pan in the direction selected - if you are already at that edge of the drawing then nothing will appear to change but if you pan to an area where there aren't any pipes, then none will be shown!

'View' - 'Plan of all system'

Clicking on this will redraw the picture of the full plan view of your scheme.

'View' - 'Front elevation'

Clicking on this will redraw the picture being the view from the front (ie. from south looking north) - useful to check if you have the right heights and slopes.

'View' - 'Side elevation'

Clicking on this will redraw the picture being the view from the side (ie. from west looking east) of your job - useful to check that heads and ranges line up.

'View' - 'Save picture for PAINT program'

Click on this option to save a BMP file of the name indicated of the whole picture (pipes and any text) for reading into PAINT or your WP program for printing out.

'View' - 'Isometrics 1 to 4'

Clicking on this will redraw the picture of your scheme as viewed from (1) the bottom left hand corner (2) from the bottom right hand corner (3) from the top left hand corner and (4) from the top right hand corner.

'Help'

This option will display this manual

'Text item box'

To the right of the 'help' option, there is a box with 'No text' given and just the pipes shown on the drawing. Just click on the 'arrow' to see a list of the other options such as 'node numbers', 'pipe size', 'pipe length' etc. that can be shown next to the pipes or heads on the drawing. Some items, such as 'flow rate' or 'pressure' can only be viewed once the calculations have been done. The text shown varies with the option selected under 'interactive edit' but you can change the option at any time. You may prefer to 'zoom in' to see the items and pipes better.

ERROR MESSAGES IN CHECKING PART

[Error 1] Start node is the same as the first pipe

The start node of the network must be unique and cannot be used again in the system. Choose another node number.

[Error 2] Start node is incorrect

Node numbers must be in the range of 1 to 9999 so this one must be corrected.

[Error 3] End node is incorrect

Node numbers must be in the range of 1 to 9999 so this one must be corrected.

[Error 4] The start and end node numbers are the same

You must use different start and end node numbers to describe a pipe otherwise it doesn't go anywhere.

[Error 5] The start node of XXX has not been given

This pipe could be out of sequence or a previous end node is incorrect as the start node given cannot pick up from a previously specified end node number.

[Error 6] Direction code of ABC has not been recognised

The directions can only be from the list shown so if you enter ABC then the program doesn't know what you mean and will substitute N for north.

[Error 7] Pipe type specified as XXX

The pipe type number is not applicable to the FHCDATA or FHCADDED data files and so 1 has been substituted.

[Error 8] Pipe size of XXX mm is not available

The pipe size in mm given does not match the pipe type specified, perhaps either the size or type is incorrect, so the program will select the nearest valid pipe size.

[Error 9] Pipes do not properly connect

The end node of this pipe has been used before in the list and so the program has connected them together but the length, direction and slope do not agree with what you have specified for this second pipe. Perhaps just the wrong measurements, wrong end node here or a previous pipe connecting to the first occurrence of the end node is in error.

[Error 10] Head code given as XXX

The head code has not been recognised - wrong code or you haven't added it yet.

[Error 11] Area given as XXX

The area of coverage for this head code cannot be greater than 21 sq.m and is normally less than 9 or 12 - however the value specified will be used.

[Error 12] Head code XXX has a 'k' factor of YYY

The 'k' factor for this head code may be incorrect or give rise to very high flow rates unless being used for a fog/mist system.

[Error 13] Duplicate head node of XXX

It would appear that you have given a head code at the ends of the two pipes quoted that join at the end node so having two heads at the same point.

[Error 14] Upstream pipe size is smaller than this pipe

The pipe quoted is supplied from a previously specified pipe that has a smaller pipe size - normally not permitted but you could have incorrectly noded up a gridded system to give such a message, which can thus be ignored.

[Error 15] Invalid tee fitting

The program has checked that the direction and/or slopes of the two or three pipes joining together at the tee at the end of the first pipe quoted match up and will give this message if they don't. For example if one pipe is North at 6 deg and the next pipe is N at 12 deg then that is not acceptable. Likewise if the second pipe was S at 30 deg then that is really strange! The program will continue with such a pipework arrangement but if one or the other pipe is wrong then perhaps you ought to change it before starting the calculations - see -FC in Q12 to ignore.

[Error 16] Pipe is duplicated

You have two occurrences of the same set of start and end nodes so one of the pipes should be deleted otherwise there will be zero flow in the other one.

You can click on 'OK' to continue, 'Print' if a hard copy of the message is required or 'Cancel' to go back to the 'Edit' part to correct the data and recheck.
In nearly all the above cases, the program will change the item that has caused the problem to a more acceptable value. However this may not be right of course and cause further spurious error messages to be given. For example, it could be that a previous pipe node number, size, length or direction is wrong but the error can only be picked up when that node is reused and so raise a warning message, which it will try to correct but doesn't 'know' what is wrong with the first pipe!

The following messages may be given in the check of the FHCDATA or FHCADDED data files :-

[Error 20] First line of file is wrong

The file appears corrupt as it should be 3 numbers separated by spaces (don't count the date/time).
[Error 21] Sequence number does not match pipe type number

You have added or deleted a pipe type and not changed the sequence number.

[Error 22] Hazen Williams 'C' factor is XXX

The 'C' factor quoted may not be right - normally in the range of 100 to 150.

[Error 23] Correction factor is XXX

The correction factor for the Hazen Williams 'C' factor does not match - normally in the range of 0.7 to 1.5.

[Error 24] Nominal sizes line = XXX

There are only 3 lines of nominal sizes lines permitted and the number entered is not 1, 2 or 3.

[Error 25] The abbreviated reference is XXX

The number of characters permitted here is 2 or 3 and you have more or less.

[Error 26] Nominal pipe sizes line

These sizes must be quoted in ascending order and the one identified is out of sequence and needs changing.

[Error 27] Actual internal bore = XXX

The actual internal diameter quoted for this pipe type and nominal pipe size in mm does not match eg. 32mm pipe given as 65.77mm diameter. The ratio is 0.7 to 1.3 so you can leave it if right but will always get this same error message.

[Error 28] Valve reference is XXX

This reference must be 2 characters long for the printout.
[Error 29] Valve equivalent length is XXX

The equivalent length for the size / type of valve is over 100m.

Normally you won't see any of these error messages unless you change the FHCADDED.TXT data file incorrectly so the format of this and the FHCDATA.TXT file is given now.

3. Tutorial, getting started with FHC

The FHC program is for the hydraulics analysis of water based fire protection systems including sprinklers, deluge, water mist and more… This is a short tutorial is design to help you in learning some of the basic concepts. If you are using the Evaluation copy of the program we trust that these notes will assist your technical review and evaluation of this innovative software package.

They are quite long so if you are not too familiar with using Windows computers, you may want to click on the 'Printout' button below to have these notes on paper so that you can work though the various options and tasks that FHC can assist in the full hydraulic calculation of sprinkler and water spray systems.

This special 'evaluation' version of FHC permits you to examine the various examples supplied, and to add to or amend these as you choose, to calculate and print them out but the pipe sizes might not be as entered and the word 'Demonstration' will be given on the results printouts. However, don't be alarmed if the source duties quoted by the program appear too high or too low - the full FHC program will calculate your systems correctly and your name and address will be given on all the screens. For further information, click on the 'Printout Order Form' below or from the 'Options' menu given on the next screen. Once you click on 'OK' here, the main picture screen of FHC will be displayed, initially blank but containing the menus described below :-

'File' - to enter a 'New' project, 'Open' an existing data file or ***'Quickest'*** for the grid estimate part as described later or to 'Exit' from the program when complete. If you come back to this menu after a job has been read in or entered, some additional options of 'Last' to open the last file amended, 'Save' to update the current file, 'Save As' to copy the file to another name or place and 'Printout' to get a quick confirmation of the data entered so far for records.

'Edit' - will be blank to start with but then used to add to or amend the project, water supply, design area, head codes and nodes/pipes information.

'Drawing' - again blank to begin as there isn't a picture yet on the screen but will allow you to 'Add' a new pipe, 'Break' an existing pipe in two, 'Delete' one or more pipes from your network, 'Edit' the details on any selected pipe, two 'Global' change options that I will describe later, to 'Renumber' or 'Resequence' the node numbers used to identify your pipes and finally, to 'View' the input data (and calculated results when done) on any pipe that you 'click' on.

'Calculate' - just click here and select the 3rd option when valid to check over and begin the hydraulic calculations for all the pipes and heads / nozzles on your project. A 'dialog' box will be given in the centre of the screen quoting the current check limits on velocity and pressure drop so just click on 'OK' to proceed - see descriptions later.

'Results' - menu will only be active after the 'sums' have been done and it allows you to view the 'Heads' summary, a similar one for 'Pipes' and the 'Check' and 'Calculate' summaries which give comprehensive statistics on your system. The 3D DXF file is not available in this demonstration version.

The **'Printout'** menu can be used, again after the calculations are complete to obtain the full results presentation.

'View' will allow alternative views and displays of all or part of your pipework system - plans, elevations and 4 isometrics from each corner of your building and can switch on or off the display of the pipe sizes as different colours or the node numbers at the pipe ends.

Various **'Options'** are supplied for 'housekeeping' duties and not of much relevance to your current use.

'Help' gives most of the supplied user manual on the screen with various search options so you can refer to the associated part if you have a problem.

TO BEGIN USING FHC

1) Click on 'OK' below.

2) When the full blank picture screen is given, you may either click on the 'two boxes' symbol on the top right to adjust the screen size with your mouse (not too small though!) or leave it full screen.

3) Click on **'File'** at the top left and then on **'Open'**.

4) Select and open the 'examples' folder, you will find a number of 'test' files in it which you may like to examine. However for now select the **'LPCGRID'** and press the open button'.

5) After a few seconds (depending on the speed of your computer), the plan of the small gridded sprinkler system (page 114 of the LPC Rules) will be shown and some of the menu displays on the top line will now become available.

6) Click on **'View'** and then on **'Front elevation'** to see the roof arrangement of pipework.

7) Click on **'View'** again but this time select one of the 4 isometric views to see the pipework from that direction. This is one of the main features of FHC - you can 'see' directly what your system looks like as a 3D drawing, not as a collection of node numbers, sizes, lengths etc.

8) Try out all the 'View's and can select other 'text' items with the box on the top right of the screen - they might be a bit cramped on the full view though - so click on **'View'** and **'Zoom'** to get the display to switch to a plan view, position your mouse somewhere about the bottom left hand corner of the array of sprinkler heads, hold its button down and slide the mouse over to the top right of the group of heads, drawing out a red square / rectangle and then release the mouse button.
9) A higher scale plan of just what you have selected will be drawn with 8 **'pan'** buttons at the 4 corners / edges of your screen. You can 'click' on any of these to move the view in that direction at the same scale or click on 'View' again and then one of the isometric views to see the 3D co-ordinates of the pipework all lining up. Perhaps switching on the node numbers now will show them better than before.

10) Move your mouse over the centre of one of the pipes and 'click' its button - a separate display will be given on the top left of your screen (which can be moved by clicking on its blue title and sliding the mouse and outline to another position on the display). Here the details about that pipe will be given so click on the 'scroll bars' to see more information or any of the 4 buttons to see the 'Previous', 'Upstream', 'Next' pipes and note that the yellow line and data display will move accordingly or 'Return to drawing' will do just that.

11) Now click on **'Edit'** on the top left and wait until the 5 page dialog box is given - clicking on the first 3 tabs **'Project'**, **'Water supply'** and **'Design Area'** will show you the way those essential items are entered (there is no need to change any of them now). The 'Head codes' part shows the way that different head / nozzle sizes are entered for subsequent selection.

12) When finished, click on **'Apply'** or **'Cancel'** (or the 'Print Input data' one if you want) to return to the picture display.

13) Click on **'Calculate'** and 'All heads given to be operating' to get a dialog box in the centre of the screen showing the current minimum / maximum velocities and maximum pressure drop per pipe values and two buttons labelled **'OK'** and **'Cancel'**.

14) Click on **'OK'** and another display will come up *(only in this evaluation version showing what pipes have been changed in size)*. Click on **'OK'** to clear this dialog box.

15) Depending on the speed of your computer, you may see a *'One moment please...'* message and then one or more displays quoting the pipes over the maximum water velocities and pressure drops so defined in step 13 - click on 'OK' *(or press the 'Enter' key)* to continue.

16) The **'Calculations Summary'** is then given and it is worth spending a few seconds reviewing the display *(clicking the mouse on the scroll bars or pressing **'PgDn'** or **'PgUp'** keys to see more of it)* before pressing **'OK'** to clear it or 'Print' if you want a hard copy. Don't worry if the source duty appears very high or low - remember the program varied some of your pipe sizes so some of these might have been critical. At least it shows that my program can cope with vastly unbalanced pipework systems.

17) Now the two menu options **'Results'** and **'Printout'** will be available and if you click on one of the pipes, you will see its input data as well as the calculated flows, pressures etc. as seen in step 10 or you can click on any of the 'View' options, even zooming in if needed, to see the 4 most remotest heads shown in red on the screen. Any pipes shown in red are beyond your specified velocity / pressure drop limits.

18) Click on **'Results'** and then **'Heads Summary'** - the data and calculated values for all your heads will be shown under various headings - try *'clicking'* on some of these to see the minimum / maximum values sorted into order and I don't expect to tell you now how to see more items with the scroll bars. Click on 'OK' when satisfied that this information will be of considerable interest to you on your real projects.

19) Click on **'Results'** and **'Pipes Summary'** this time to get a similar display but for all the pipes on this job - again clicking on the headings will sort that column into ascending order - click on 'OK' when done.

20) You can either click on the remaining options in the **'Results'** menu or click on **'Printout'**. A new dialog box will be given with its description in the yellow box. Now ensure your printer is connected, is *'on'* and has some paper in it and click on **'Start'** or **'Cancel'** if you don't want to do this task now. Your printer should start up and depending on its speed and memory, 7 pages should be generated being the full results presentation for this project.

21) You may have to wait just a few seconds until this finishes but a display needs clicking on *(or pressing 'Enter')* to see your drawing again. If you are using the Evaluation copy of FHC the word *'demonstration'* will be printed on each page of the report

22) Perhaps you want to see some of the **'Drawing'** options in action or are limited in time and so just to go back to step 3 and select one of the other test jobs and repeat some or most of the steps 4 to

21) again or 'Exit' the program.

23) Assuming the ***LPCGRID*** job is on the screen, select a **'Plan'** view and then from the **'Drawing'** menu choose **'Edit'**.

24) Move your mouse onto the centre of one of the range pipes and click its button. A large dialog box will be given confirming the start / end node numbers of your selected pipe and all its information, some items will be zero or blank if not applicable. I assume you are familiar with 'combo' and 'list' boxes (if not just try clicking on the various boxes and buttons on their right hand sides - it doesn't matter if you inadvertently change something you don't mean to at this stage - just click on 'Cancel' to reshow your picture) so try changing the pipe size or type - it is best not to vary the length or direction unless you want to see what assorted messages you get when you put in some obviously 'wrong' information on the drawing. You can always click on 'File' and 'Open' the same file again and decline the offer to save the data that has changed.

25) Click on 'Apply' to redo the checking and screen display or 'Cancel' if nothing altered and then click on 'Drawing' again but this time, select 'Delete' if feeling adventurous. Again move the mouse to a suitable mains or range pipe and click. The pipes that this pipe supplies will be shown in red and a dialog box telling you how many pipes are affected - click on 'No' - don't delete for now unless you really want to erase those pipes / heads and try calculating again!

25) Click on 'Drawing' and then 'Global' changes to see a multipage box - try clicking on the various tabs and options if you want to make some general changes to your job and then 'Cancel' when complete.

26) The next option on the 'Drawing' menu just brings up the same dialog box as above but you need to have selected the pipes / heads in plan view, just like zooming in (see step 8). There is no reason to vary

the information but no harm will come if you make any changes to the data - if you turn off all the sprinkler heads the program will just tell you so and refuse to do any calculations until some heads are added.

27) If you want to renumber an existing node number, select the 'Drawing' menu option and then 'Renumber'. Point to the pipe end that you want to select and press the mouse button - a small box with its yellow help message will be shown. Either type in a new number in the range of 1 to 9999 (or just to be crafty, put in one you know already exists like 100) and click on 'OK' or on 'Cancel' to get back to your picture.

28) The next option on the 'Drawing' menu is called 'Resequence' and allows you to renumber the whole system, say starting at 100 in steps of 10 (or from 456 in steps of 43 if you want or even 9754 down in steps of -76!) if many changes have been made.

29) We haven't covered the 'Add a pipe' and 'Break a pipe in two' options from the 'Drawing' menu because this gridded system is complete but these two are used extensively to repeatedly add pipes / heads to your system as you create it or to insert a new node number somewhere along an existing pipe where one or more new pipes are needed.

30) Naturally I could go on and on now about what FHC can do and give the exact commands for reviewing, adding, amending and deleting pipes to form your complete design area but hopefully now you will have grasped some of the features and procedures in my program.

31) The key to FHC is the visual feedback you get from each addition or change to your system that you make. If you have a pipe going North with a head and the end and then connect another pipe going vertically or to the East, South or West then the program will generate a warning message as you cannot get such a fitting. If you change a pipe type from MW to HW then the drawing will get redrawn but will look exactly the same as no variation as taken place to the x, y and z co-ordinates.

32) The only drawback to such a visual system is that some extra pipes may be needed over the previous SPRINKLE / SPRAY programs (or others offered by different suppliers) ie. for a gridded range, FHC will need a minimum of 4 pipes (from main to elbow, then to roof apex, then to elbow on other side before connecting to the other main) whereas this could have been called one pipe in these other programs (but did you get the actual pipe lengths right? One never knew because these programs had no way of checking that the lengths and fittings were correct).

33) Entering the horizontal pipe length and direction / slope for FHC is usually far easier than calculating the actual sloping length and static change and then possibly typing in the wrong values and spending ages trying to get rid of 0.1m static error in the loops. By the way, FHC doesn't need these either as well as working out where the elbows and tees are!

4. Instructions for installing the FHC program from the CD.

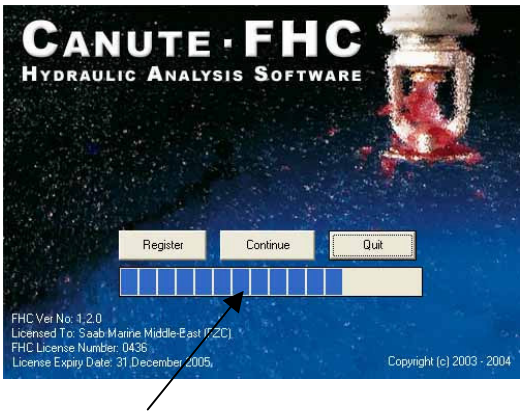
1. If you have an existing version of FHC on your computer you should backup any FHC project files and Pipe data files, which you have created or modified. The old FHC program should then be uninstalled.
2. Close down all other application before attempting to install the FHC program.
3. Insert the FHC install CD into the computers CD drive
4. The CD should automatically start to run and you will see the installation wizard start to load. If this does not happen you will have to use the Windows explorer (+ e) and locate the CD drive and find the file called 'start.exe'.
5. Once the install wizard has finished loading you will see the 'Welcome page' press the *Next* button to continue.
6. The next screen displays Canute LLP Licence agreement for the FHC program. You must read this agreement and then select the *'YES – I Accept the terms of the License Agreement' (only if you accept the agreement)* before you can press the *Next* button.
7. The next screen asks for some user information this must be entered before you can continue.
8. The next screen will set up 'short cuts' on to the Desktop and Start menu.

9. The confirm set-up settings page allows you to review your options before you start to copy the FHC program to your computer. If you wish you can use the 'Back' button to change any of the option or the 'Cancel' button to stop the installation wizard. If you are happy with settings press the 'Next' button to START the installation of the FHC program.

5. Registering the FHC program

You can use the FHC program for up to 7 days or a maximum of 30 times, after this time if you have not completed the registration process the FHC program will not run.

When you first start the FHC program you will see a screen as below, you now have three options 'Register', 'Continue' or 'Quit'

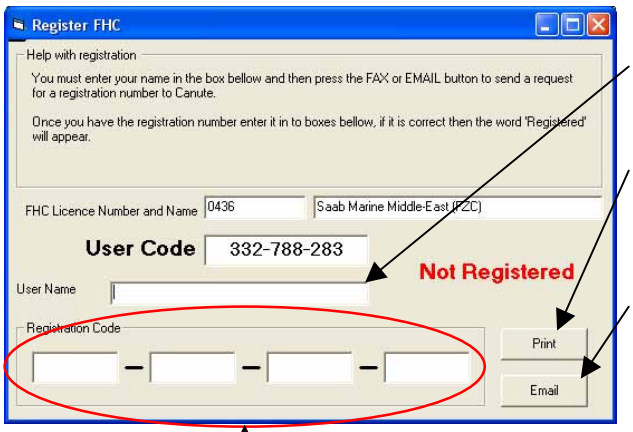


The 'Quit' button will stop the FHC program and return you to the windows desktop.

If you press the 'Continue' button the FHC program will start and you will be able to use it as normal except you will not be able to printout any report.

The 'Register' button will open the 'Registration' form as below:

The progress bar will give you an indication of how much time you have left to register.



You must now enter **Your Name** into the user name box

You can now press the 'Print' button to print out a registration form to fax to us.

Or if you have an email client installed on your computer you can press the 'email' button to automatically send an email to us. Please einsure that the email has been sent by checking your outbox and sent email items.

Enter your 16-digit code into the 4 boxes above

You can now continue to use the FHC program by pressing the 'Continue' button on the splash screen.

When you receive the 16-digit registration code from us you must open the 'Register' form by pressing the button on the splash screen. You must then enter the code into the 4 boxes, FHC will confirm if your registration was successful or not.

This systems of registration is for version 1.2.0 and above, if you do not have this version of the FHC program you must update.

6. Appendix A: Format of Pipe Data Table Files [PDT]

The pipe type data file contains information about the number of pipes, pipe sizes (both OD and ID), pipe fittings and other information required by the FHC program. You should not modify this file unless you are absolutely sure that you know what you are doing.

Line 1 Time and Date (hh:mm, dd mmm yyyy)

Line 2 Number of pipe types (maximum = 30), number of sizes (max=20), number of fittings and valve types (max=20). Example 17,13,9

Pipe Type Each pipe type will now have one line with the following information with each entry separated by a comma.

Code Number (1 to maximum)
Hazen Willams 'C' factor
Multiplier for fitting equivalent lengths
Roughness in mm (Used for water mist systems NFPA 750)
Sizing Line for OD of pipes (1, 2, or 3 only)
Short Code (2 or 3 characters only)
Description of pipe (maximum of 50 characters and no commas)

Example:
1,120,1.000,0.0460,1,MW ,Medium weight steel pipe to BS1387 [1]

Next 3 lines Nominal pipe diameters (OD) in mm separated by commas to correspond to the Sizing Line entered in ***Pipe Type*** above. This information is the pipes size, which is displayed in the FHC program.

Example:
20 ,25 ,32 ,40 ,50 ,65 ,80 ,100 ,125 ,150 ,200 ,250 ,300

Pipe Type Data For each ***Pipe Type*** list the internal diameters (ID) in mm that must line up with the nominal pipe (OD) above, each entry to be separated by commas.

Example:
21.63,27.31,35.97,41.86,52.98,68.67,80.68,105.14,0.00,155.32,208.30,0.00,0.00

Fittings and Valves

Fitting Type Each fitting type will now have one line with the following information with each entry separated by a comma.

Short Code (2 characters only)
Description of fitting (maximum of 50 characters and no commas)

Example:
ST,Screwed tee or cross with flow through branch

However the first four lines have significance and must corresponded to the fittings listed bellow:

1. 90 Deg elbow
2. 90 deg welded elbow
3. 45 deg elbow
4. Tee with flow through branch

Even if you do not have one of the fittings list you must included the line. This is necessary as the FHC program automatically allocates the pipe fitting when you draw it on the screen and uses this information to find the equivalent length.

After the four mandatory fittings you can list any other fittings and valves you wish up to a maximum of 20 including the four above.

Each Fitting

List of equivalent length in m separated by a comma of each Fitting Type of each nominal pipe size used. This data is normal taken from the BS5306 part 2, EN12845 or NFPA 13

Once all the Fitting types have been entered in metric you must then list the equivalent length in feet separated by commas. This set of data is normal taken from NFPA 13 and will by used when you design an installation to NFPA or FM requirements.

File Name

Once you have entered all the information into the PDT file you should save it into the FHC folder (normally C:\FHC\PipeData) using a descriptive file name and a three letter file extension PDT.

Example: mypipe.pdt

Example of a Pipe Data Table file

```
10:09,19 Dec 2003
17,13,9
 1,120,1.000,0.0460,1,MW ,Medium weight steel pipe to BS1387            [ 1]
 2,120,1.000,0.0460,1,HW ,Heavy weight steel pipe to BS1387             [ 2]
 3,120,1.000,0.0150,1,GMW,Galvanised medium weight steel pipe to BS1387  [ 3]
 4,120,1.000,0.0150,1,GHW,Galvanised heavy weight steel pipe to BS1387   [ 4]
 5,120,1.000,0.0460,1,HWS,Heavy weight steel pipe to BS3600              [ 5]
 6,100,0.714,0.0200,1,CIF,Cast iron flanged pipe to BS2035 Class C       [ 6]
 7,100,0.714,0.0200,1,CGI,Cast grey iron flanged pipe to BS4622          [ 7]
 8,110,0.850,0.0200,1,CDI,Centrifugally cast ductile iron pipe to BS4772 [ 8]
 9,100,0.714,0.0200,1,CCI,Centrifugally cast iron pipe to BS1211 Class C [ 9]
10,140,1.330,0.0015,1,PVC,UPVC pipe to BS3506 Class E                   [10]
11,150,1.490,0.0015,2,CUN,90/10 Cu Ni pipework                          [11]
12,140,1.330,0.1500,1,CEM,Cement lined pipework                         [12]
13,120,1.000,0.0460,1,S40,A.P.I. 5L Schedule 40 pipe                    [13]
14,120,1.000,0.0460,1,S80,A.P.I. 5L Schedule 80 pipe                    [14]
15,150,1.490,0.0015,1,BM ,Blazemaster PVC pipe                          [15]
16,150,1.490,0.0015,3,HPE,Polyethylene SDR 11                           [16]
17,150,1.490,0.0015,3,HPE,Polyethylene SDR 17.6                         [17]
20  ,25  ,32  ,40  ,50  ,65  ,80  ,100  ,125  ,150  ,200  ,250  ,300
25  ,30  ,38  ,44  ,57  ,76  ,89  ,108  ,000  ,000  ,000  ,000  ,000
000  ,000  ,000  ,000  ,000  ,000  ,90  ,110  ,125  ,180  ,225  ,250  ,315  ,355
21.63,27.31,35.97,41.86,52.98,68.67,80.68,105.14,  0.00,155.32,208.30,  0.00,  0.00
20.41,25.68,34.34,40.23,51.36,67.04,79.06,103.31,  0.00,154.30,208.30,  0.00,  0.00
21.46,27.14,35.80,41.69,52.81,68.50,80.51,104.97,  0.00,155.15,206.10,  0.00,  0.00
20.24,25.51,34.17,40.16,51.19,66.87,78.89,103.14,  0.00,154.13,204.00,  0.00,  0.00
 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,  0.00,  0.00,158.30,208.30,258.80,  0.00
 0.00, 0.00, 0.00, 0.00,51.95, 0.00,77.41,102.87,  0.00,153.96,205.01,256.00,  0.00
 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,81.23,100.45,  0.00,150.50,200.55,250.60,  0.00
 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,83.31,103.91,  0.00,154.68,205.23,256.03,311.60
 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,81.90,107.33,  0.00,159.73,211.62,263.49,  0.00
 0.00,28.60,36.30,41.40,51.90, 0.00,76.60, 98.60,  0.00,144.90,192.00,239.20,283.50
21.00,26.00,34.00,40.50,53.00,71.10,82.90,102.00,  0.00,  0.00,  0.00,  0.00,  0.00
 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,100.00,  0.00,150.00,200.00,250.00,300.00
 0.00,26.64,35.08,40.94,52.48,62.68,77.92,102.26,  0.00,154.08,202.74,254.56,  0.00
 0.00,24.30,32.50,38.14,49.22,58.98,73.66, 97.18,  0.00,146.36,  0.00,  0.00,  0.00
 0.00,27.97,35.41,40.59,50.88,61.54,74.93,  0.00,  0.00,  0.00,  0.00,  0.00,  0.00
 0.00, 0.00, 0.00, 0.00, 0.00,73.60,90.00,101.20,145.90,182.40,202.75,255.55,288.10
 0.00, 0.00, 0.00, 0.00, 0.00,79.80,97.40,110.80,159.60,199.40,221.60,279.20,314.80
SE,90 deg screwed elbow
WE,90 deg welded elbow
45,45 deg screwed elbow
ST,Screwed tee or cross with flow through branch
GV,Gate valve - Straightway
SV,Alarm or non-return valve (Swinging)
MV,Alarm or non-return valve (Mushroom)
BV,Butterfly valve
GL,Globe valve - Straightway
 0.63, 0.77, 1.04, 1.22, 1.46, 1.89, 2.37,  3.04,  0.00,  4.30,  5.67,  7.42,  0.00
 0.30, 0.36, 0.49, 0.56, 0.69, 0.88, 1.10,  1.43,  0.00,  2.00,  2.64,  3.35,  0.00
 0.34, 0.40, 0.55, 0.66, 0.76, 1.02, 1.27,  1.61,  0.00,  2.30,  3.05,  3.89,  0.00
 1.25, 1.54, 2.13, 2.44, 2.91, 3.81, 4.75,  6.10,  0.00,  8.61, 11.34, 14.85,  0.00
 0.00, 0.00, 0.00, 0.00, 0.38, 0.51, 0.63,  0.81,  0.00,  1.13,  1.50,  1.97,  0.00
 0.00, 0.00, 0.00, 0.00, 2.42, 3.18, 3.94,  5.07,  0.00,  7.17,  9.40, 12.30,  0.00
 0.00, 0.00, 0.00, 0.00,12.08,18.91,19.71, 25.36,  0.00, 35.88, 47.27, 61.85,  0.00
 0.00, 0.00, 0.00, 0.00, 2.19, 2.86, 3.55,  4.56,  0.00,  6.38,  8.62,  9.90,  0.00
 0.00, 0.00, 0.00, 0.00,16.43,21.64,26.80, 34.48,  0.00, 48.79, 64.29, 84.11,  0.00
   2,   2,   3,   4,   5,   6,   7,   10,   12,   14,   18,   22,   27
   1,   2,   2,   2,   3,   4,   5,    6,    8,    9,   13,   16,   18
   1,   1,   1,   2,   2,   3,   3,    4,    5,    7,    9,   11,   13
   4,   5,   6,   8,  10,  12,  15,   20,   25,   30,   35,   50,   60
   0,   0,   0,   0,   1,   1,   1,    2,    2,    3,    4,    5,    6
   0,   5,   7,   9,  11,  14,  16,   22,   27,   32,   45,   55,   65
   0,   5,   7,   9,  11,  14,  16,   22,   27,   32,   45,   55,   65
   0,   0,   0,   0,   6,   7,  10,   12,    9,   10,   12,   19,   21
   0,   5,   7,   9,  11,  14,  16,   22,   27,   32,   45,   55,   65
Pipe data provided by Canute LLP
```

7. Appendix B - FHC Shortcut Keys

Shortcut	Description
F1	Help
F2	Plan of system
F3	Front elevation
F4	Side elevation
F5	South West
F6	South East
F7	North West
F8	North East
F9	Calculate – Select Individual Heads
F11	Calculate – Select Group of heads
F12	Calculate All Heads or Calculate Selection
Ctrl + F1	Project Manger
Ctrl + A	Add pipe
Ctrl + B	Break pipe
Ctrl + C	Copy by Node number
Ctrl + D	Delete pipe
Ctrl + E	Pipe Edit
Ctrl + F	Find Node
Ctrl + M	Move pipe
Ctrl + N	New – FHC Project
Ctrl + O	Open – FHC Project
Ctrl + P	Project Data
Ctrl + R	Renumber Node
Ctrl + S	Save – FHC Project
Ctrl + U	Undo
Ctrl + V	View Details on a pipe
Ctrl + Y	Copy by selection
Ctrl + Z	Zoom – All pipes

8. Canute LLP - Licence Agreement

Canute LLP - Licence Agreement
For the
FHC, dated 1st December 2003

1 INTRODUCTION

NOTICE: THE FOLLOWING IS A LEGAL AGREEMENT. PLEASE READ IT CAREFULLY. INSTALLATION OR USE OF THE SOFTWARE PROVIDED WITH THIS AGREEMENT (THE "SOFTWARE") CONSTITUTES ACCEPTANCE OF THE TERMS OF THIS AGREEMENT. IF YOU DO NOT AGREE WITH ALL OF THE TERMS AND CONDITIONS OF THIS AGREEMENT, YOU MUST (i) IMMEDIATELY CEASE USING THE SOFTWARE, (ii) DESTROY ALL COPIES OF THE SAME, INCLUDING ANY COPIES STORED ON YOUR HARD DRIVE AND ANY ARCHIVAL COPIES, AND (iii) FOLLOW THE PROCEDURES ESTABLISHED BY THE MANUFACTER.

LICENSE GRANT. Canute Limited Liability Partnership ("Canute") grants you a non-exclusive, non-transferable right and license to use the Software as follows:

2 LICENCE

2.1 Specific conditions of use which apply to the type of licence you have acquired from Canute Software are:

2.1.1 **Evaluation Licence:** You may use the Software within your organisation to access whether it meets your needs for a period of up to 14 days from its supply to you. At the end of this period, if you do not purchase another licence from Canute you must destroy all copies of the Software supplied to you, including copies installed on any computer, and all related documentation.

2.1.2 **End-User PC Licence:**
(a) With a single End-User PC Licence you may install and use one copy of the Software on a single computer. You may not share the licence between different computers, nor install it on a server based computer, nor use the Software on more than one computer at the same time. As a special exception, the primary user of the Software may make a second copy for his or her exclusive use on either a home or portable computer, but only one copy can be used at any time.

(b) In addition to the above, if you have bought a licence for a number of concurrent users you may install the Software on any number of computers at one single physical (geographical) location notified to Canute provided it is used on no more computers than that number of licensed users at any one time.

2.1.3 **Site Licence:** You may install and use the Software on any number of computers located at the single physical (geographical) location notified to and agreed by Canute.

2.1.4 **Corporate Licence:** You may install and use the software on any number of computers at a number of physical (geographical) locations notified to and agreed by Canute.

2.2 You are granted the right to use the software for 12 months from the date of purchase after that date you must pay the annual licence fee, which will entitle you to use the software for an additional 12-month period.

2.3 Canute reserves the right to increase the annual licence fee annually.

3 RESTRICTIONS ON USE

3.1.1 You may make a reasonable number of copies of the Software solely for backup and recovery purposes. Any such copies shall in all respects be subject to the terms and conditions of this Agreement.

3.1.2 You shall not make copies of the Software additional to those expressly permitted in this Licence Agreement.

3.1.3 You shall not copy any written documentation accompanying the Software.

3.1.4 You shall not remove or obscure any copyright and trademark notices or other proprietary notices relating to the Software. All notices must be duplicated as it appears on the Software on all authorised copies.

3.1.5 You shall not alter, modify, reverse engineer, decompile, disassemble or create derivative works based on the Software.

3.1.6 You may not sale, assigned, distributed, transfer or sublicense the software to any other person.

3.1.7 You shall not use the Software in any way other than in a manner specifically licensed under this Agreement.

3.1.8 You shall not display the Software on a public bulletin board, website, chat room or by any other unauthorised means.

4 INTELLECTUAL PROPERTY RIGHTS

The copyright, patents, trade marks and all other intellectual property rights in the Software and related documentation are owned by and remain the property of Canute or its suppliers and are protected by national laws and international treaty provisions. You do not obtain any rights in the Software other than those expressly granted in this Agreement.

5 TERMINATION

This Agreement is effective until terminated. This Agreement will terminate automatically if you fail to comply with any provision of this Agreement. Upon notice of termination from Canute you shall destroy the documentation and all copies of the Software promptly.

6 UPDATE POLICY

Canute may create, from time to time, updated versions of the Software. Canute will make any such updated versions available to licensees who have paid the update fee. If you acquire an updated version of the Software then all copies of the previous version must be destroyed and not used, except for one copy, which may be retained solely for archival purposes.

7 WARRANTY

7.1 Subject to the limitations upon its liability set out in clause 8, Canute warrants that:

7.1.1 for a period of 90 days from you purchasing the Software, it will materially conform to the electronic documentation provided with it; and

7.1.2 with respect to any physical diskette(s), the same shall be free from defects in materials and workmanship for a period of 90 days from purchase.

7.2 In the event of notification within the warranty period stated in clause 7.1, Canute shall replace the defective Software and/or diskette(s). Your remedy for breach of the warranties set out in clause 7.1 shall be limited to replacement of the defective materials and shall not encompass any other damages.

7.3 Save as stated herein, Canute expressly disclaims all other conditions, warranties, terms and undertakings, expressed or implied, statutory or otherwise, relating to the Software and related documentation or technical support including but not limited to warranties of quality, performance, satisfactory quality or fitness for a particular purpose.

8 LIMITATION OF LIABILITY

8.1 Nothing in this Agreement shall limit Canute liability for:

8.1.1 fraud or other criminal act;

8.1.2 personal injury or death caused by our negligence;

8.1.3 any other liability that cannot be excluded by law.

8.2 Subject to clause 8.1, Canute accepts no liability for any indirect or consequential loss or damage, or for any loss of data, profit, revenue, anticipated savings or business, however caused and even if foreseeable or made known to Canute.

8.3 Except as provided in clause 8.1, Canute maximum liability to you for any cause whatsoever will be limited to the amount paid for the Software.

9 SEVERABILITY

If a Court or other competent authority decides that any provision of this Agreement is void or otherwise ineffective in whole or in part then any other part and the other terms and conditions of this Agreement shall continue in full force and effect.

10 THIRD PARTY RIGHTS

The parties do not intend that any term of this Agreement shall be enforceable solely by virtue of the Contracts (Rights of Third Parties) Act 1999 by any person who is not a party to this Agreement.

11 ENTIRE AGREEMENT

This Agreement constitutes the entire agreement between the parties with respect to the subject matter of this Agreement and supersedes all previous agreements, arrangements or undertakings between the parties relating to the subject matter of this Agreement and any representations or warranties previously given or made to it.

12 ASSIGNMENT

You may not assign this Agreement nor any of its rights or obligations hereunder nor sub-license the use (in whole or in part) of the Software without Canute prior consent.

13 NOTICES

13.1 All notices shall be given:

13.1.1 to Canute LLP by post to Seventy Seven, Holbeck Lane, Leeds, LS11 6UL or email info@canutesoft.com;
13.1.2 to you at either the e-mail or postal address you provide during any ordering process.

13.2 Notice will be deemed received when an e-mail is received in full (or else on the next business

day if it is received on a weekend or a public holiday in the place of receipt) or 3 days after the date of posting.

14 GOVERNING LAW

This Agreement is governed by and interpreted in accordance with English law. Any disputes or claims relating to this Agreement shall be subject to the exclusive jurisdiction of the English Courts.