SPIRAL MODULE

OPERATING MANUAL

Model K 8LM5/2

(Frame in 2 parts)

Two Identical Modules supplied designated ‘F’ and ‘G’

Supplied Oct 14

8LM5/2 Feed Distributor

8LM5/2 Stool

8LM5/2 Stool fixing U-bolts

8LM5/2 Product Piping

SP 1,2,3,4 Sand

SP 5,6,7,8 Sand

SP 1,2,3,4 Mids

SP 5,6,7,8 Mids

SP 1,2,3,4 Heavies

SP 5,6,7,8 Heavies

8LM5/2 Spiral Module
Product Pipe markings

8LM5/2 Spiral Module
Feed Pipe markings

SWMS

SPIRAL MODULE OPERATING MANUAL
Model: 8LM5/2

CONTENTS

INTRODUCTION

This manual relates to the supply of two idendical modules of eight duplex Krebs-SWMS LM5 Series spirals (16 spiral starts in total).

The spirals are housed in a modular, type K, steel frame with a top fed static feed distributor mounted on a support stool above the spiral frame. The spirals are designed to produce three product streams i.e. Heavies, Middlings and Lights.

The separated products are conveyed by means of product collection pipes to their required discharge points.

The trial assembled module has been match marked prior to packing and considerable care must be taken when unpacking and assembling the module at site.

The LM5 designation refers to the basic concept used in the design of the spiral. They are primarily used for treating low-grade heavy mineral feed.

1.0 SPECIFICATION and TECHNICAL DESCRIPTION

1.1 Spiral Concentrators

The SWMS Model LM5/2, low-grade mineral spiral has been selected for this application.

The LM5 spiral has been designed primarily to treat pulp streams with a heavy mineral content of up to 25% by weight. The spiral is tolerant of changing feed conditions so few operational adjustments are necessary making it an ideal unit for most rougher, scavenger and retreat applications.

Starts:
The LM5 spiral is supplied in duplex configuration.(LM5/2)
Turns:
Each LM5 spiral trough has 5 turns beginning at the feed box and ending at the product box.
Feed Box:
A heavy duty cast polyurethane feed box is fitted to the trough by means of a bolted flange. The box is back fed with a tangential outlet to ensure maximum use of the spiral separating surface.
Product Box:
A heavy duty cast polyurethane box is attached to the spiral trough by means of a bolted flange. Two adjustable product cutters are located in the box to divide the stream into Heavies, Middlings and Lights fractions.

LM5 dimensions & information

Spiral outside diameter	650mm
Spiral centre column	88.9mm
Spiral pitch	406mm
Number of turns	5
Cutters on helix	none
Cutters in product boot	2

The spiral helix is constructed from GRP with a polyurethane wear surface. The latest reverse lamination technology is used in the manufacturing process.

1.2 Feed Distributor

The spiral module is supplied with the appropriate top fed static feed distributor to enable each spiral start to be fed evenly. The distributor is constructed from polyurethane lined GRP. The distributor consists of a primary feed well with an adjustable annular discharge to control the volumetric flow. The feed is allowed to drain from the feed well to the main tank of the distributor where a head builds up over the outlets. Each outlet is vented to atmosphere to null any siphon effects. The discharge from the outlets is controlled by venturi type orifice liners which enables fine-tuning of the feed distribution system.

Typically, a 25mm orifice liner requires 150mm of static head in the main tank to give a flow rate to each trough of approximately $4m^3/hr$. This combination of balanced steady head feed well and controlled discharge distribution tank results in a very precise division of flow.

Each outlet from the distributor is connected to one spiral start by 50mm OD polyethylene pipe using moulded polyurethane fittings. The piping system is supplied pre-cut and match marked for easy assembly.

1.3 Product Collection Piping

Products are collected from each of the outlets and drained to the appropriate discharge points by polyethylene pipes (with polyurethane fittings) suspended below the spiral bank.

Pipe diameters for the products are as follows:

Lights	75mm, 90mm OD, PE SDR11 pipe
Middlings	50mm, 63mm, 75mm OD PE, SDR11 pipe
Heavies	50mm, 63mm, 75mm OD PE, SDR11 pipe

The design results in an enclosed and splash-proof collection system.

1.4 Spiral Support Frame

The spirals are retained by a lightweight but sturdy welded steel frame manufactured from rectangular hollow section and various rolled steel profiles. The frames are shot blasted and flame spray galvanised before painting to ensure an extremely high level of corrosion resistance.

The type C, modular frame consists of two parts, P1and P2 each housing 4 duplex spirals. The parts are bolted together to form the completed module. The design allows the parts to be laid down horizontally, with the spirals packed inside, for shipping.

1.5 Trial Assembly

The module has been fully assembled and match marked prior to despatch from the works.

2.0 INSTALLATION OF SPIRAL MODULES

The spiral module is made up of the following items.

a. Spirals and spiral frame
b. Spiral Feed Distributor
c. Feed Distributor Support Stool
d. Spiral Feed Piping
e. Spiral Product Piping

Before installation begins the assembly should be unpacked and checked visually to ensure no damage has occurred in transit and the assembly is complete.

Once the spirals have been unpacked from the frame, the module can be reassembled. The frames should be returned to the upright position and securely bolted together paying close attention to the orientation markings, N. The spirals are then located according to the match marking and turned so that the outlets are positioned as shown on the base plan.

The frame complete with spirals can be placed in the desired final location and bolted down. The frame is designed so it can be safely lifted from the top corners with the spirals fitted.

The feed distributor, attached to its appropriate stool, should be located on the spiral frame as match marked. At this point it is worth noting two important points with regard to the distributor feed. First, the feed pipe should be independently supported (see diagram). Second, the feed slurry should be well mixed before entering the distributor.

Piping of the individual spirals may now commence. Before packing at the works, the necessary combinations of pipes and fittings for each spiral will have been assembled and

match marked as shown in the Assembly Guide. It is therefore only necessary to match up the labels on the pipe work with the appropriate distributor outlet, spiral feed box or spiral product boot to achieve correct fitting and construction of the module.

The only task to be completed before commissioning is to check the spiral assembly for blockages and to check all parts have been correctly assembled.

3.0 OPERATION

The operating objective is to obtain maximum heavy particle recovery to a small controlled weight. Spiral feed enters the spiral feed box and is directed smoothly onto the spiral profile. As the pulp passes down the trough, separation of particles occurs according to specific gravity. The heavy particles progress to the inner profile while lighter particles together with the majority of water and slimes are forced to the outer section.

The profile of the separating trough has been developed such that the path for a particular particle is relatively constant for wide fluctuations in feed grade, feed tonnage and feed pulp density.

Using the LM5 spirals it is possible to use a fixed cutter system that requires little adjustment once the equipment has been set up and commissioned.

The major variables affecting spiral performance are the feed conditions (slurry volume, tonnage & density). The positions of the product cutters do not affect the separation but are used to control the flow to each product fraction. The general area of operation should have been established by preliminary test work so that only fine-tuning and optimisation of the process needs to be done after initial plant commissioning.

3.1 Commissioning

The spiral circuit should initially be run on water and the flows balanced as far as possible. At this stage any leaks should be noted and repaired. Any blockages should be cleared.

Spiral circuits are often prone to overflowing/splashing when run on water but the flow settles down as solids are added. The solids concentration should be slowly increased until the circuit is fed at correct feed density and tonnage.

The circuit should be checked for blockages and if slow moving, thick slurries occur, it may be necessary to add dilution water to the feed to prevent sanding up. Once full solids loading has been achieved, the spiral cutters should be adjusted according to the separation performance.

3.2 Spirals

It is impossible to generalise on the optimum conditions for spiral operation. These will vary according to spiral type, feed conditions and the objectives of the separation. They should be determined through metallurgical test work before installation of the spirals and constantly updated as operational data becomes available.

Feed conditions are dependent on the specific gravity of the feed material and the proportion of heavy minerals in that feed. They are also dependent on the amount of fine particles to be recovered and the overall size distribution. General rules for spiral operating conditions are that solids tonnage should be low enough to ensure mobility of particles in all separating zones.

Within these limits it is advisable to maximise the feed parameters to fully utilise the volume capacity of the spiral design. The only restriction being the volume flow rate should be low enough to allow fine heavy particles to migrate to the centre of the spiral. Typical operating conditions are in the range 1.5-2.0 tph solids feed rate and 25-40% solids pulp density.

Spiral concentrators require a certain feed rate before entering the operating area. If there is insufficient feed, spirals may be taken out of operation by blocking distributor outlets or the tonnage increased by returning spiral products (e.g. middlings) back to the feed.

When operating spirals it is important that the entire separating surface of the trough is clean and completely wetted. This ensures the particles being separated on the spiral surface are free to report to their respective product areas. To wet out the spiral properly gently hose it down with a fine water spray as it starts up. Pay particular attention to the inner area of the main spiral trough. Wetting out becomes easier as the solids content of the feed slurry increases and the spiral surface “wears in”.

3.3 Distributors

When the correct volume feed rate is reached, the distributor should be checked for even distribution by taking timed samples from a selection of the outlets.

Possible causes of uneven distribution are:

1. Severe segregation in feed pipe to distributor
2. Insufficient feed volume
3. Tramp material or oversize feed in the distributor

When operating the distributor it is essential that the incoming feed slurry is homogeneous and that a steady feed is maintained to the tank.

4.0 MAINTENANCE

There are no moving parts in the spiral or distributor assembly, so maintenance is not normally a problem. Checks for wear and accumulated material should be carried out regularly. Note that the distributor outlets have push-fit, polyurethane orifice liners to make replacement easy if necessary.

Any build up of solids in front or behind the product boot cutters may cause blockages and disrupt the flow, resulting in poor performance. Regular inspections and frequent washing is required to remove any material or build up on the spiral surface or cutters. This is usually not a problem if the spiral feed is properly de-trashed.

On shut-down the spirals should be hosed down to prevent particles drying onto and sticking to the spiral surface. It may be necessary to remove dried-on material from the inner section of the trough by a combination of brushing and washing.

The 50mm PE pipes between the distributors and spiral feed boxes are designed to run approximately 35% full during normal operating conditions.

To ensure long service life from these pipes it is recommended that they are rotated through 120 degrees before the pipe wall becomes excessively thin. The correct time scale must be determined by regular inspections carried out during shut down periods. All horizontal sections of the product collection pipes should also be rotated at the appropriate time to prolong service life.

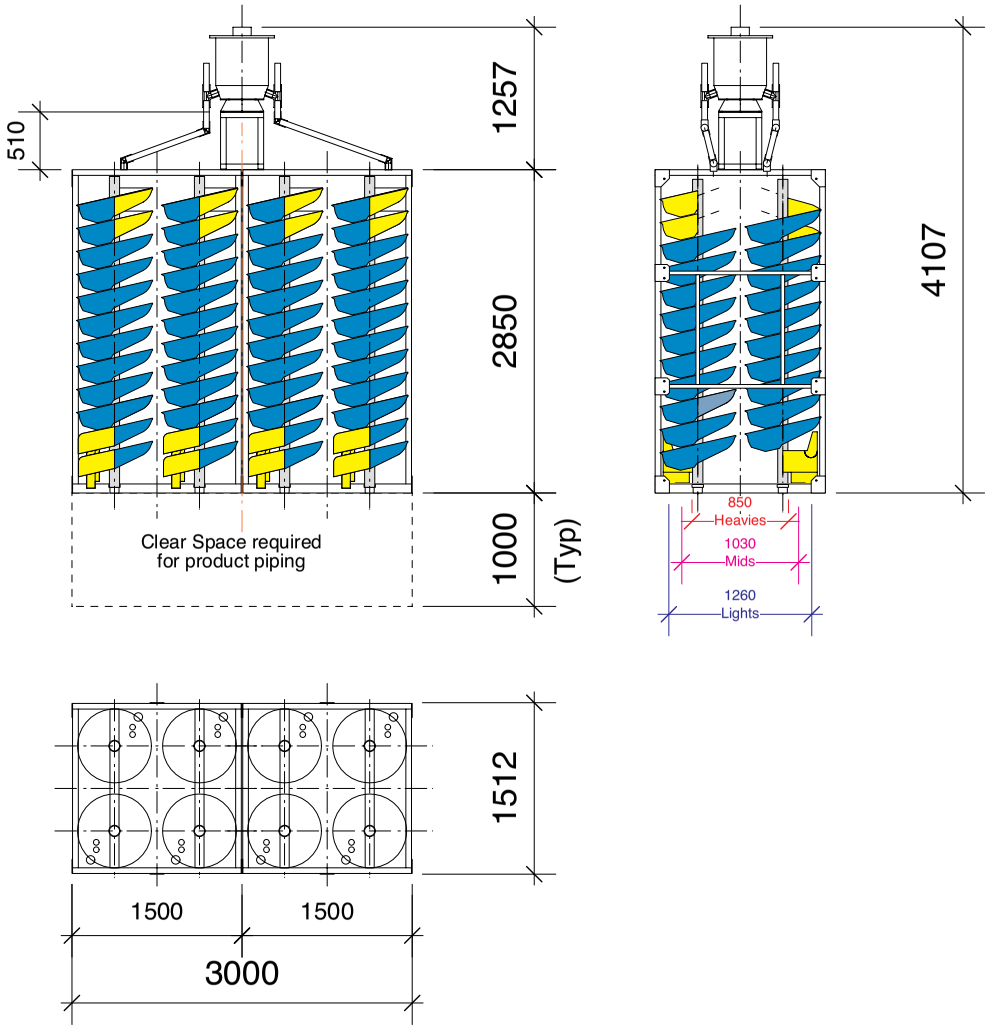
In general, all piping parts manufactured from polyurethane have a very long service life. If replacements are required these are normally available from SWMS as ex-stock items.

5.0 SAFETY.

The individual spiral units are not designed to support a person's weight. Do not climb on the spirals.

Normal ambient temperatures do not affect these units. However the equipment should not be exposed to excessive heat.

Fibreglass, polyurethane, ABS, PVC, PE and rubber are affected by hot objects and flames so extreme care must be taken when grinding, welding or oxy-acetylene equipment is used close to or above the spiral installation.



Feed Inlet
160mm OD, 142mm ID

Feed Distributor
16 way Type A,
Top Fed

Frame
Type 'K' Welded Construction
(frame in 2 Parts)
Galvanised & Painted

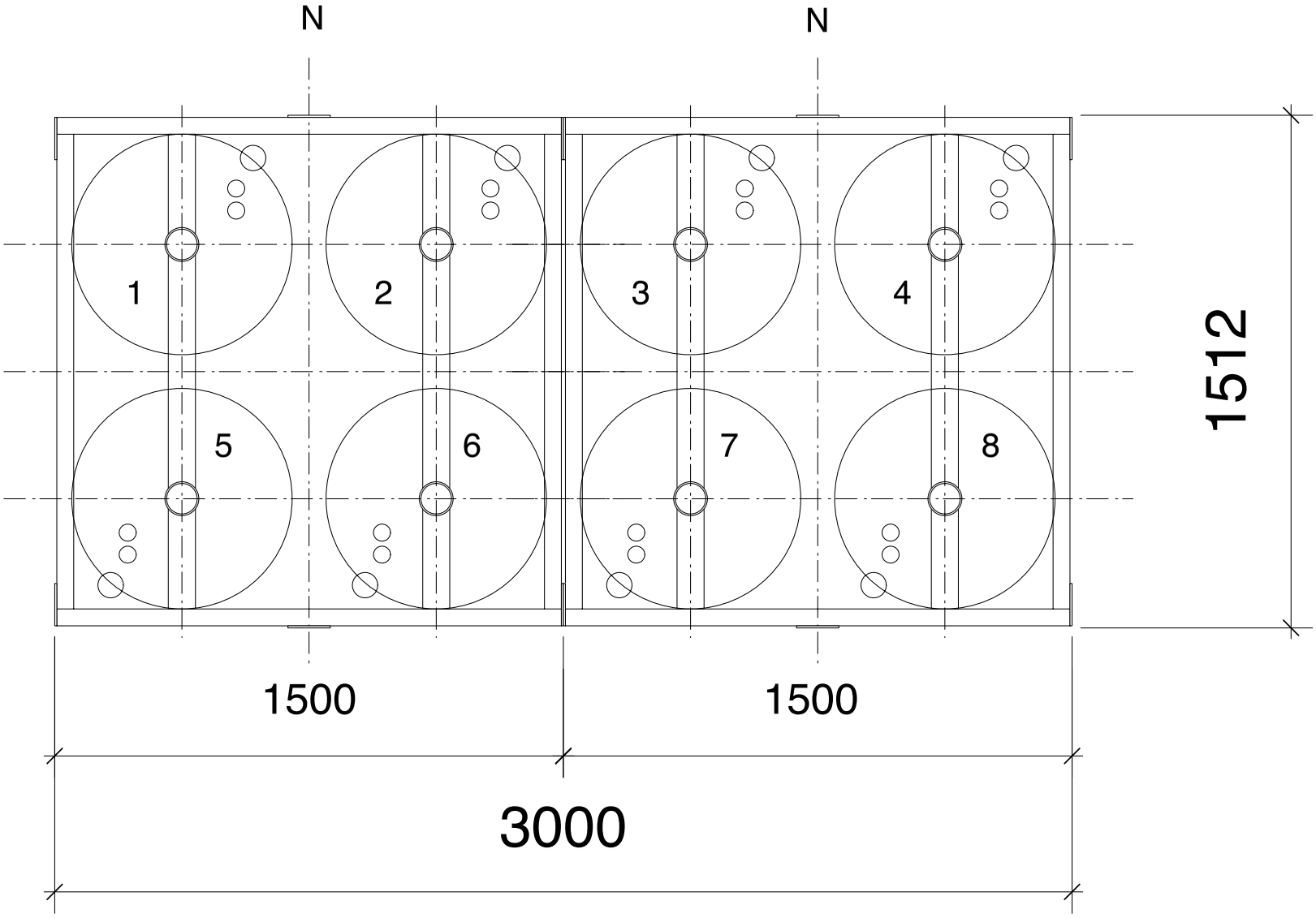
Spirals
8 Duplex LM Series, 5 turn
(16 starts)
GRP & PU construction
Cast Polyurethane wear parts
Stacker Product Box

Collection Launder System
Enclosed SWMS system with cast PU fittings and PE pipe custom design to suit installation.

WARNING
Do not cut or weld adjacent to the spirals without covering them first, as damage to the separating surface will result.

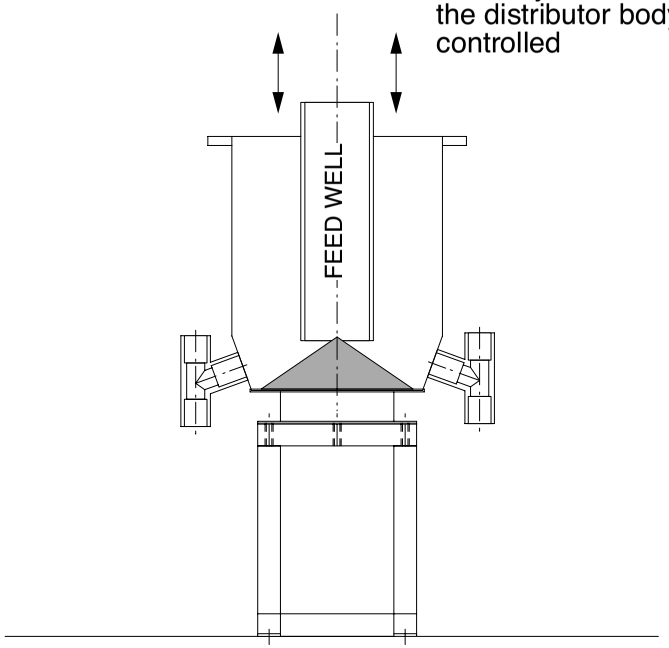
	Title	8LM5/2 Spiral Module	Client	Scale 1:60
		GENERAL ARRANGEMENT		Date 2 Sept 2014
		Type K Frame (2 parts)		Dwg No.

8LM5/2 SPIRAL MODULE
Base Plan

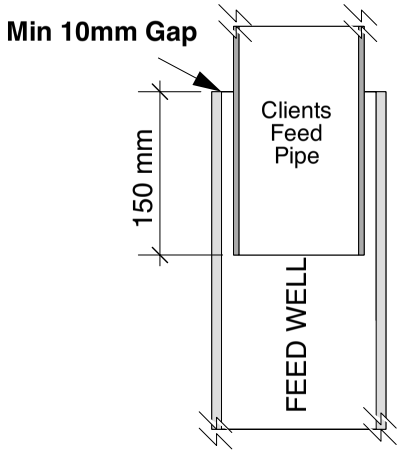


Schematic Diagram of Type A Spiral Feed Distributor

Feed Well is adjustable vertically so that the flow into the distributor body may be controlled

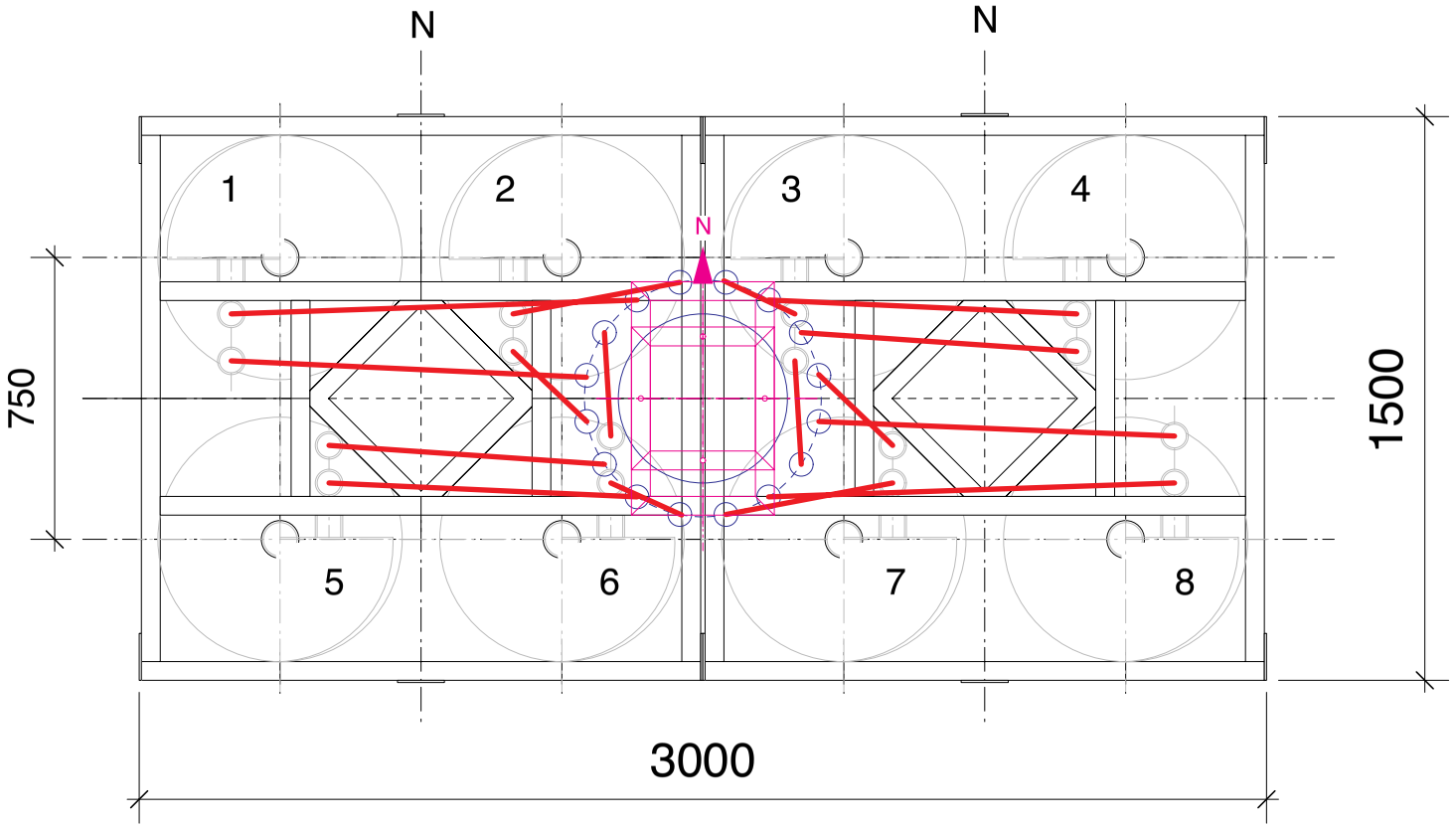


Typical Feed Well / Feed Pipe arrangement

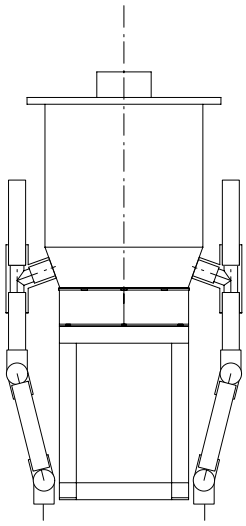


NOTE
1. Feed Well is 142 mm ID
2. Clients Feed Pipe to extend at least 150mm into Feed Well.
3. Clients Feed Pipe should be independently supported

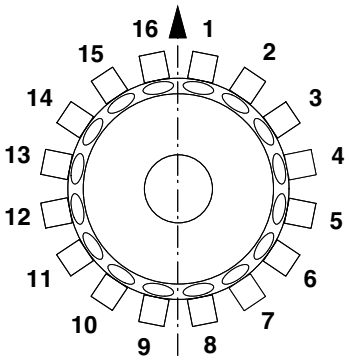
8LM5/2 SPIRAL MODULE
Spiral feed Layout

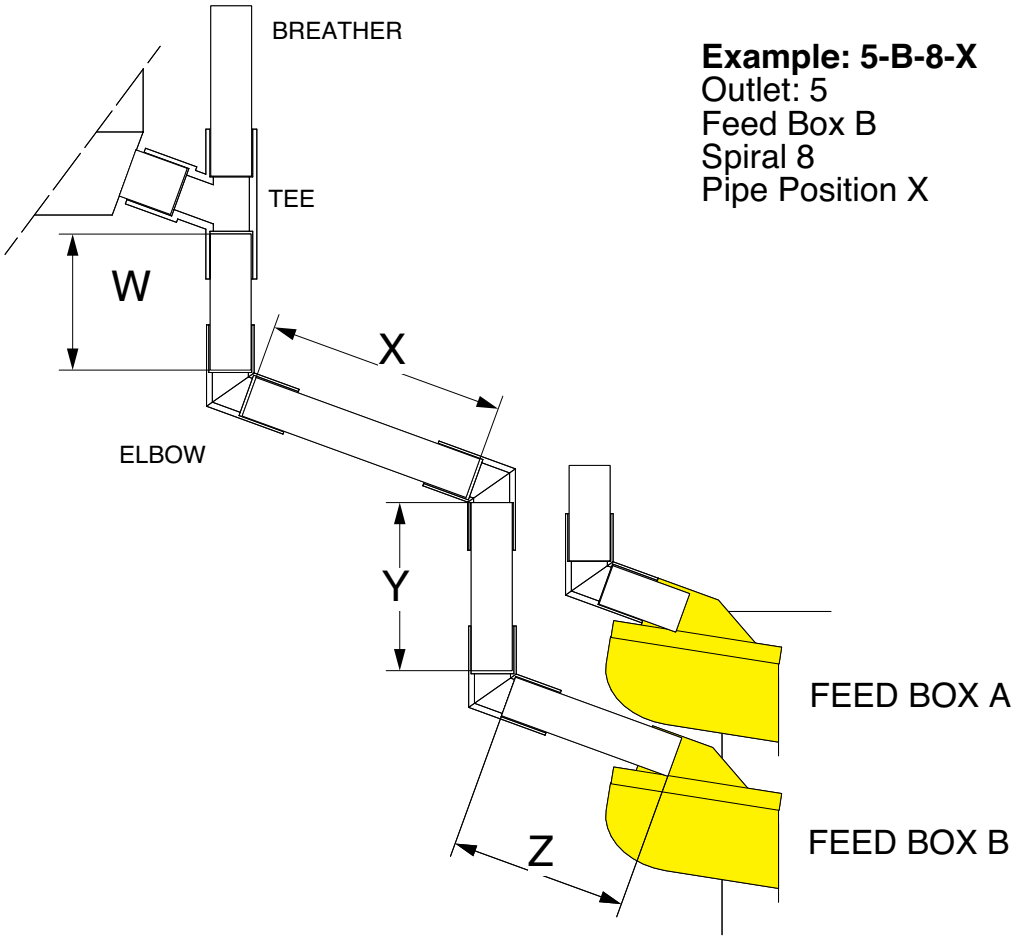


KEY to 8LM5/2 Feed Piping



'N'





Example: 5-B-8-X
Outlet: 5
Feed Box B
Spiral 8
Pipe Position X

8LM5/2 Spiral Module

Feed Pipe Cutting List

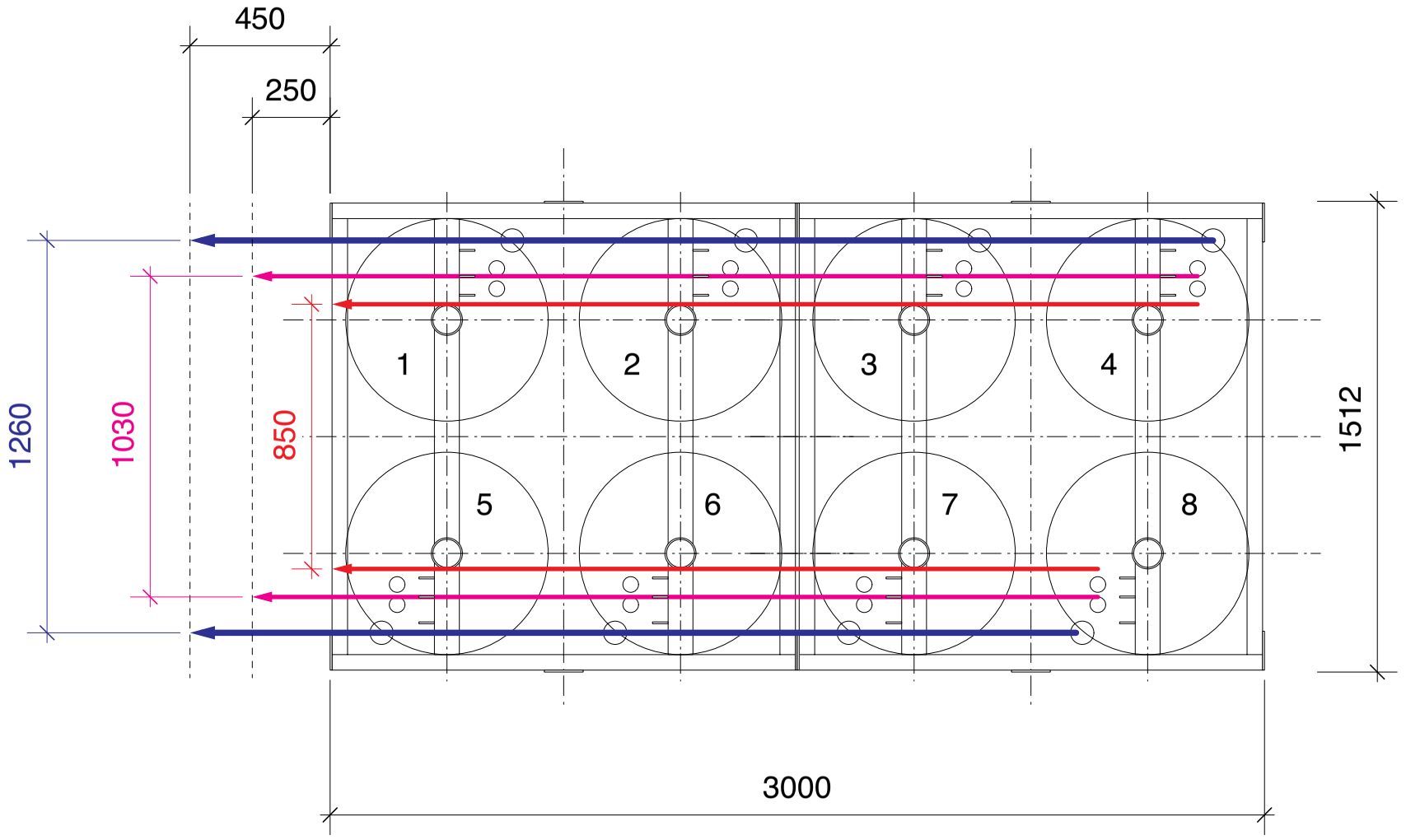
Material: 50mm PE Pipe SDR11

dimensions: mm

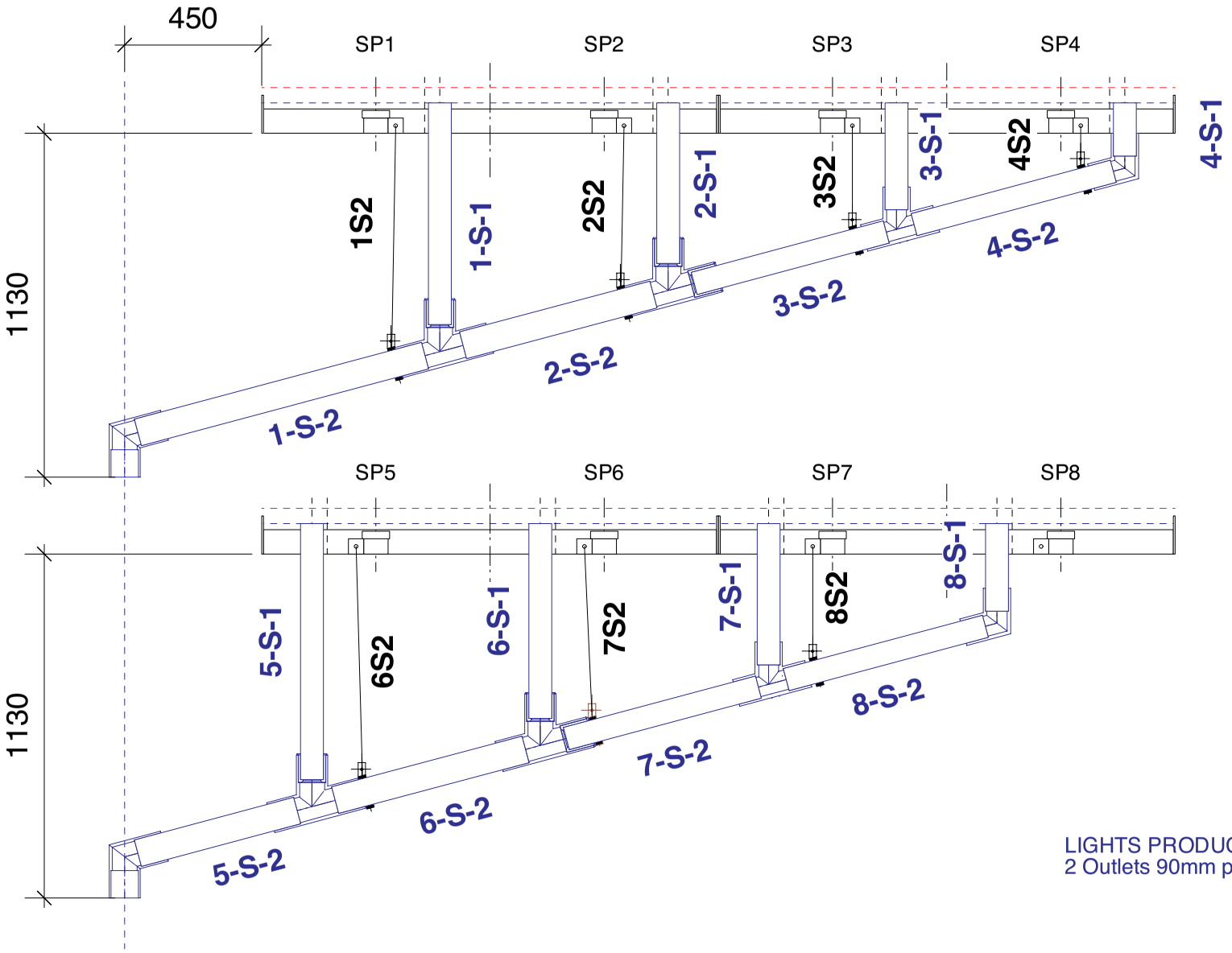
Mark	W	X	Y	Z
F1-A-3-	420	185	220	125
F2-A-4-	245	830	170	125
F3-B-4-	270	740	330	250
F4-B-7-	445	245	340	220
F5-B-8-	195	965	330	250
F6-B-3-	440	255	330	250
F7-A-8-	155	1110	170	125
F8-A-7-	380	440	170	125
F9-A-6-	420	185	220	125
F10-A-5-	245	830	170	125
F11-B-5-	270	740	330	250
F12-B-2-	445	245	340	220
F13-B-1-	195	965	330	250
F14-B-6-	440	255	330	250
F15-A-1-	155	1110	170	125
F16-A-2-	380	440	170	125

BREATHER PIPES: 16 each 250 mm
ORIFICE LINERS: 16 each 25 mm I.D.
TEES: 16 each 50MM I.D. 20 deg Yellow
ELBOWS: 48 each 50mm I.D. 20 deg. Yellow
DISTRIBUTOR: 16 WAY TYPE: 'A' Top Fed
ALL PIPES are 50mm O.D. PE, SDR11
ALL DIMENSIONS - mm

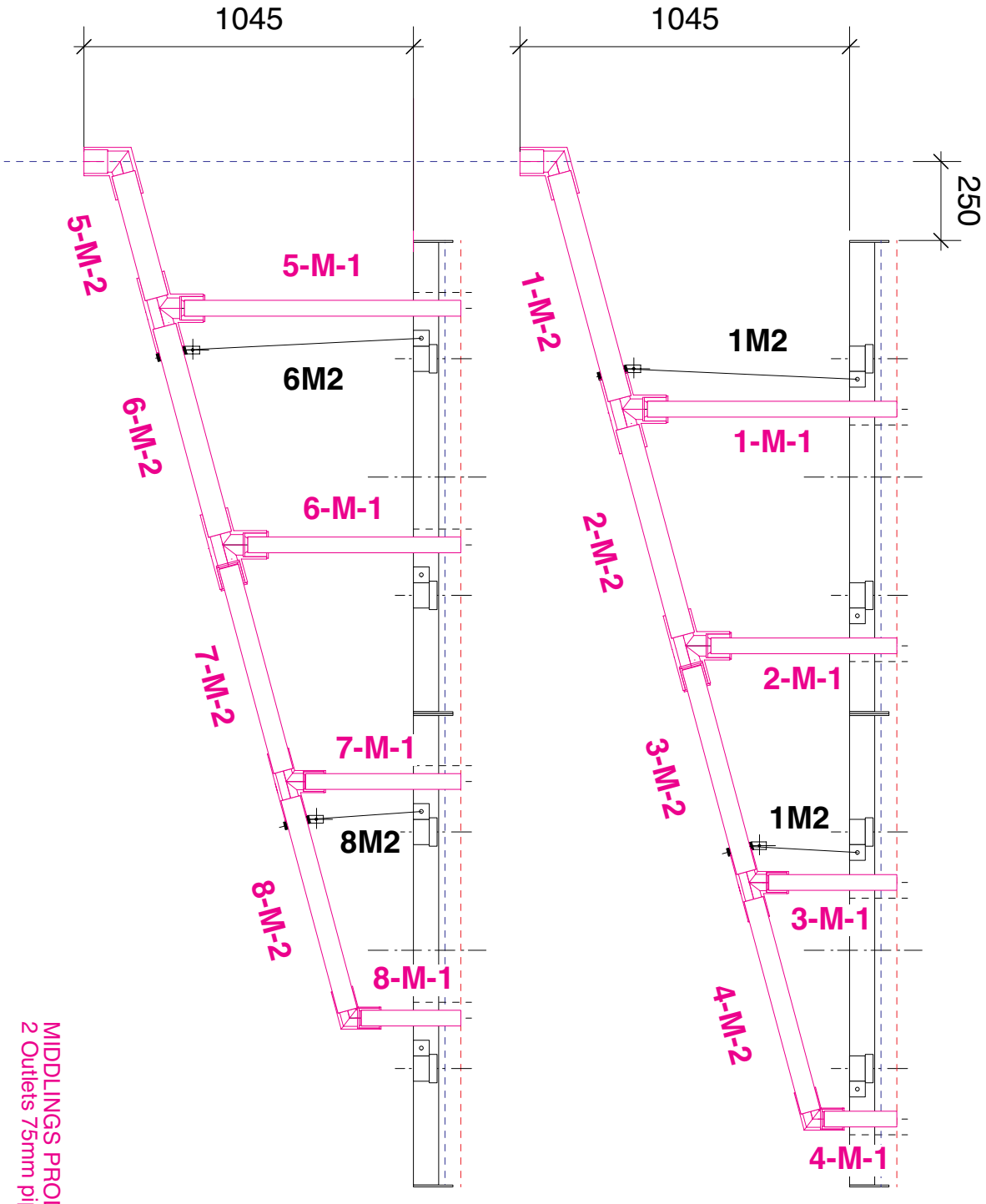
8LM5/2 Spiral Module
Standard Product Piping



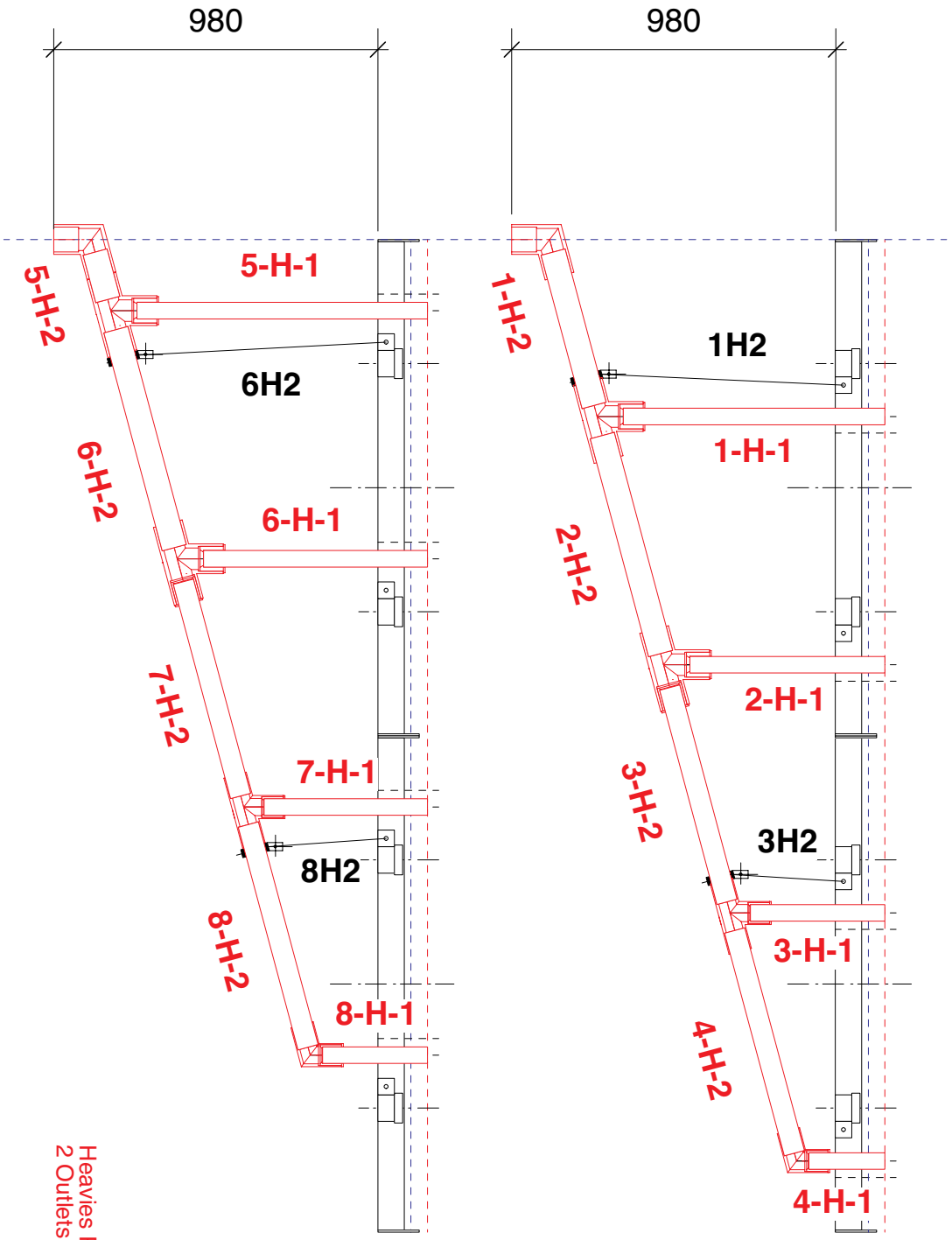
Heavies - 2 Outlets 75mm pipe (980mm below steel frame)
Middlings - 2 Outlets 75mm Pipe (1045mm below steel frame)
Lights - 2 Outlets 90mm pipe (1130mm below steel frame)



LIGHTS PRODUCT PIPING
2 Outlets 90mm pipe



MIDDLINGS PRODUCT PIPING
2 Outlets 75mm pipe



Heavies Product Piping
2 Outlets 75mm Pipe

Product Collection Piping
Parts List (8LM5/2 Module)

Lights		
Quantity	**Description**	**Part No.**
2	75 Elbow 15°	P200
2	75 Tee	P220
2	90 Elbow 15°	P300
6	90/75 Reducer	P310
4	90 Tee	P320
4	75 K Clamp	PU75
3	90 K Clamp	PU90
7	Support bar	SS203
	75mm PE Pipe	PE75
	90mm PE Pipe	PE90

Mids		
Quantity	**Description**	**Part No.**
2	63 Elbow 15°	P100
4	63/50 Reducer	P110
2	63 Tee	P120
2	75 Elbow 15°	P200
4	75/50 Reducer	P210
2	75/63 Reducer	P215
4	75 Tee	P220
2	63 K Clamp	PU63
	75 K Clamp	PU75
4	Support bar	SS203
	50mm PE Pipe	PE50
	63mm PE Pipe	PE63
	75mm PE Pipe	PE75

Heavies		
Quantity	**Description**	**Part No.**
2	63 Elbow 15°	P100
4	63/50 Reducer	P110
2	63 Tee	P120
2	75 Elbow 15°	P200
4	75/50 Reducer	P210
2	75/63 Reducer	P215
4	75 Tee	P220
2	63 K Clamp	PU63
2	75 K Clamp	PU75
4	Support bar	SS203
	50mm PE Pipe	PE50
	63mm PE Pipe	PE63
	75mm PE Pipe	PE75

8LM5/2 Spiral Module
Product Piping Cutting List
Module 'F"

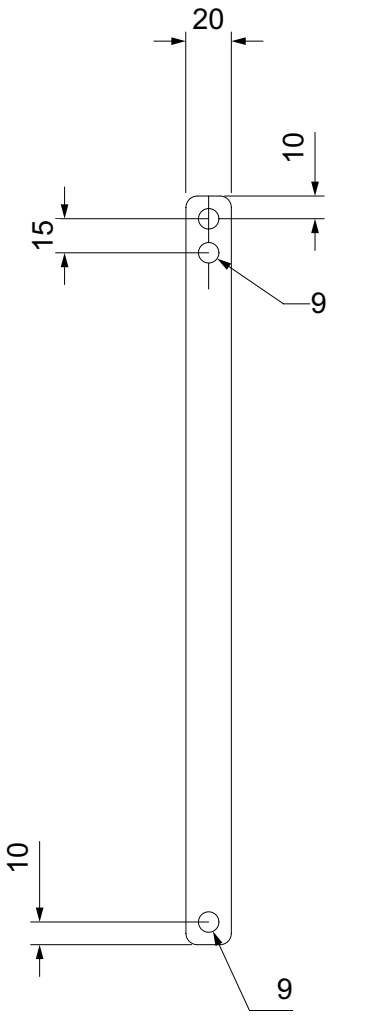
50 mm		63 mm		75 mm		90 mm	
Mark	Length	Mark	Length	Mark	Length	Mark	Length
F 1-M-1	785	F 3-M-2	665	F 1-S-1	725	F 1-S-2	970
F 2-M-1	585	F 4-M-2	690	F 2-S-1	520	F 2-S-2	640
F 3-M-1	400	F 7-M-2	665	F 3-S-1	350	F 5-S-2	540
F 4-M-1	225	F 8-M-2	690	F 4-S-1	170	F 6-S-2	640
F 5-M-1	870			F 5-S-1	840		
F 6-M-1	670	F 3-H-2	665	F 6-S-1	635		
F 7-M-1	490	F 4-H-2	690	F 7-S-1	460		
F 8-M-1	310	F 7-H-2	665	F 8-S-1	280		
		F 8-H-2	690				
F 1-H-1	785			F 3-S-2	650		
F 2-H-1	585			F 4-S-2	670		
F 3-H-1	400			F 7-S-2	650		
F 4-H-1	225			F 8-S-2	670		
F 5-H-1	870						
F 6-H-1	670			F 1-M-2	730		
F 7-H-1	490			F 2-M-2	680		
F 8-H-1	310			F 5-M-2	400		
				F 6-M-2	680		
				F 1-H-2	475		
				F 2-H-2	680		
				F 5-H-2	140		
				F 6-H-2	680		

8LM5/2 Spiral Module

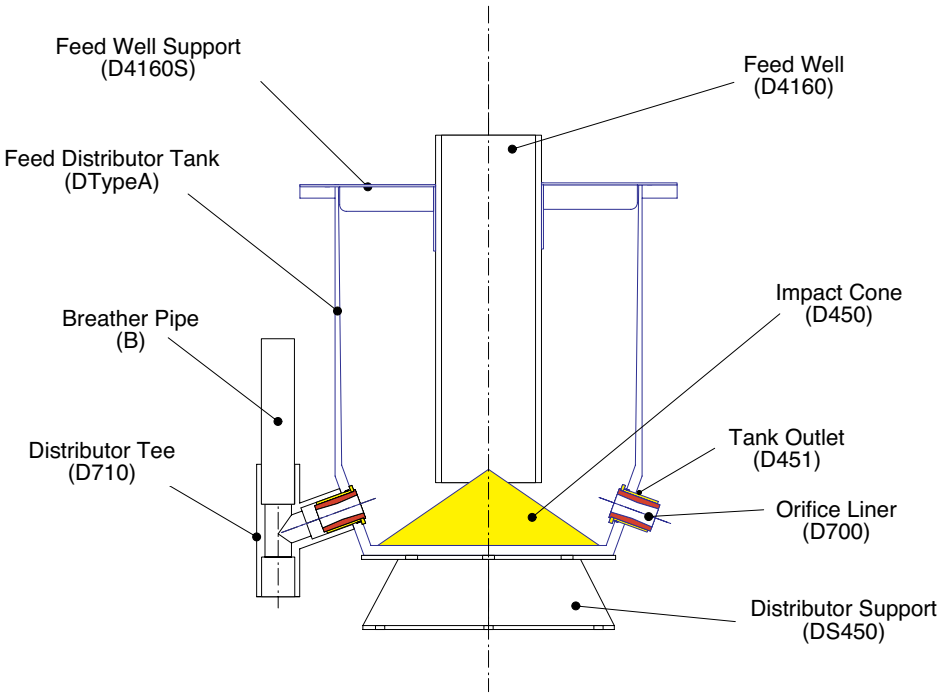
Product Piping Support Bars
Cutting List
Module 'F'

	Marking	mm
F	1S2	740
F	2S2	540
F	3S2	345
F	4S2	145
F	6S2	765
F	7S2	565
F	8S2	380
F	1M2	745
F	3M2	345
F	6M2	760
F	8M2	360
F	1H2	745
F	3H2	345
F	6H2	760
F	8H2	370

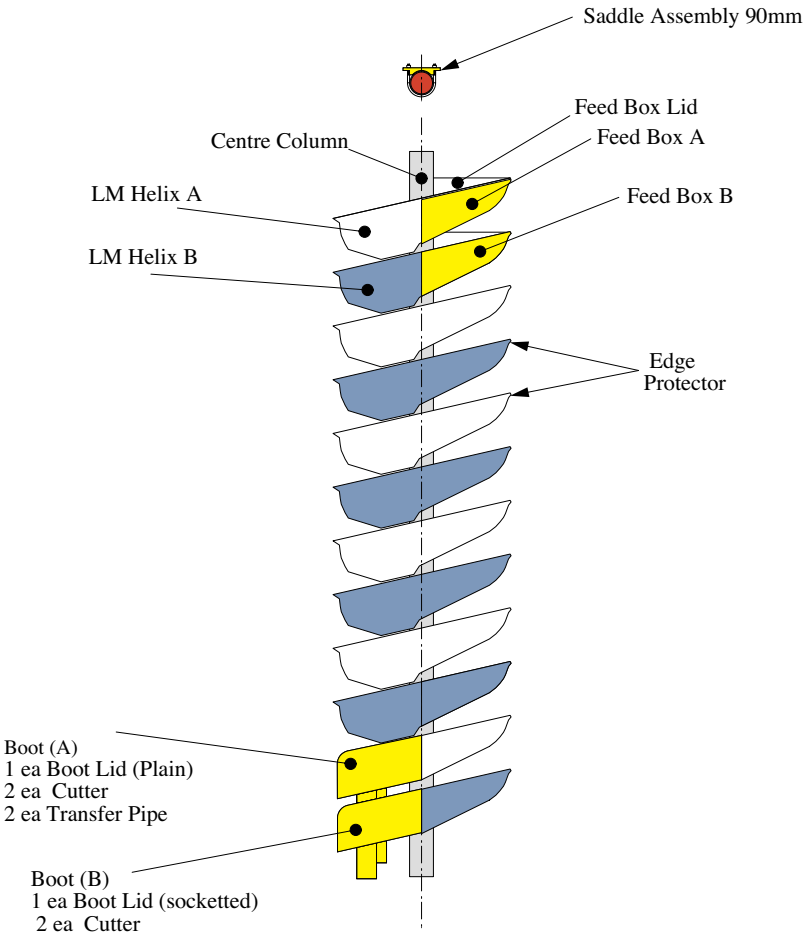
Spiral Module
Product Piping
Support Bar Detail
material 3mm stainless steel flat bar



Spiral Feed Distributor
Parts Locator



Spiral Parts Locator
Model LM5/2
2 helices per centre column



SPIRAL MODULE PARTS LIST

CLIENT: **Model: K 8LM5/2**

Assembly	Component	Part Number
Assembly	Support Frame (Type K)	4LMX-2-5
Distributor	Feed Well	D4160
Distributor	Feed Well Support	D4160S
Distributor	450 Cone	D450
Distributor	450 Tank Outlet (Mineral)	D451
Distributor	Orifice Liner 25mm	D700
Distributor	Distributor Tee 50mm Yellow	D710
Distributor	50mm Elbow 20° Yellow	D720
Distributor	Distributor Outlet Plug 25mm	DOP25
Distributor	Distributor Support	DS450
Distributor	450 Distributor	DTypeA
Pipe	50mm PE Pipe	PE50
Pipe	63mm PE Pipe	PE63
Pipe	75mm PE Pipe	PE75
Pipe	90mm PE Pipe	PE90
Pipe	75 KU Clamp	PU75
Pipe	90 KU Clamp	PU90
Pipe	Support bar	SS203
Pipe	63 KU Clamp	PU63
Pipe Fittings	63 Elbow 15°	P100
Pipe Fittings	63/50 Reducer	P110
Pipe Fittings	63 Tee	P120
Pipe Fittings	75 Elbow 15°	P200
Pipe Fittings	75/50 Reducer	P210
Pipe Fittings	75/63 Reducer	P215
Pipe Fittings	75 Tee	P220

SPIRAL PARTS LIST

CLIENT: **MODEL: K 8LM5/2**

Assembly	Component	Part Number
Pipe Fittings	90 Elbow 15°	P300
Pipe Fittings	90/75 Reducer	P310
Pipe Fittings	90 Tee	P320
Spiral	Edge Protector 9.7m	EP9.7
Spiral	Feed Box	L001
Spiral	Feed Box Lid	L002
Spiral	Boot	L003
Spiral	Boot Lid (Plain)	L004
Spiral	Boot Lid (socketted)	L005
Spiral	Transfer Pipe	L006
Spiral	Cutter	L007
Spiral	Saddle Assembly 90mm	L010
Spiral	Centre Column	LMCC