FIBREGLASS PIPE SYSTEMS

1.0 GENERAL

.1 Section 15400 refers to those portions of the Work that are unique to the supply and installation of Fibreglass Reinforced Plastic Pipe and Fittings. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

.2 Related Work

.1	Excavating, Trenching and Backfilling	Section 02223
.2	Aggregates and Granular Materials	Section 02226
.3	Sanitary Sewers	Section 02731
.4	Sewage Forcemains	Section 02732

.3 References

.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance - Section 01400.

2.0 MATERIALS

.1 Resin

.1 The resin used shall be of a commercial grade and shall be evaluated as a laminate by test, or known from previous services to be acceptable for the environment. Unless otherwise specified, the same resin will be used throughout the laminate.

.1 For sanitary sewage applications the resin shall be Ashland Aropol K1903 isophathalic resin or approved equal.

.2 When resin has been supplied by the manufacturer with an optimal monomer content for normal use, styrene or other monomer shall not be added except for minor adjustments of viscosity. Such additions shall not be more than 5% by weight and shall be consistent with the resin manufacturer's recommendations.

.3 The resin may contain thixotropic agents as required for viscosity control to a maximum of 3% by weight.

.4 Antimony compounds or other fire retardant agents may be added as required for improved fire resistance.

.5 The resin shall be suitable for service at temperatures specified in the Contract Documents or on the Contract drawings.

.2 Glass Fibre Reinforcing Materials

.1 All glass fibre used as reinforcing materials, except the surfacing veil, shall be commercial Grade E glass. Glass fibre made from other glass will only be acceptable if physical and chemical properties are equal to or better than Grade E glass.

.2 Surfacing veil used on surfaces exposed to chemical attack shall be commercial Grade 'C' glass.

.3 All glass fibres shall have received a chemical surface treatment immediately after they were formed. The sizing agent for this surface treatment shall be compatible with the resin to be used. The diameter of the glass fibres shall be selected by the manufacturer for imparting optimum properties to the F.R.P. laminates.

.4 Continuous rovings, woven rovings and chopped strand mat shall be selected by the manufacturer to provide the physical strength requirements described herein.

.3 F.R.P. Laminate

.1 The laminate shall consist of the following:

.1 Primary chemical-resistant surface
.2 Internal anti-wicking barrier
.3 Additional reinforcing layers as required
.4 Exterior surface.

.2 The primary chemical-resistant surface shall be between .25 and .50 millimetres thick. This surface shall be a resin rich surface containing less than 20 percent of reinforcing material.

.3 The internal anti-wicking barrier shall have a minimum thickness of 3.0mm and shall be reinforced with more than 20% and less than 30% by weight of chopped strand mat.

.4 Additional reinforcing layers shall be built up for providing sufficient strength to meet the mechanical requirements. This additional thickness may be constructed either by hand lay-up or by filament winding.

.1 Hand Lay-Up Construction

.1 For hand lay-up laminate alternate layers of chopped strand mat and woven roving shall be added until the required number of layers have been applied or the required wall thickness has been obtained. The exterior of all hand lay-up laminates shall consist of a chopped strand mat. Mat and woven rovings shall be lapped at least 50 millimetres. All overlaps shall be offset from those in previous layers.

.2 Reinforcing materials shall be placed into a layer of liquid resin applied to the mold or to the laminate already on the mold. The resin shall then be worked through the material from below to the outer surface.

.3 Glass content shall be between 30% and 50% by weight.

.4 Laminates shall meet the mechanical properties of Table 1, based on total thickness of laminate, including liner. A factor of safety of 10 shall be applied for calculating allowable working stresses.

Table 1

Requirements for Properties of Newly Fabricated Reinforced-Polyester Laminates

Property at 73.4°F (23°C)	Thickness (mm)				Test Method
	5 or less	6	8	10 and Up	
	MPa	MPa	MPa	MPa	
Ultimate tensile strength, min.	6	8	10	10	ASTM D638
Flexural strength, minimum	10.7	12.7	13.3	14.7	ASTM D790
Flexural modulus of elasticity (tangent), minimum	467	533	600	667	ASTM D790

.2 Filament Wound Construction

.1 Filament wound structural laminates shall be constructed by saturating continuous rovings in a resin bath and then winding the rovings in a controlled pattern on a suitable mold. Each cover, or bi-directional layer, shall consist of two complete layers of continuous rovings. Rovings of each layer shall be placed parallel and close together touching each other. Each layer shall be placed at equal but opposite angles to the axis of the mold. The rovings of these layers shall be interwoven at uniform intervals not exceeding 2.0 metres. The winding pattern shall be regular and shall produce a dense laminate without unreinforced resin pockets.

.2 Filament wound structural laminates shall consist of not less than two covers. Each cover shall consist of two layers of rovings.

.3 Glass content shall be between 60% and 70% by weight.

.4 Winding angles shall be between 45° and 70° off the horizontal axis.

.5 Laminates shall meet the mechanical properties of Table 1.

.4 F.R.P. Pipe

.1 F.R.P. pipe shall be produced to uniform lengths, either flanged or plain ended.

.2 Flanges will be to Sub-section 2.5.

.3 Minimum pipe wall thicknesses shall be as per Table 2 (hand layup) or Table 3 (filament wound). Thickness may be varied to accommodate higher temperatures. Working temperatures will be as outlined in the Contract Documents or on the Contract Drawings.

.4 Plain ended pipe shall have the pipe face machined flat and square.

.5 Flanges

.1 Flanges shall be constructed to dimensions as per Drawing No. B515-15-A as an integral part of a stub or fitting.

.2 The inner liner shall extend across the face of the flanges.

.3 Flange faces shall not be machined.

.4 Each flanged stub or fitting shall have a minimum of 2 layers of 815 g/m² woven rovings extending without a break into the flange.

The first layer of roving shall be close to the inner liner of the pipe. The last layer shall be on the outside, covered by one layer of mat. Flange thickness 'W' shall be made up of alternate layers of mat and woven roving. As many of these composite layers as permitted by neck dimensions 'X' shall taper out in shear section "4W" or in layup 'K', see Drawing No. B515-15-A. The longest layers shall be placed towards the outside.

.5 Minimum glass content in flange and flange neck shall be 40% by weight.

.6 Flanges for 690 KPa and higher pressure ratings shall have a built-up FRP ring of thickness 'F' when specified in Drawing No. B515-15-A. This ring shall reinforce the flange and provide sufficient seating surface for bolts and washers. It shall be constructed after flange and stub are cured.

Table 2

Reinforced Polyester Pipe – Minimum Wall Thickness (Hand-Layup)

Normal Pipe Diameter (mm)	Pressure Rating – KPa (PSI)					
	345 (50)		690 (100)		1035 (150)	
	Layers: Mat/Roving	'T' mm	Layers: Mat/Roving	'T' mm	Layers: Mat/Roving	'T' mm
50	Mat. Only	5.0	Mat. Only	5.0	Mat. Only	5.0
75	Mat. Only	5.0	Mat. Only	5.0	2/1	6.5
100	2/1	6.5	2/1	6.5	2/1	6.5
150	2/1	6.5	2/1	6.5	4/3	9.5
200	2/1	6.5	3/2	8.0	5.4	11.0
250	2/1	6.5	4/3	9.5	6.5	13.0
300	2/1	6.5	5/4	11.0	7/6	14.5
350	3/2	8.0	6/5	13.0	8/7	16.0
400	3/2	8.0	7/6	14.5	9/8	17.5
450	4/3	9.5	7/6	14.5	10/9	19.0
500	4/3	9.5	8/7	16.0	11/10	20.5
600	5/4	11.0	9/8	17.5	13/12	22.0
750	6/5	13.0	11/10	20.5	15/14	25.5

.7 The ring laminate shall be constructed from alternate layers of chopped strand mat and woven rovings, either parallel or normal to flange face, or it may be wound with uni-directional filaments, provided washers will have a smooth seating surface and filaments are well wetted out. The bond between stub and ring shall be broken by applying a suitable parting agent under the ring up to the bolt circle.

.8 Flanges may be laminated onto pipes or fittings as per Drawing No. B515-15-A.

Pipe or fitting ends shall be cut true and square to the centreline. At the end, the structural wall shall be bevelled approximately 30° exposing the liner. The liner of the flange face shall be laid up on a flange mold and pushed onto the pipe or fitting end while still soft. After the liner has cured, complete the flange laminate as per paragraph 2.5.4.

Table 3

Reinforced Polyester Pipe – Minimum Wall Thickness (Filament Wound)

Normal Pipe Diameter (mm)	Pressure Rating – KPa (PSI)					
	345 (50)		690 (100)		1035 (150)	
	Covers	'T' mm	Covers	'T' mm	Covers	'T' mm
50	2	5.3	2	5.3	2	5.3
75	2	5.3	2	5.3	3	6.6
100	3	6.6	3	6.6	3	6.6
150	3	6.6	3	6.6	5	9.1
200	3	6.6	4	7.9	7	11.1
250	3	6.6	5	9.1	8	13.0
300	3	6.6	7	11.1	9	14.2
350	4	7.9	8	13.0	11	16.8
400	4	7.9	9	14.2	12	18.0
450	5	9.1	9	14.2	14	20.6
500	5	9.1	11	16.8	14	20.6
600	7	11.7	12	18.0	15	21.8
750	8	13.0	14	20.6	18	25.4

.9 Flange tolerances shall be:

Flange thickness:	± 2 mm
Alignment:	perpendicular to ½° to axis of stub or fitting
Flatness of Flange Face:	± 1 mm
Flatness of Flange Back:	± 3 mm of inside pipe diameter.

.10 Full face flange diameters and drilling of flange and back-up flanges shall conform to the following standards:

50 mm up to 600 mm sizes:	ANSI B16.5 for 150 lb. Steel Flanges
650 mm up to 1200 mm sizes:	ANSI B16.1 for 125 lb. Cast Iron Flanges.

.11 Bolt holes in flanges shall be drilled.

.12 Inside of bolt holes and outside edge of flanges shall be brush coated with resin. Bolt holes shall be drilled oversize to allow for thickness of resin.

.6 Fittings

.1 Elbows

.1 Structural laminate shall have 1.5 times the number of mat and woven rovings specified for hand lay-up pressure pipe in Table 2.

.2 Flanges shall be constructed as per Drawing No. B515-15-A as an integral part of the fitting laminate. Butt ends shall be tapered at approximately 10:1 to the minimum wall thickness given in Table 2.

.2 Reducers

.1 Structural laminate shall be equal to those specified in Table 2 for pipe size equal to large end diameter.

.2 Flanges shall be constructed as per Drawing No. B515-15-A as an integral part of the fitting.

.3 Butt ends shall be fabricated sufficiently long to allow for field installation as per Sub-section 3.0.

.3 Molded Tees

.1 Liner and structural laminate shall be constructed on suitable mold with rounded transition between branch and run. Radius of the transition shall be equal to 1/3 of the inside diameter of the branch or 100 mm maximum.

.2 Structural laminate shall have 1.5 times the number of mat and woven rovings specified in Table 2 for pipe of equal diameter and pressure rating to the run of tee.

.3 Taper butt ends at 10:1 to the nominal wall thickness in Table 2.

.4 Flanges shall be full-face type.

.5 Molded tees for design pressure over 517 KPa shall be reinforced with bands of continuous filament rovings wound at uniform tension diagonally across main run and circular around branch.

Width of bands shall be 1/3 inside diameter of branch, up to 100 mm maximum width. Thickness of bands shall be 1/3 of wall thickness of tee but not less than 3 mm. Bands shall taper to feather edges.

.6 A filler laminate equal to wall thickness of the tee shall be placed centered under crossing of the bands. The filler laminate shall taper to a feather edge at a radial distance of ½ of the main run diameter.

3.0 INSTALLATION

.1 Trench Excavation and Backfill:

Trench excavation and backfill as per Sub-section 5.2.

.2 F.R.P. Field Joints

.1 Protection of Working Areas

.1 The cure of FRP laminates and their bond to existing laminates is affected by temperature and humidity.

.2 Whenever possible, field joints shall be made in heated and ventilated buildings.

.3 If field joints have to be made outside, they shall be made under suitable covers to provide shade during sunny periods and to protect the work against possible rain showers.

.4 When the relative humidity is more than 70%, or when the air temperature is less than 15° (60°F), field joints shall be made inside a protective enclosure. This enclosure shall be heated until the relative humidity has decreased to 60% or less. The minimum temperature in the enclosure shall be 15°C (60°F).

.5 Excavations for field joints on underground pipe lines shall be kept free of standing water. the bottom of the excavation inside the protective enclosure shall be covered with polyethylene, if evaporating moisture raises the relative humidity above those stated in clause 3.2.1.4.

.6 When working inside buildings, the contractor shall avoid spreading grinding dust onto equipment or other working areas.

.7 Glass reinforcing material shall be protected from moisture at all times. They shall be kept in their polyethylene bags until used for layups.

.2 Preparation of Pipe Ends

.1 Pipe ends shall be fitted to each other with a maximum gap of 6mm. After fitting, exposed glass fibres on the edges shall be brush coated with hot resin (see clause 3.2.3).

.2 Thin wall pipe 500 (20") or larger shall be aligned with each other and fixed in place by inserting a suitable expandable device. This alignment device shall hold the inside diameters concentric and provide a backing for the gap between the pipe ends all around the circumference.

.3 Pipe 450 (18") or smaller and heavy wall pipe may be held in place by external means or may be secured with hot patches (see paragraph 3.2.3.12).

.4 Pipe ends shall be cleaned by grinding with a coarse disc (#16 grit) in a power grinder for the width of the joint layup plus 150 (6") equally spaced on either side of the gap. This grinding operation shall remove all contamination and unreinforced resin from the surface and shall expose the glass reinforcing of the pipe laminate. High edges caused by differences in wall thickness shall be ground off to a 10:1 slope. (See also paragraph 3.2.2.7).

.5 Pipe ends may be ground in advance of fitting and installing the pipes, provided the ends can be kept dry. During storage all preground pipe ends shall be covered with plastic bags secured with masking tape. The maximum permissible interval between pregrinding and layup of the field joint depends on the prevailing weather conditions. It should not exceed 24 hours unless permitted by the Engineer.

.6 When pipes are cleaned and secured in place the gap between ends shall be cleaned of grinding dust with a clean and dry brush. Do not use compressed air. The clean gap shall be filled with resin paste containing short glass fibre and silica powder. The paste shall remain sufficiently liquid for bonding to surfaces but shall not flow out of vertical or overhead crevices. A small amount of talc or similar substance may be added to improve workability.

.7 Resin paste shall not be used as filler when wall thicknesses differ. All fillers between pipe and joint shall consist of laminates, reinforced with chopped strand mat. The only permitted exceptions are 15 (1/2") radius putty fillers in the root of three-way fittings. These filler laminates shall have cured and the exotherms shall have dissipated before the joint laminate may be applied.

.3 Lay-Up of Field Joints

.1 After the resin paste is cured and immediately before commencing the layup of the joint laminate, the pipe ends shall be cleaned again by lightly grinding the entire joint area. This grinding shall remove all resin smears, finger marks, soil stains or other contaminations from the pipe walls. Wiping with acetone is not permitted.

.2 The grinding dust shall be brushed off with a clean dry brush. Do not blow dust off with compressed air. The grinding dust shall be completely dry and fall off the brush while brushing. If a damp pipe surface or high humidity causes the dust to cake and to cling to the bristles, the joint layup work shall be terminated. (See paragraph 3.2.1.4).

.3 The cleaned joint area shall be brush coated with a thin layer of resin for 150 (6") either side of the gap and the first layup of the joint shall then be applied.

.4 Joint laminates shall be started by applying two mats centered over the gap between the pipe ends. These mats shall be well wetted out with resin and thoroughly rolled out with grooved steel rollers. When all air bubbles within the mats and between pipe and mats have been removed, the balance of the laminate shall be applied in alternate layers of woven roving and mat, ending with a layer of mat. Woven roving shall never be in contact with pipe or cured laminates. The technique of applying the laminates depends on the preference of the contractor, providing the resulting joint is of acceptable quality. However, if a joint consists of a single layup only, all mat and roving layers shall be applied to the pipe one layer at a time with all ends staggered.

.5 The joint laminate shall be uniformly wetted out without dry spots or resin rich areas. It shall be shaped smoothly, be of uniform thickness and contain 30-50% glass reinforcing and 70-50% resin, by weight. Air bubbles within the laminate or between pipe and laminate are not permitted. Joints in the glass reinforcing shall overlap approximately 150 (6") and shall be staggered.

.6 Each layup shall consist of a minimum of 4 mats and 3 woven rovings. The maximum thickness per layup shall be 7 mats and 4 rovings. The first layup shall have a minimum of 5 mats and 3 rovings. The total number of mat and rovings to be used for the various pipe sizes and pressure rating are listed in Tables A and B. Field joint kits supplied by vendors of FRP pipe shall be adjusted to suit this tabulation, if necessary.

.7 After the first layup is cured and the exotherms (heat produced while resin is curing) have dissipated, the other layups shall be completed in a similar manner as the first one. Before each new layup, unreinforced resin smears and other contaminants shall be removed by touch-up grinding, grinding dust shall be brushed off, all ground surfaces of pipe and the previous layup shall be brush coated with resin. Grinding of the first layup is not required if its surface is clean and smooth, well cured and the second layup is started within one hour after the first one was cured. the joint shall then be completed in the sequences and to the dimension shown on Table B, Field Joint Layup Details.

.8 If it seems likely that the next layup of a joint cannot be started within the next 2 hours, the fresh laminate may be wrapped tightly with cellophane or similar material for preventing contamination and air inhibition of the surface resin. Before commencing the next layup, the surface gloss, gross irregularities, and unreinforced resin smears on each side of the laminates shall be removed by grinding.

.9 Field joints, and all ground areas near the joints shall be brush coated with waxed resin during the initial cure of last laminate.

.10 An inside layup shall be completed on all joints for pipe diameters of 750 mm (30") and larger and on all accessible joints of smaller pipes. Inside layups shall be wax-coated.

.11 The pot life of resin for field joints shall be between 25 and 35 minutes. Pot life is the time the resin remains usable after adding the catalyst. The pot life shall be adjusted by varying the ratio of resin and curing chemicals as required by prevailing temperatures in accordance with recommendations by the resin manufacturer. The recommended minimum ratio of catalyst shall be maintained at all times. If the pot life is still too short at the minimum catalyst ratio, the contractor shall obtain advice from the fabricator of the FRP pipe or from the Engineer.

.12 Resin for brush coating exposed cut edges or for hot patches shall have a pot life of 5-10 minutes.

.13 Laminates which cannot be completed and properly rolled out with grooved steel rollers, within the pot life of the resin, shall be removed from the pipes while the resin is still soft. The pipes shall then be cleaned and prepared again as noted in paragraph 3.2.2.4 and a new layup shall be made. Layups with less than the numbers of glass reinforcings specified shall not be permitted.

.14 If resin in a laminate does not gel within 60 minutes, or its cure is not substantially complete within 2 hours of adding the catalyst, the contractor shall apply heat. The laminate shall be kept heated until its cure is completed. Laminates not cured satisfactorily after 25 hours shall be removed from the pipe and remade.

.15 Laminates which have been cured with excessive exotherms and show evidence of brittleness or pinholes shall be removed and remade.

.16 The cost of remedial work under 3.2.3.13, 3.2.3.14 and 3.2.3.15, including the cost of new materials, shall be to the Contractor's account.

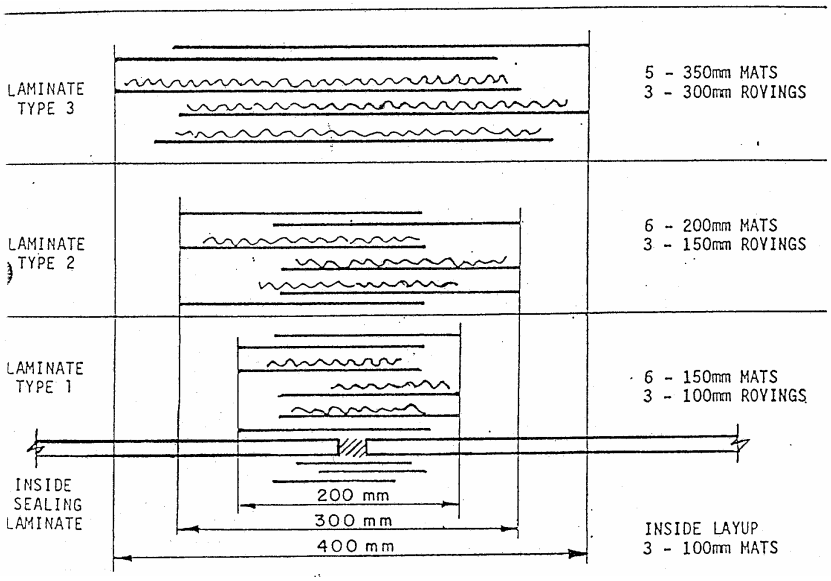
.17 The Engineer may at any time ask the Contractor to remove a completed or partially completed field joint from the pipe. If the bond between the pipe and joint is satisfactory, and if the joint laminate is of an acceptable quality, the contractor will be reimbursed for the cost of removing the joint and replacing it. If either the bond or the quality of the laminate is not acceptable, the Contractor shall remove additional joints as instructed by the Engineer. The cost of all remedial work shall then be to the Contractor's account.

Table A
Type of Field Joints for Diameter and Pressure Rating

See Table B for layup details

Diameter	Pressure Rating			
	Gravity	345 kPa (50PSI)	690 kPa (100PSI)	1035 kPa (150 PSI)
50mm	Type 1	Type 1	Type 1	Type 1
75mm	1	1	1	1
100mm	1	1	1	1
150mm	1	1	1+2	1+2
200mm	2	1+2	1+2	1+2
250mm	2	1+2	2+3	2+3
300mm	2	2+3	2+3	2+3
350mm	2+3	2+3	2+3	2+3
400mm	2+3	2+3	2+3	1+2+3
450mm	2+3	2+3	2+3	1+2+3
500mm	2+3	2+3	2+3	1+2+3
550mm	2+3	2+3	1+2+3	1+2+3
600mm	2+3	2+3	1+2+3	Type 1+2+3
750mm	2+3	2+3	1+2+3	
900mm	2+3	2+3	Type 1+2+3	
1050mm	2+3	2+3		
1200mm	Type 2+3	Type 1+2+3		

Table B
Field Joint Layup Details



See Table A for Type of Joint to be Used

4.0 TESTING

.1 Testing Procedure:

.1 The Contractor shall provide all labour, materials and equipment necessary to carry out the tests. Testing shall be performed in a manner satisfactory to and in the presence of the Engineer.

.2 Testing shall be carried out after completion of backfilling with all service connections and laterals in place.

.3 Cost incurred for witnessing unsuccessful tests shall be borne by the Contractor.

.2 Testing Fibreglass Air Header:

.1 Fibreglass air header systems shall be pressure tested at 140 kPa for thirty minutes.

.2 No drop of pressure within thirty minutes shall constitute a successful test.

.3 Testing Fibreglass Pipe Gravity Flow Systems:

.1 Open ends shall be plugged so as to be airtight. Air shall be slowly supplied until the air pressure reaches 20.7 kPa. At least two minutes shall be allowed for pressure stabilization before proceeding. The time in minutes for the pressure to drop from 20.7 kPa (3.0 PSI) to 17.2 kPa (2.5 PSI) shall not be less than the following:

Pipe Size	100mm	150mm	200mm	250mm	300mm	350mm	375mm
Maximum Air Pressure Loss Time	2 min 32 sec	3 min 50 sec	5 min 06 sec	6 min 22 sec	7 min 39 sec	8 min 56 sec	9 min 30 sec

.2 For pipe sizes of over 375 mm, the time in minutes for the pressure to drop shall not be less than 0.0256 times the pipe diameter in millimeters.

.4 Testing Fibreglass Pipe Forcemain:

.1 Pipe shall be filled with water and all air expelled.

.2 Using water, pipe shall be pressurized to 1.5 times working pressure unless specified otherwise in the Contract Documents or on the Contract Drawings.

.3 No pressure drop over thirty minutes shall constitute a successful test.

.5 Cleaning:

.1 Air headers shall have all debris removed from line. Lines shall be given final cleaning by drawing a damp polyurethane pig through line. Cleaning may be done in stages to accommodate varying pipe diameters.

.2 Gravity flow and pressure systems may be cleaned by flushing.

5.0 EXECUTION

.1 Internal Piping

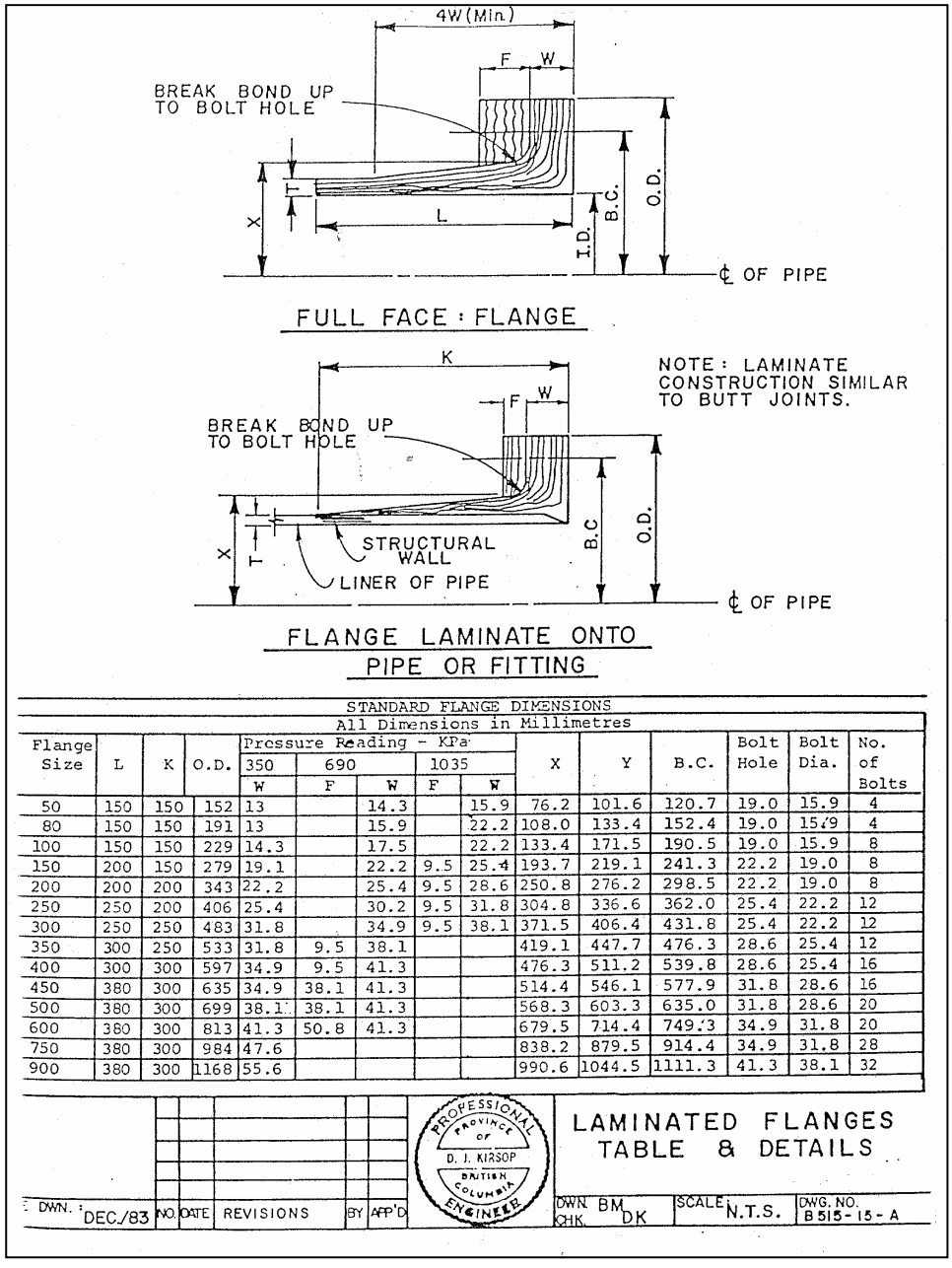
.1 To requirements of Contract Documents and Contract Drawings.

.2 External Piping

.1 To requirements of Sections 02223 – Excavating, Trenching and Backfilling, Section 02731 – Sanitary Sewers and Section 02732 – Sewage Forcemain and Contract Drawings.

.2 Pipe trench to be in accordance with contract drawings. All bedding and pipe surround material to be in accordance with Granular Pipe Bedding and Surround Material (19mm minus), as defined in Section 02226- Aggregates and Granular Materials.

6.0 SUPPLEMENTAL DRAWING



STANDARD FLANGE DIMENSIONS
All Dimensions in Millimetres

Flange Size	L	K	O.D.	Pressure Reading - KPa 350 W	690 F	690 W	1035 F	1035 W	X	Y	B.C.	Bolt Hole	Bolt Dia.	No. of Bolts
50	150	150	152	13		14.3		15.9	76.2	101.6	120.7	19.0	15.9	4
80	150	150	191	13		15.9		22.2	108.0	133.4	152.4	19.0	15.9	4
100	150	150	229	14.3		17.5		22.2	133.4	171.5	190.5	19.0	15.9	8
150	200	150	279	19.1		22.2	9.5	25.4	193.7	219.1	241.3	22.2	19.0	8
200	200	200	343	22.2		25.4	9.5	28.6	250.8	276.2	298.5	22.2	19.0	8
250	250	200	406	25.4		30.2	9.5	31.8	304.8	336.6	362.0	25.4	22.2	12
300	250	250	483	31.8		34.9	9.5	38.1	371.5	406.4	431.8	25.4	22.2	12
350	300	250	533	31.8	9.5	38.1			419.1	447.7	476.3	28.6	25.4	12
400	300	300	597	34.9	9.5	41.3			476.3	511.2	539.8	28.6	25.4	16
450	380	300	635	34.9	38.1	41.3			514.4	546.1	577.9	31.8	28.6	16
500	380	300	699	38.1	38.1	41.3			568.3	603.3	635.0	31.8	28.6	20
600	380	300	813	41.3	50.8	41.3			679.5	714.4	749.3	34.9	31.8	20
750	380	300	984	47.6					838.2	879.5	914.4	34.9	31.8	28
900	380	300	1168	55.6					990.6	1044.5	1111.3	41.3	38.1	32

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D. J. KIRSOP

LAMINATED FLANGES TABLE & DETAILS

NO.	DATE	REVISIONS	BY	APP'D

DWN. : DEC./83 DWN. BM CHK. DK SCALE: N.T.S. DWG. NO. B515-15-A