SITE CONTAINMENT REVIEW REPORT

FOR

PROPOSED NEW TANK FARM AND TERTIARY CONTAINMENT

AT

BROCKLESBY LIMITED
CROSSLAND LANE
NORTH CAVE
BROUGH
HU15 2PG

ON BEHALF OF

Brocklesby Limited

Project ref: **28576/CON/JHC**

Date First Issued: **21st May 2021**

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Appendices

Appropriately Qualified Person Statement:
This report has been prepared and written by Jeremy Collins BSc (Hons) MCIWEM, Senior Civil Engineer. Who has Over 12 year's industry experience across reinforced concrete, water retaining structures, building & structures, SuDS & Highway design and detailing. In addition Jeremy has designed and detailed 9 Anaerobic Digestion plants been fully compliant to CIRIA C736 & EA (BAT) Guidance.

Report contains material based upon information within CIRIA C736

Document Revision Box			
Revision	Date	Description	Author
01	21th May 2021	Draft issued	JHC
02	25th May 2021	Final Issue	JHC

1.0 Brief

GGP Consult has been requested by HC Consultancy on behalf of the client Brocklesby Limited to prepare a verification report covering the new tank farm bund wall height, the sites tertiary containment and provide a sign off document covering the construction works undertaken for the above.

The report shall be broken down into the following sections;

Section 2	-	New Tank Farm Containment Calculations
Section 3	-	Site tertiary Containment
Section 4	-	Site Final Inspection & Sign off.

Section 2 New Tank Farm Containment Calculations

2.1 Site Description

GGP was commission to provide design and detail package of a new tank farm 16No 3.5m DIA Tank 14.5m high, with a further 4No 8.5m DIA tanks, 10.0m high.

2.2 Design Philosophy

The new tank farm was to be bunded with insitu reinforced concrete walls to the perimeter and a piled floor slab.

The wall will be set to an appropriate calculated height to cater for the requirements set out in the *CIRIA* guidance.

The report has been adjusted to suit as-built condition.

2.3 Bund Capacity

2.3.1 110% of the largest Tank Capacity

The largest proposed tank will be 8.5m DIA and 10.0m high giving a total capacity of 567m³.

Tank Volume	= **567m³**
110% Volume	**= 624m³**

2.3.2 25% of Total Tank Capacity

The following tanks are to be placed in the new tank farm.

3.5m DIA x 14.5m H	= 139.5m³	x 16No.	= 2,232.00 m³
8.5m DIA x 10.0m H	= 567.0m³	x 4No.	= 2,268.00 m³
Total tank Volume			**= 4,500.00m³**
25% Volume			**= 1,125.00m³ < 110%**

THEREFORE 25% CAPACITY WILL BE USED FOR THE BUND VOLUME

2.4 Available Bund Volume

A detail assessment of the bund proposed levels has been undertaken.

The available bund volume has been calculated based on a minimum bund wall height of 1.600mm across a total area of 941m^2.

Based on the above details this would provide a total volume of **1,505.6m^2.**

The above volume includes **all tank bases, buildings & tanks** themselves.

By using these volumes, it will be suitable for checking the 25% required capacity, as part of this scenario it is assumed all tanks fails allowing the use of the tank area itself up to the 1.60m high bund wall level.

The total bund volume has been calculated to be 1,505.6m^3 with the tank and vessels area included.

Volume = 1,505.6m³ > 1,125.0m³ PASS

It has therefore been demonstrated that the available bund volume of the as built bund wall levels provides more than sufficient volume to contain the 25% volume.

2.5 Quantitative Assessment for the 25% Arbitrary Allowance

In accordance with the *CIRA C736,* guidance, the following section shall review the 25%.

Based on the detailed assessment undertaken using AutoCad, an available volume equates to **1,505.60m^3**

Rainfall shall now be considered.

2.5.1 Rainfall Allowance

At the time of a failure, it can be assumed that the drainage system will be empty providing an allowance is made for rainfall equal to a 1:10 year return period 24hr duration before & 8 days' duration after a failure event (*CIRA C736, Section 4.3.3, page 43 & 44).*

For a first estimate fig 4.2 average rainfall depths (from HR Wallingford, 1986) shall be used.

Based on the below table (see following page), a total rainfall depth of 83mm (29mm + 54mm) should be accounted for.

29mm of rainfall occurred across the tank farm area 24hr before a failure event, equating to 27.3m³ (941x0.029=27.3).

Based on the above the tank will have sufficient capacity to contain the first 29mm.

1,125.0m³ + 27.3m³ = 1,152.3m³ < 1,505.6m^3 **PASS**

Now to consider 8 days of rainfall be 54mm.

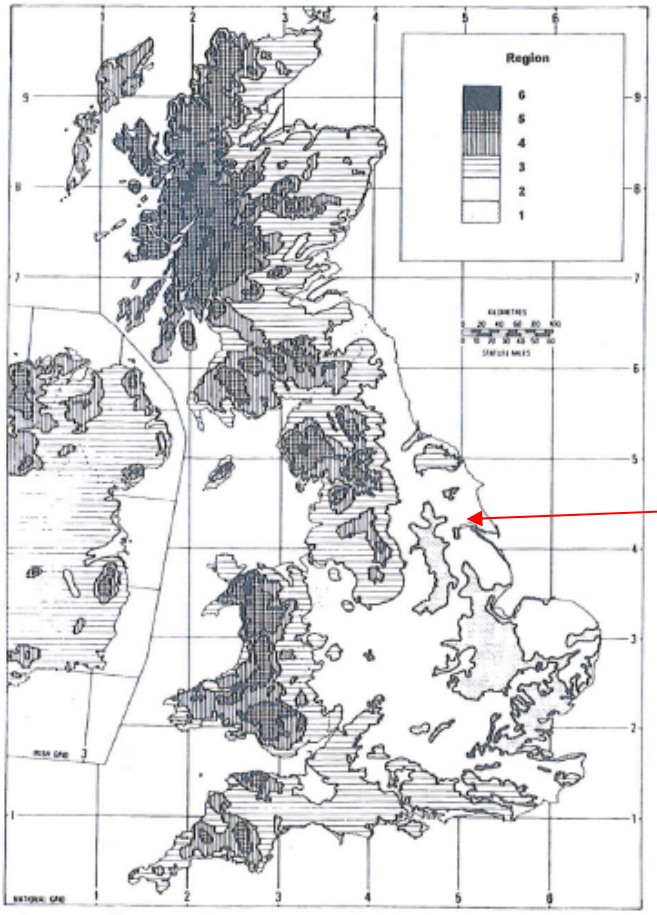
54mm of rainfall occurred across the site dirty water area 8 days after a failure event, equating to 50.8m³ (941x0.054=50.8).

Based on the above the tank will have sufficient capacity to contain the first 29mm but not the additional 54mm.

1,125.0m³ + 27.3m³ + 50.8 = 1,203.1m³ > 1,505.6m^3 **– Pass**

It can now be concluded that the bund will have sufficient capacity to contain a failure event including rainfall.

Freeboard & dynamic effects shall now be considered.



Region	Standard annual average rainfall (mm)	Rainfall depth (mm) 10-year return period	
		24-hr duration	8-day duration
1	<600	29	54
2	600–800	32	65
3	800–1200	41	95
4	1200–1600	52	120
5	1600–3200	88	231
6	3200	106	288

Notes

It should be stressed that Figure 4.2 should only be used to derive a first estimate for considering containment volumes. This is for two reasons:

1 The figure is based on *Flood studies report* (Institute of Hydrology, 1975) data produced up to 1986.

2 Climate change effects since the publication of HR Wallingford (1986) will have resulted in different annual rainfall figures.

Detailed design should therefore be based on the output of the FEH rainfall.

Figure 4.2 Average rainfall depths (from HR Wallingford, 1986)

Based on the above table at total rainfall depth of 83mm (29mm + 54mm) should be added to the bund wall height.

2.5.2 Freeboard & Dynamic Effects

An allowance for freeboard in bund and dynamic effects should be added to the final bund height required for the worse case failure i.e. 110%.

Freeboard / Firefighting Foam

The tank contents is of a flammable nature and therefore the allowance for firefighting foam shall be considered necessary for this development equating to 0.1m.

Surge

CIRA C736, Section 4.4, page 53 & 54. fig 4.7.

Table 4.7 Surge allowance (in the absence of detailed analysis)

Type of structure (see Part 3)	Allowance
In situ reinforced concrete and blockwork bunds	250 mm
Secondary containment tanks	250 mm
Earthwork bunds	750 mm

Based on the above table at total surge allowance of 250mm should be added to the bund wall height.

Surge shall be considered at the time of failure;

The available bund volume at time of failure will be 1,505.6m³.

25% volume = 1,125.0m³.

1,505.6m³ LESS 1,125.0 = 380.6m³.

Wall available surge height = 380.6 / area (941) = 0.404m

Therefore, based on the above and the as-built wall height of 1.6m has complied with the surge allowance required set out in table 4.7 above.

Within the CIRIA document rainfall & surge can either be considered additions to each other or the surge height (250mm) can include for rainfall where suitable justifiable.

This can be justified in two stages;

Stage one, 29mm of rainfall occurred across the site dirty water area 24hr before a failure event, equating to 27.3m³.

Detailed calculation indicated a spare available volume of 353.3m³ based on a wall height of 1.60m.

or a max water level of 1.225mm above GL i.e. 0.375m Freeboard.

The above is deemed to be acceptable.

Stage two, 54mm of rainfall occurring across the site dirty water area for 8 days after a failure event.

At this stage we would consider the surge effects from the failure would have settled and the water would have found its natural level of 1.225mm above GL as per stage 1 above.

By the end of the 8 day period the rainfall would generate an additional 50.8m³.

This would reduce the available volume down to 302.5m^3

The water level would be resting after 8 days of rainfall, leaving 321mm for wind effects.

2.5.3 Quantitative Assessment Conclusion

It has been demonstrated within section 2.5 that the designed as-built wall level of 1.6m in height fulfils the requirement set out for the assessment of rainfall and surge in accordance with the CIRIA C736 guidance.

It has further been demonstrated that the new tank farm will have 0.321m for surge / freeboard.

2.6 Jetting Failure

The failure of a storage tank through a rupture or corrosion of the side wall, could result in the escape of a jet of liquid. This is referred to as jetting.

The risk of jetting cannot be designed out, however maintenance of the tank through internal inspections can assess the condition of the tank. However, this is not always practical or feasible.

The tank farm is positioned centrally to the overall site, with terry containment to the full site boundary. This tertiary containment will provide protection against jetting.

This is considered as an acceptable protection measure.

2.7 As-Built Design Summary

- 25% of all tank volume has demonstrated to be the worst-case design option when compared against 110% of the largest tanks.
- Analysis of the proposed structural slab levels has demonstrated an available volume equal to 1,505.6m³ based on the As Built wall level of 1.60m in height.
- Surge allowance of 250mm has been incorporated within the as- built wall level in accordance with the CIRIA guidance.
- All bund wall heights have been constructed to a minimum level equal to 1.60m in height.

2.8 Summary and Compliance Statement

It has been demonstrated within the report that the sites containment system has been constructed in compliance with the recommendation and guidance set out within CIRIA C736.

The As-built bund wall 1.60m in height AOD will contain the 25% volume.

Section 3 Site Tertiary Containment

3.1 Site Tertiary Description & Capacity

GGP were requested to review the site tertiary containment system and provide an assessment on the overall capacity and that capacity against firefighting water demand.

The sites tertiary containment consists of extensive concrete external slabs with kerb upstands to the full perimeter. Within the lower areas along the perimeter i.e. to the frontage of the new tank farm loading apron. A trief kerb has been introduced to provide an increase depth locally ensuring the wider area of the sites tertiary containment system would be utilised without overtopping occurring in these lower areas.

The effective flood depth across the tertiary containment area varies between 0.38.m – 0.00m.

From an assessment using the site level survey within AutoCAD, an average depth across the full site area could be considered as 0.180m accounting for the high and low spot across the large area.

The free available area has been calculated to be 9,097m².

Assuming the average depth of 0.180m across this full area. A maximum containment volume can be calculated.

9,097 x 0.180m **= 1,637.5m³**

The following section shall review this available volume against a potential fire water demand.

3.2 Fire Water Volume

The required fire water volume to be contained within the sites full containment systems covering both secondary and tertiary systems has be calculated using CIRIA C736, Section 4.3.4 Firefighting Water.

Currently the site has no fixed firefighting systems i.e. automated sprinkler system. Two onsite fire hydrant are present located at gate 1 and gate 2

All fires must be tackled by use of Fire Engine's / Tender's.

The following assessment has been carried out using Box 4.1, Table 4.4.

Based on the solids and liquids storage on site, the severity rating can be concluded as medium. For a medium severity rating a total water demand equates to 1,080m³ / hr, for a minimum requirement of 4hours. This provides a total fire water volume of 4,320m³

Section 3.3 shall now review the full site available volume considering both Tertiary & secondary containment systems.

3.2.1 Tertiary Containment Volume

The available volume has been concluded to be 1,637.5m³ as outline in section 3.1 above.

2.3.2 Secondary Containment Volume

New Tank Farm - 1

Area	= 941m²
Free Flood Area	= 503m²
Bund Height	= 1.6m
Volume	= **804.8m³**

Existing Bund - 1

Area	= 292m²
Free Flood Area	= 193m²
Bund Height	= 1.6m
Volume	= **308.8m³**

Existing Bund - 2

Area	= 417m²
Free Flood Area	= 264m²
Bund Height	= 0.5m
Volume	= **132.0m³**

Existing Bund - 3

Area	= 105m²
Free Flood Area	= 66m²
Bund Height	= 1.6m
Volume	= **104.0m³**

Existing Bund - 4

Area	= 88m²
Free Flood Area	= 60m²
Bund Height	= 1.6m
Volume	= **96.0m³**

Total Overall Bund Volume = 1,445.60m³

Additional capacity can be found in the rainwater storage tanks that would receive water from the tertiary containment under its normal daily operation.

Rainwater Storage Tanks

2No 159m³ Tanks	= 318.0m³
1No 200m³ Tank	= 200.0m³
Volume	= **518.0m³**
Total Overall Volume	**= 1,963.60m³**

2.3.3 Summary of Fire Water Capacity

Based on the assessments the site should look to contain up to 4,320m³ with the available storage volume on site in both the secondary & tertiary containment been 3,601.1m³.

Therefore, the site falls short of the required capacity by 718.9m³.

Tankering of fire water is deemed an acceptable method, where sufficient time would be available to organise an tankering operation. Based on the available volume this would provide 3hr & 20mins before the tertiary containment would being to over top.

Tankering could be arranged within this timescale given Brocklesby Limited have onsite tankers which could undertake this operation of removing any potential shortfalls.

Section 4 Site Final Inspection & Sign Off

4.1 Brief / Conclusion

GGP was commission undertake a final inspection of the new tank farm and confirm that it had been constructed in accordance with GGP design drawing and the As-built containment was in accordance with the standards set out in CIRIA C736.

This inspection was carried out on February 2021 and covered by separated Sign off Letter contained within Appendix II.

The letter confirmed As-built was accordance with GGP drawing and meet the required of CIRIA C736. At the time of preparing the letter, details of the pip penetration through the water were not available.

These details have now been received with copies of the product datasheet's contained within Appendix III.

Following a review of the datasheet for Link Seal, it is deemed to meet the requirement with product certification. It is also noted these are used else where on the site with the local Environment Agency officer's having knowledge of these and accepting them as installed.

It is recommended these are inspected monthly to ensure they remain secure and watertight along with any further product maintenance requirements.

Jeremy Collins of GGP Consult undertook a further final inspection of the site tertiary containment 15th April 2021.

On inspection, the kerbing to the new tank farm off loading apron was completed with trief kerb installed and tie in to the original kerbing along the eastern boundary adjacent to the swale.

All areas have been concreted with no visible cracks at the time of the inspection noted.

It was noted a couple of areas still required sealing to the concrete joints, but this was progressing at the time of the inspection. At the time of the inspection the external slab to the off loading area was seen to be holding water at the low area, while the remaining slab was dry.

We consider that the new tertiary containment to the area around the new tank farm / off loading areas has been constructed and sealed in accordance with the guidance / detail within the CIRIA C736.

For Brocklesby Limited

Report Written by:-

J H Collins BSc., (Hons), MCIWEM
Associate Director – Drainage & Infrastructure

APPENDIX I

Secondary & Tertiary Catchment Plan

DRAWN AT 1:1 ON A1 FRAME

NOTES:-

All existing manholes to have cover, invert and pipes checked.

Site Permit Boundary

Tertiary Containment Flood Catchments Area

Secondary Containment Flood Area's

Secondary Containment Bund Outline

Rev	Date	Description	DR	CH
A	25/05/21	For Approval	JHC	

UVDB empowered by Achilles Registered

Link-up empowered by Achilles Qualified via Audit

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Client
BROCKLESBY Ltd.

Job Title
Alteration to Existing
Brocklesby Ltd

Drawing Title
External Works
Existing & Proposed
Containment Catchment
Plan

Status
Approval

Scale 1:400 @ A1

Date May 2021

Drawn By J. Collins | Checked J.H.C | Approved J.H.C

Drg. No. 28576 / 170

Rev A

NOT FOR CONSTRUCTION

APPENDIX II

Tank Farm Sign off Letter.

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Our ref: JHC/ 28576

28th February 2021

Brocklesby Ltd
Crossland Lane
North Cave
Brough
HU15 2PG

For the attention of Robert Brocklesby

Dear Rob,

Re: Brocklesby Ltd – Tank Farm Final Inspection & Sign off – Final Certificate

The new tank farm achieved civil construction completion in February 2021. Brocklesby Ltd are currently in the process of fitting the associated pipework for the new tank and process equipment.

The New Tank Farm has been constructed to the following drawing reference (See Appendix I)

1. GGP-28576-101-G-Piling Layout
2. GGP-28576-201-H-General Arrangement
3. GGP-28576-202-F-Sections

GGP Consult can confirm the above drawing are based on GGP original intended design and reflect the final construction.
The tank farm has been designed as a water retaining bund with reinforced insitu cast slab and walls.

Jeremy Collins of GGP Consult undertook a final inspection of the new tank farm 19th February 2021.
On inspection, the tanks have been installed, with little mechanical installation completed.

The tank bund was visually inspected internally and externally. All concrete surfaces and joints were inspected. Random spot check was carried on ton the sealant within the walls and slab. All spots check where found to be sealed with adhesion to the concrete surface.

The workmanship of the sealed joints inspected were found to be to a very good standard.

At the time of the inspection the bund was seen to be holding water, with no leaks or dam spots seen on the wall joints.

We consider that the bund has been constructed and sealed in accordance with the construction drawing and the containment calculations.

Therefore, the design is in accordance with CIRIA C736 and the As-Built construction has been carried out in accordance with the construction drawing submitted as part of the permit application.

Penetration through the wall were noted with core hole's visibly awaiting pipes. The sealing detail should be checked to be compliant with CIRIA C736 before these works are undertaken.

Image (Left) showing bund holding water

Image (Right) showing typical wall joint sealed

Image (Left) showing core holes through bund wall

Image (Right) showing external face of bund walls

Yours sincerely
For GGP Consult

J.H.Collins
BSc, (Hons), MCIWEM
Associate Director

Appendix I – As-Built Drawing

Piling Schedule

Pile Reference	Easting	Northing
P1	488139981	432165699
P2	488140596	432164165
P3	488141549	432161794 REF. F
P4	488142333	432159842
P5	488143117	432157890
P6	488143900	432155938
P7	488144684	432153986
P8	488145468	432152034
P9	488146252	432150082
P10	488147036	432148130
P11	488147820	432146178
P12	488141881	432166462
P13	488142870	432164001
P14	488143449	432162558 REF. F
P15	488144233	432160606
P16	488145017	432158653
P17	488145801	432156701
P18	488146585	432154749
P19	488147369	432152797
P20	488148153	432150845
P21	488148937	432148893
P22	488149721	432146941
P23	488144700	432167594
P24	488144575	432165224 REF. F
P25	488145340	432163317
P26	488146124	432161365
P27	488146908	432159413
P28	488147692	432157461
P29	488148476	432155509
P30	488149260	432153557
P31	488150044	432151605
P32	488150828	432149652
P33	488151612	432147700
P34	488145664	432167981

Piling Schedule

Pile Reference	Easting	Northing
P35	488146466	432165984
P36	488147231	432164077
P37	488148015	432162125
P38	488148799	432160172
P39	488149583	432158220
P40	488150367	432156268
P41	488151151	432154316
P42	488151935	432152364
P43	488152719	432150412
P44	488153503	432148460
P45	488147555	432168740
P46	488148357	432166743
P47	488149123	432164836
P48	488149907	432162884
P49	488150691	432160932
P50	488151475	432158980
P51	488152258	432157028
P52	488153042	432155076
P53	488153826	432153124
P54	488154610	432151171
P55	488155394	432149219
P56	488149446	432169500
P57	488150248	432167503
P58	488151014	432165596
P59	488151798	432163644
P60	488152582	432161691
P61	488153366	432159739
P62	488154150	432157787
P63	488154934	432155835
P64	488155718	432153883
P65	488156502	432151931
P66	488157285	432149979

Piling Schedule

Pile Reference	Easting	Northing
P67	488151337	432170259
P68	488152139	432168262
P69	488152905	432166355
P70	488153689	432164403
P71	488154473	432162451
P72	488155257	432160499
P73	488156041	432158547
P74	488156825	432156595
P75	488157609	432154643
P76	488158784	432151716 REF. F
P77	488159177	432150738
P78	488153228	432171019
P79	488154030	432169021
P80	488154796	432167115
P81	488155580	432165163
P82	488156364	432163210
P83	488157148	432161258
P84	488157932	432159306
P85	488158716	432157354
P86	488159500	432155402
P87	488160284	432153450
P88	488161068	432151498
P89	488155120	432171778
P90	488155922	432169781
P91	488156687	432167874
P92	488157471	432165922
P93	488158255	432163970
P94	488159039	432162018
P95	488159823	432160066
P96	488160607	432158114
P97	488161391	432156161
P98	488162175	432154209
P99	488162959	432152257

Piling Schedule

Pile Reference	Easting	Northing
P100	488157011	432172538
P101	488157813	432170540
P102	488158579	432168634
P103	488159363	432166682
P104	488160147	432164729
P105	488160930	432162777
P106	488161714	432160825
P107	488162498	432158873
P108	488163282	432156921
P109	488164066	432154969
P110	488164850	432153017
P111	488158902	432173297
P112	488159243	432171496
P113	488159727	432169095 REF. F
P114	488161254	432167441 REF. F
P115	488162038	432165489
P116	488162822	432163537
P117	488163606	432161585
P118	488164390	432159633
P119	488165174	432157680
P120	488165957	432155728
P121	488166741	432153776
P122	488160793	432174057
P123	488161595	432172059
P124	488162361	432170153 REF. F
P125	488163145	432168200 REF. F
P126	488163929	432166248
P127	488164713	432164296
P128	488165497	432162344
P129	488166281	432160392
P130	488167065	432158440
P131	488167849	432156488

Piling Schedule

Pile Reference	Easting	Northing
P132	488168633	432154536
P133	488162684	432174816
P134	488164971	432173415
P135	488165219	432170115 REF. F
P136	488165036	432168960 REF. F
P137	488165820	432167008
P138	488166604	432165056
P139	488167388	432163104
P140	488168172	432161152
P141	488168956	432159199
P142	488169740	432157247
P143	488170524	432155295
P144	488165320	432175875
P145	488166122	432173877
P146	488166888	432171970
P147	488167672	432170018
P148	488168456	432168066
P149	488169240	432166114
P150	488170023	432164162
P151	488170807	432162210
P152	488171591	432160258
P153	488172375	432158306
P154	488173159	432156354
P155	488167955	432176933
P156	488168757	432174936
P157	488169523	432173029
P158	488170307	432171077
P159	488171091	432169125
P160	488171875	432167172
P161	488172659	432165220
P162	488173443	432163268
P163	488174227	432161316
P164	488175011	432159364
P165	488175795	432157412
P166	488170591	432177991
P167	488171393	432175994
P168	488172159	432174087
P169	488172942	432172135
P170	488173726	432170183
P171	488174510	432168231
P172	488175294	432166279
P173	488176078	432164327
P174	488176862	432162375
P175	488177646	432160422
P176	488178430	432158470

Piling Schedule

Pile Reference	Easting	Northing
P177	488173226	432179050
P178	488174028	432177052
P179	488174794	432175146
P180	488175578	432173193
P181	488176362	432171241
P182	488177146	432169289
P183	488177930	432167337
P184	488178714	432165385
P185	488179498	432163433
P186	488180282	432161481
P187	488181066	432159529
P188	488175861	432180108
P189	488176664	432178111
P190	488177429	432176204
P191	488178213	432174252
P192	488178997	432172300
P193	488179781	432170348
P194	488180565	432168395
P195	488181349	432166443
P196	488182133	432164491
P197	488182917	432162539
P198	488183701	432160587
P199	488178497	432181166
P200	488179299	432179169
P201	488180065	432177262
P202	488180849	432175310
P203	488181633	432173358
P204	488182417	432171406
P205	488183201	432169454
P206	488183985	432167502
P207	488184768	432165550
P208	488185552	432163598
P209	488186336	432161645
P210	488181934	432180227
P211	488182700	432178321
P212	488183484	432176369
P213	488184268	432174416
P214	488185052	432172464
P215	488185836	432170512
P216	488186620	432168560
P217	488187404	432166608
P218	488188188	432164656
P219	488188972	432162704
P220	488181132	432182225
P221	488159634	432154314 REF. F

TOTAL PILES : 219

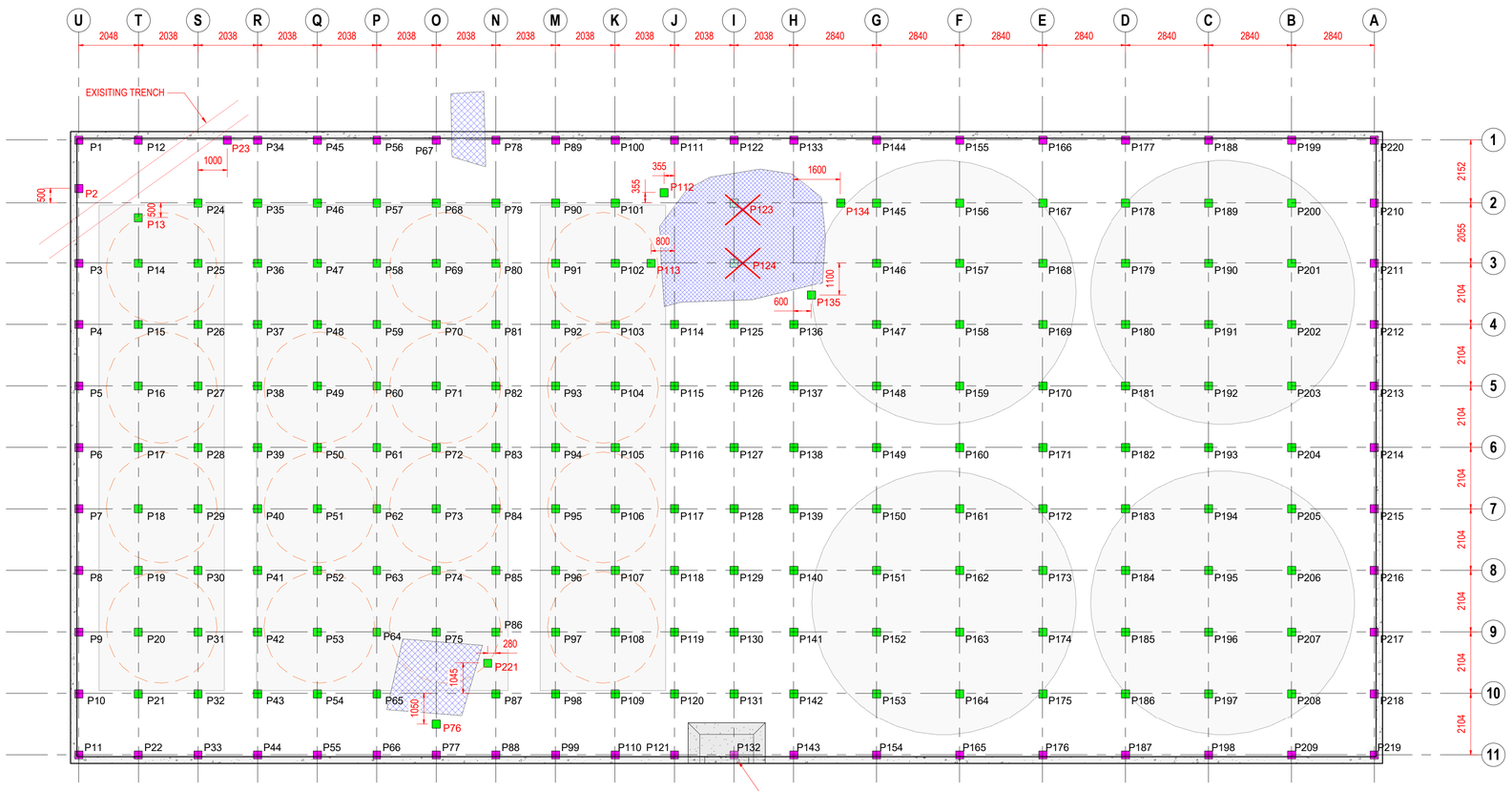
STEEL TUBE PILES

PILE CUT-OFF LEVEL:
-0.400m BELOW SSL
(EXCEPT P132 (-0.800mm))

PILE LOADS:
- HORIZONTAL UNFACTORED LOADS GENERALLY **+/- 20kN**

DENOTES VERTICAL SWL: 450kN

DENOTES VERTICAL SWL: 700kN



PILE LAYOUT
1 : 100

PILE P132 CUT OFF LEVEL 400mm LOWER THAN ALL OTHER PILES TO SUIT SUMP LEVEL

Piling Notes

1. Piles to be designed by Specialist, using information provided in the geotechnical report. The Specialist is to confirm their detail prior to works commencing on site.
2. All piles shall be designed by Specialist as steel tube piles.
3. All piles to be designed to resist a horizontal load of 20kN per pile.
4. Piles to be load tested in accordance with the "ICE Specification for Piling and Embedded Retaining Walls" (SPERW).
5. All piles to be integrity tested and the results recorded for inspection.
6. Testing:
   - Minimum one working test for each pile size
   - Minimum 1 preliminary pile test per 500 piles
   - Minimum 1 working pile test per 100 piles
7. A minimum factor of safety of 2.5 x safe working load shall be provided.
8. Design life 75 years.
9. All piles must be designed to comply with the specified load test settlement criteria.
10. The setting out tolerance for all piles shall not exceed 75mm in any directions.
11. Pile cut level 50mm projection unless noted otherwise.
12. All piles to be brought up and cast to ground level, or a minimum 300mm above cut-off level, by the piling sub-contractor.
13. The main contractor shall to agree and record the lengths of all piles before placing concrete.
14. Pile reinforcement projection in to pile cap in accordance with Eurocode 2.
15. Minimum structural concrete grade C28/35.
16. Minimum cover to reinforcement 50mm unless noted otherwise.
17. Minimum laps in accordance with Eurocode 2.

Rev	Date	Description	DR	CH
G	19/08/20	TYPE OF PILE NOTE AMENDED	SG	CM
F	18/08/20	EXISTING SERVICE TRENCH AND CONCRETE BASE ADDED	SG	JC
E	14/08/20	ISSUED FOR CONSTRUCTION	SG	JC
D	03/08/20	TANKS AND PILES MIRRORED	SG	CM
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B	17/06/20	PILE LAYOUT AMENDED, EXTERNAL WALL HEIGHT RAISED	SG	LK
A	19/02/20	FOR PRICING	JA	MW

UVDB empowered by Achilles Registered
Link-up empowered by Achilles Qualified via Audit
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Client
BROCKLESBY

Job Title
PROPOSED TANK FARM BUND

Drawing Title
PILING LAYOUT

Status
CONSTRUCTION

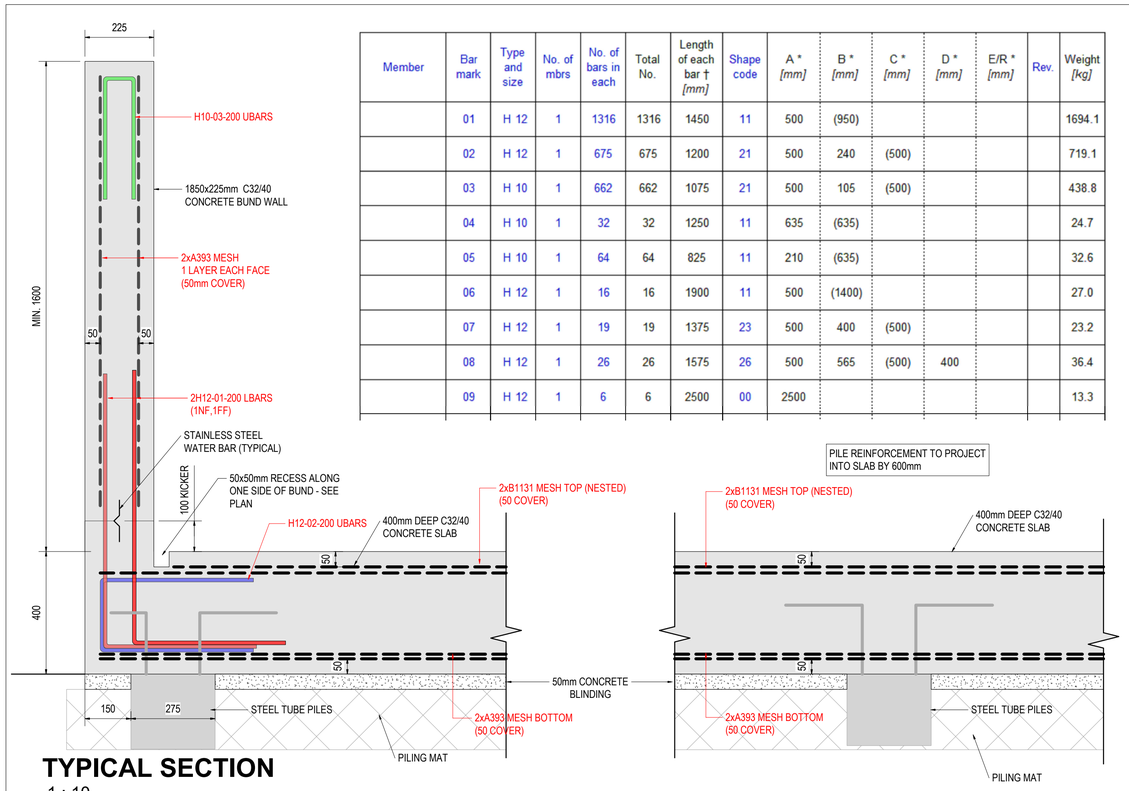
Scale	Date
1 : 100	FEB' 2020

Drawn By	Checked	Approved
JA	MW	MW

Drg. No.	Rev
28576 101	G

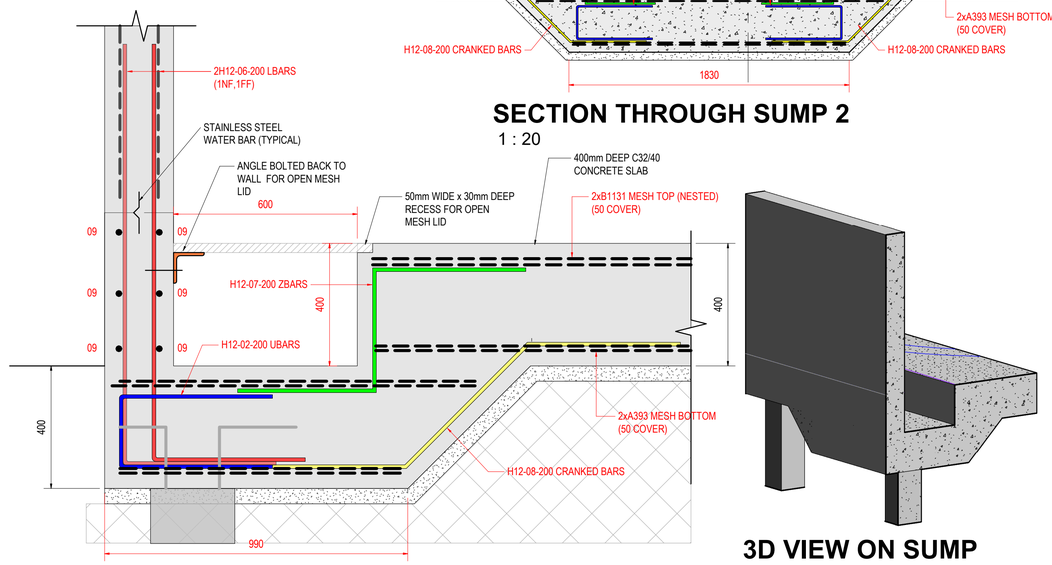
A1 - ORIGINAL SHEET SIZE

Member	Bar mark	Type and size	No. of mbrs	No. of bars in each	Total No.	Length of each bar † [mm]	Shape code	A * [mm]	B * [mm]	C * [mm]	D * [mm]	E/R * [mm]	Rev.	Weight [kg]
	01	H 12	1	1316	1316	1450	11	500	(950)					1694.1
	02	H 12	1	675	675	1200	21	500	240	(500)				719.1
	03	H 10	1	662	662	1075	21	500	105	(500)				438.8
	04	H 10	1	32	32	1250	11	635	(635)					24.7
	05	H 10	1	64	64	825	11	210	(635)					32.6
	06	H 12	1	16	16	1900	11	500	(1400)					27.0
	07	H 12	1	19	19	1375	23	500	400	(500)				23.2
	08	H 12	1	26	26	1575	26	500	565	(500)	400			36.4
	09	H 12	1	6	6	2500	00	2500						13.3

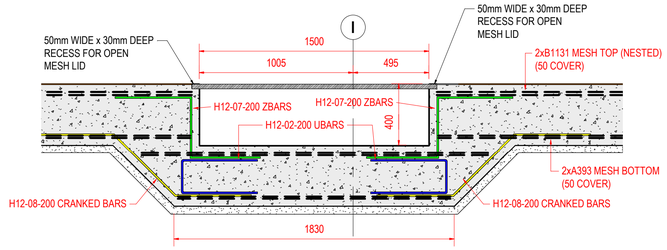


TYPICAL SECTION
1 : 10

BOLTS FOR TANK BASES
USE M24 (8.8) BOLTS
FIXED WITH R-KEX II RAWL PLUGS
550mm EMBEDMENT

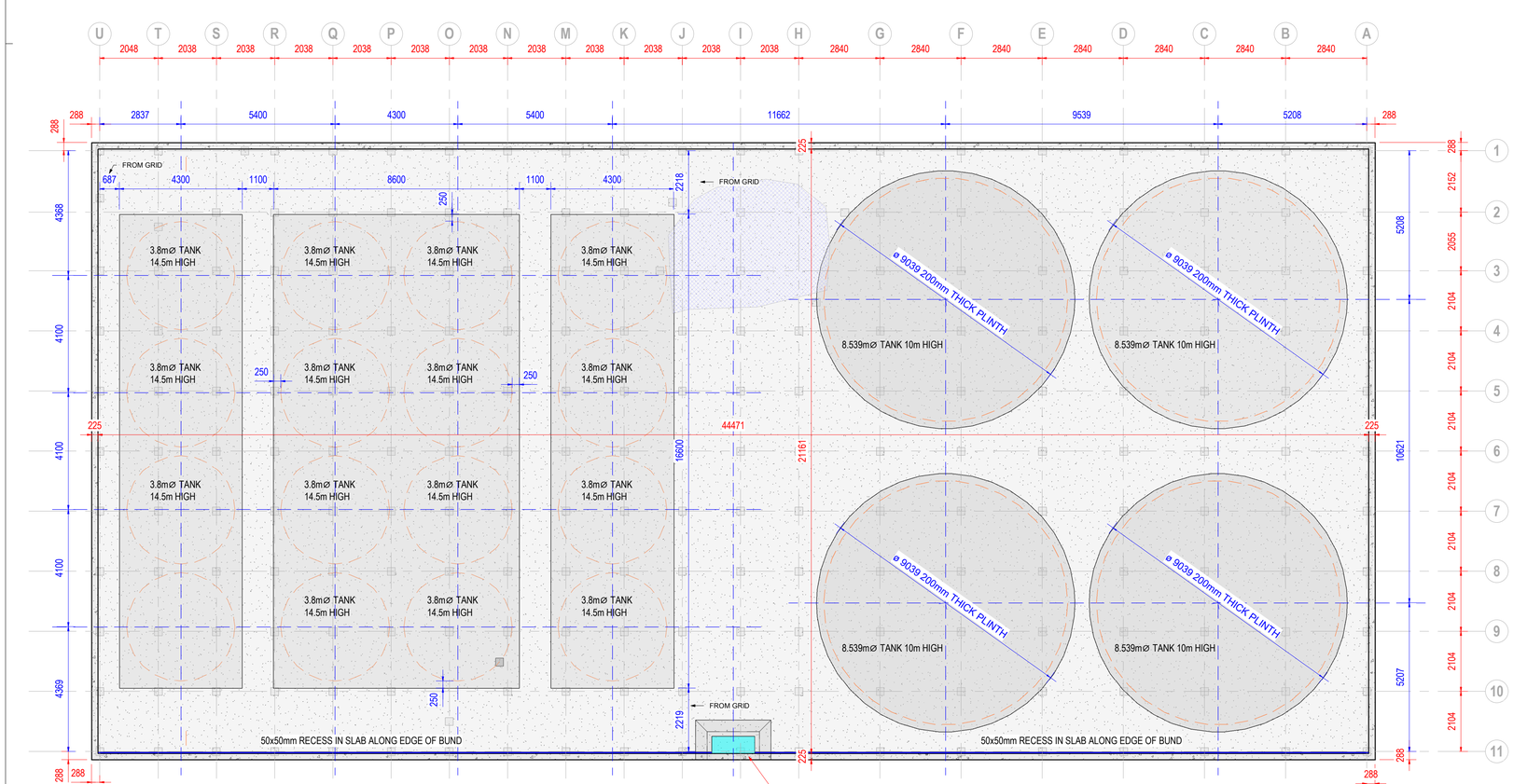


SECTION THROUGH SUMP 1
1 : 10

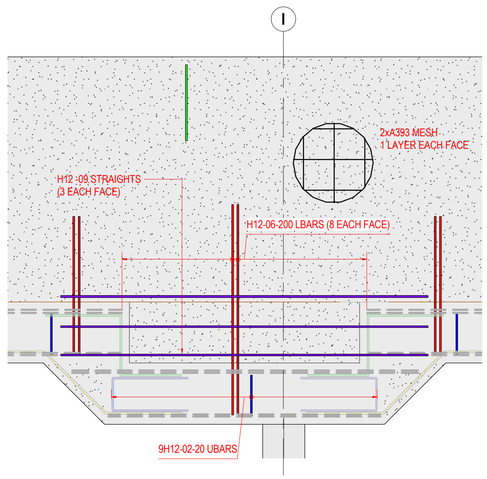


SECTION THROUGH SUMP 2
1 : 20

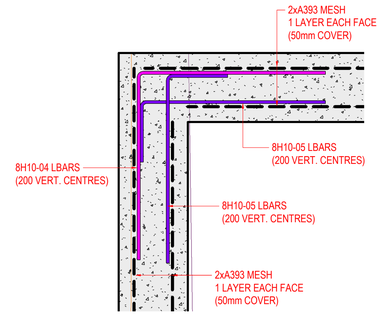
3D VIEW ON SUMP



PLAN ON TANK BUND
1 : 100



ELEVATION ON WALL AT SUMP LOCATION
1 : 20



TYPICAL 1850 HIGH CORNER DETAIL
1 : 10

4No. THUS REQUIRED

Concrete Notes

1. Concrete grades to be designated concretes:
   - Blinding GEN1
   - Ret. walls RC32/40
   - Slab RC32/40
2. Concrete finishes to be:
   - Ground beams Basic
   - Slab - surface to be power floated to acceptable finishes.
3. Concrete cover:
   - Foundations 50mm Bottom, 50mm Top & Sides.
   - Slab 50mm
4. All soft spots to be removed / replaced with well compacted granular material.
5. Concrete chemical resistance class DS-2.
6. Concrete testing required according to BS EN 12350-1:2000 and specification.
7. Concrete structures shown on this drawing to be in accordance with Eurocode2.
8. All concrete materials and operations are to be in accordance with the 'National Specification for Structural Concrete'.
9. Fixing and placement of holding down bolts to be the responsibility of the main contractor.
10. Minimum laps to be in accordance with BS 8110.
11. Bottom of excavations to be flat, clean & dray when concrete is poured.
12. Any obstructions encountered during excavation works shall be notified to the Engineer as soon as possible.
13. The formation shall be inspected by Building Control prior to casting concrete, & shall be free from debris, topsoil & deleterious matter.
14. Immediately after compaction, concrete shall be protected from rain, rapid temperature change, frost and drying out.
15. Compaction of sub-grade to be in accordance with MCHW specification.

Rev	Date	Description	DR	CH
H	24/09/20	TANK BOLTS NOTE ADDED	SG	CM
G	19/08/20	TYPE OF PILE NOTE AMENDED	SG	CM
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A	19/02/20	FOR PRICING	JA	MW

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Link-up empowered by Achilles Qualified via Audit
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Client: BROCKLESBY

Job Title: PROPOSED TANK FARM BUND

Drawing Title: GENERAL ARRANGEMENT & DETAILS & REINFORCEMENT

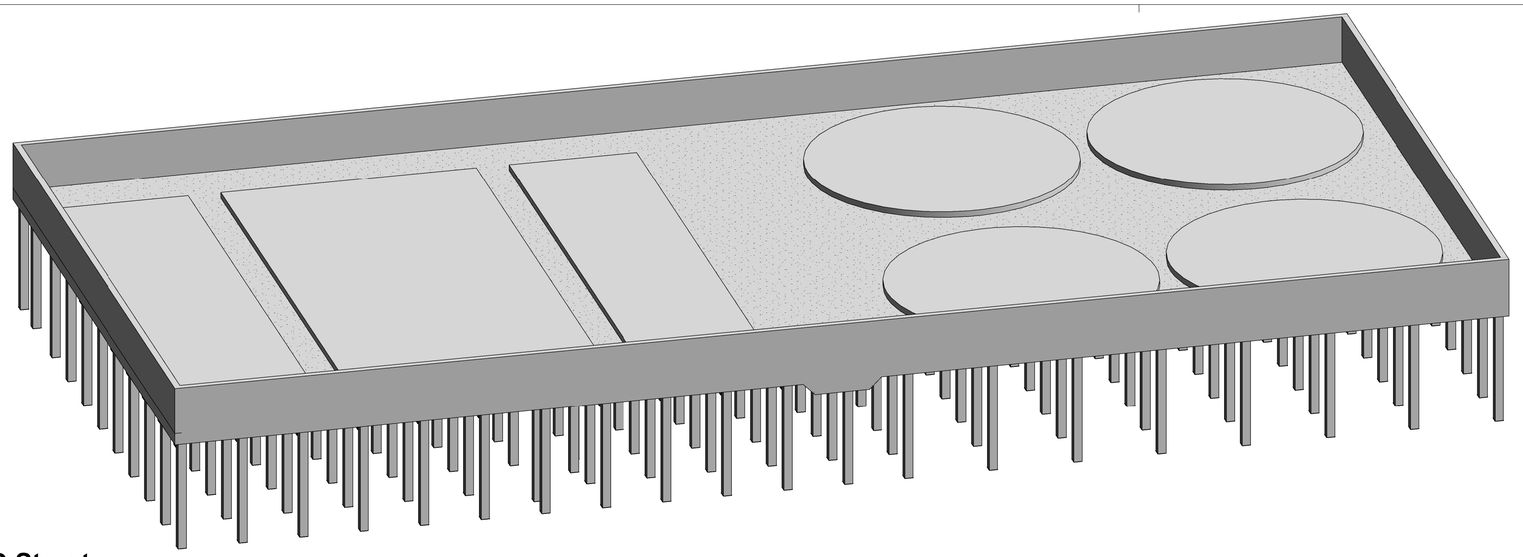
Status: CONSTRUCTION

Scale: As indicated | Date: FEB' 2020

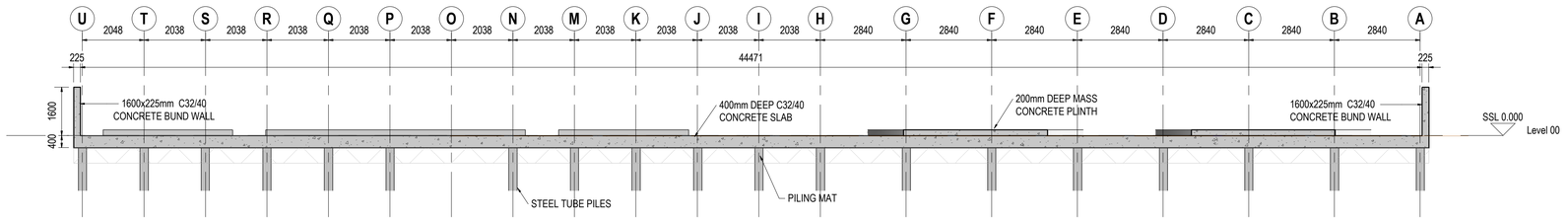
Drawn By: JA | Checked: MW | Approved: MW

Drg. No.: 28576 | Rev: 201 H

A1 - ORIGINAL SHEET SIZE

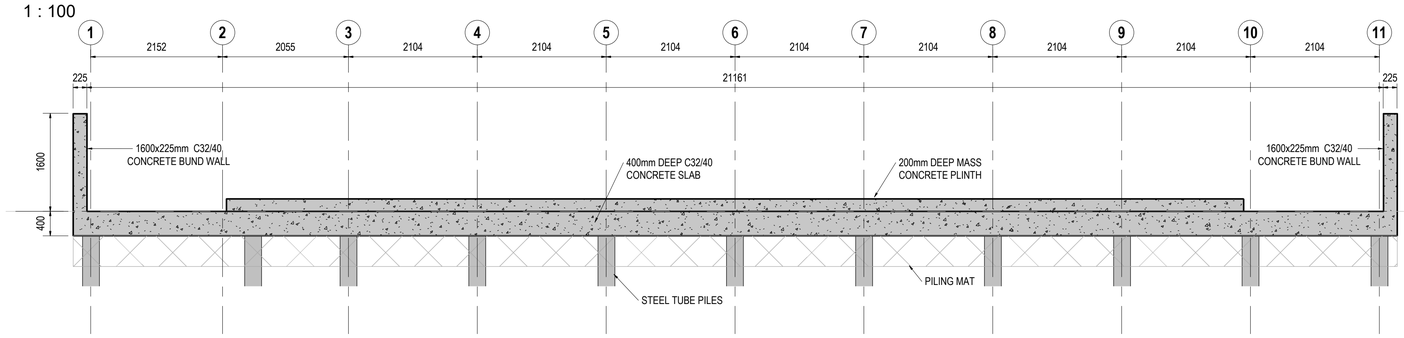


3D Structure



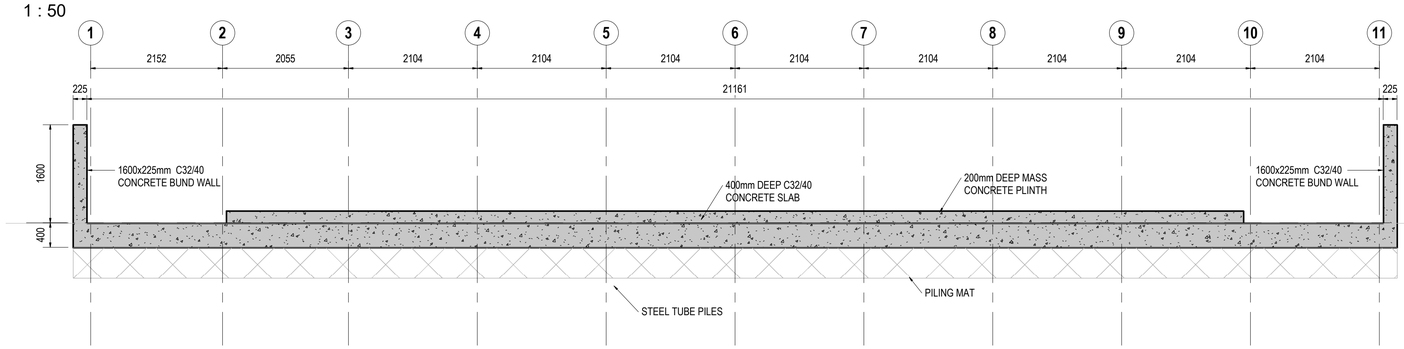
SECTION C-C

1 : 100



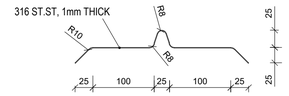
SECTION B-B

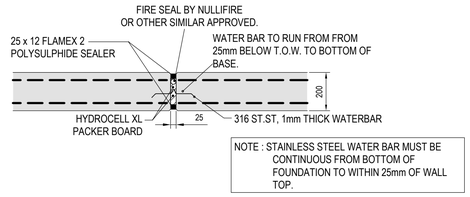
1 : 50



SECTION A-A

1 : 50

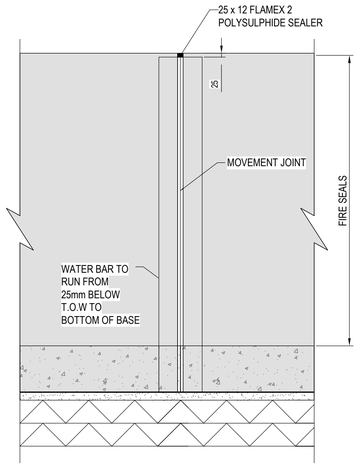




NOTE : STAINLESS STEEL WATER BAR MUST BE CONTINUOUS FROM BOTTOM OF FOUNDATION TO WITHIN 25mm OF WALL TOP.

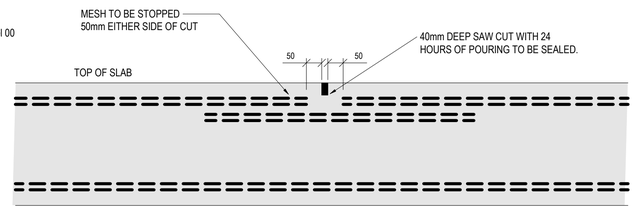
MOVEMENT JOINT DETAIL (IN WALL)

(SCALE 1:20)



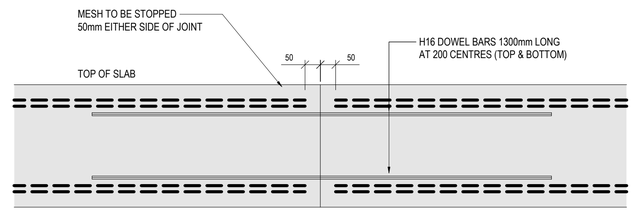
ELEVATION OF WATER BAR IN BUND WALL

(SCALE 1:20)



TYPICAL SAW CUT DETAIL

SCALE: 1:10 @ A1



TYPICAL CONSTRUCTION JOINT DETAIL

(JOINT POSITIONED TO SUIT CONTRACTORS POUR SEQUENCE)

SCALE: 1:10 @ A1

Rev	Date	Description	DR	CH
F	19/08/20	TYPE OF PILE NOTE AMENDED	SG	CM
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A	19/02/20	FOR PRICING	JA	MW

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Client: BROCKLESBY

Job Title: PROPOSED TANK FARM BUND

Drawing Title: PROPOSED SECTIONS THROUGH BUND & JOINT DETAILS

Status: CONSTRUCTION

Scale: As indicated | Date: FEB' 2020

Drawn By: JA | Checked: MW | Approved: MW

Drg. No.: 28576 202 | Rev: F

A1 - ORIGINAL SHEET SIZE

Appendix II – Bund Calculations

	Project			Job No.
GGP CONSULT	Brocklesby Tank Farm			**28576**
	Drawing ref.	Calculations by	Checked by	Calc. Sheet No.
	Unit			Date Nov-20

Tank Bund Calculation

Option 1 - 110% of biggest tank

1 No Large tank 8.539m diameter tank x 10m length
Area = 57.28m^2
Volume = 578.8m^3

110% Volume = 635.8m^3

Bund Area = 44.471m x 21.161m = 941.05m^2

- Area of rest of tanks (353m^2)
= 588m^2

height of bund wall = 635.8/588 = = 1.08m high
+ 0.25 (fire fighting and rain)
= 1.33m high

Option 2 - 25% of All tanks

4 No large tanks volume = 2315.2m^3
16 No small tanks volume = 2630m3
Total = 4945m^3
x 0.25 = 1236.25m3

Bund wall height = 1236.25/941.05 (bund area) = 1.313m high
+ 0.25m (fire fighting and rain)
= 1.563m high

APPENDIX III

Link Seal Datasheets

PIPE EQUIPMENT SPECIALISTS LTD

OFFICIAL UK DISTRIBUTOR

Link-Seal®

Link-Seal® modular seals are considered to be the premier method for permanently sealing pipes of any size passing through casing pipes, walls, floors and ceilings. In fact, any cylindrical object may be quickly, easily and permanently sealed, as they pass through barriers, by the patented Link-Seal® modular seal design.

Ductile iron, concrete, metal as well as plastic pipes may be hydrostatically sealed within walls to hold up to 1.4 bar (20 psig) 12m (40ft of static head). Electrical or telecommunications cable may be sealed within conduit as they enter vaults or manholes. The annular space between carrier pipes passing through casings may be sealed against the entry of water, soil or backfill material.

With a wide variety of hardware/elastomer combinations, Link-Seal® modular seals are easily configured to achieve the best possible match for service conditions encountered. High temperature seals, fire seals (Factory Mutual Approved) and oil resistant seals may be ordered to meet special or unique service applications. For the system approach, metal or non-conductive Century-Line® sleeves with water stops may be ordered with Link-Seal® modular seals to ensure correct positioning and a water tight seal of the installation within poured concrete walls.

Link-Seal® modular seals are also available for a wide variety of special applications, temperature extremes, exotic chemical combinations and for “out of round” or non-centered applications. Please contact us for your special application

PIPE EQUIPMENT SPECIALISTS LTD
66 DUKESWAY, TEESSIDE INDUSTRIAL ESTATE, THORNABY, STOCKTON-ON-TEES, TS17 9LT, ENGLAND
TEL: +44 (0) 1642 769789 FAX: +44 (0) 1642 769456
www.pipe-equipment.co.uk Email: info@pipe-equipment.co.uk

ISOQAR REGISTERED UKAS MANAGEMENT SYSTEMS 0026
Certificate Number: 1253

Benefits/Features

Saves Time and Money

Link-Seal® modular seals install in up to 75% less time compared to lead-oakum joints, hand-fitted flashings, mastics, or casing boots.

Positive Hydrostatic Seal

Link-Seal® modular seals are rated at 1.4 bar (20 psig) 12m (40ft of head), which exceeds the performance requirements of most applications.

Long Seal Life

Link-Seal® modular seals are designed for use as a permanent seal. Seal elements are specially compounded to resist aging and attack from ozone, sunlight, water, and a wide range of chemicals.

Maximum Protection Against Corrosion

Standard fasteners have a two-part zinc dichromate and proprietary corrosion inhibiting coating. Corrosion resistant 316 stainless steel available for maximum corrosion protection.

Certifications/Approvals

Factory Mutual Fire Approved. Also a wide variety of approvals from various Federal agencies, associations, code groups, laboratories, and organizations.

ISO Quality Assurance

Link-Seal® modular seals are manufactured in an ISO 9001:2000 certified facility.

Configure a Link-Seal® Modular Seal to Match Your Application

16 sizes, color-coded EPDM, Nitrile, and Silicone elastomers may be used with various hardware options to match performance characteristics with service conditions.

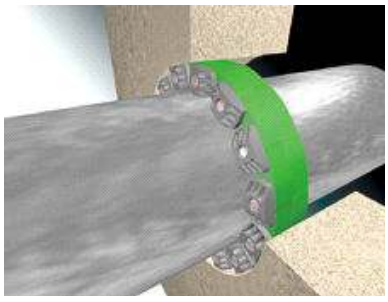
Typical Applications for sealing wall penetrating pipes

Century-Line® Model CS Sleeves in combination with low-durometer EPDM (blue) Link-Seal® Modular Seals

Century-Line® Model CS Sleeves are ideal for poured wall construction. Made of HDPE thermoplastic, they are lightweight and easy to handle. Molded-in and reinforcing ribs serve to anchor the sleeve in the wall and resist pour forces. Nailer end caps are provided to make placement in forms simple and accurate. Sleves are available in 16 diameters, up to 25", and any length. In the event of a field change they can be shortened with ordinary hand tools.

Typical Applications - Mechanical Contractors - Interior Piping Systems * Floor Sleeves * Wall Sleeves * Manhole Pipe Entry Seals * Waste Treatment Plants * Cased Road Crossings * Elevator Shafts * Power Generating Dams * Thermal Storage Systems * Fire Protection Wall Penetrations * Cased Railroad Crossings * Electrical Isolation of Pipes * Precast Concrete Pipe Seals *Insulated Pipe Seals * Dual Containment Seals * Marine Applications * Noise Dampening

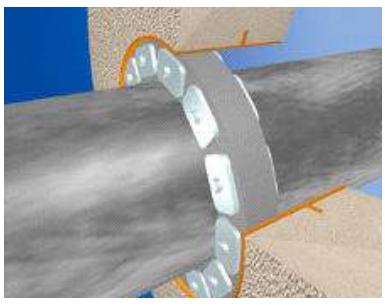
Pre-cast or Cored Wall Openings in Combination with Nitrile (green) Link-Seal® Modular Seals



Link-Seal® Modular Seals are also commonly installed in cored wall openings or pre-cast openings such as those formed by the use of Cell-Cast® Disks for pipe penetration hole forms.

Typical Applications - Flexible Sign & Pole Supports * Electrical Isolation of Pipe Supports for Corrosion Protection * Mining * Pulp & Paper * Decorative Fountains * Bank Tube Transfer Systems * Pool Contractors * Electrical Contractors * Marine Applications * Waste & Water Treatment * Telecommunications * Railway Crossings * Valve Pits * Refrigeration Buildings * Overhead Signs * Guard Post Assemblies * Power Generation Dams * Offshore Oil Rigs * High Pressure Tank Guards * Underground Steel Tanks * Centuryline

Model WS Steel Sleeves in combination with Silicone (grey) Link-Seal® Modular Seals



Model WS Steel Sleeves are made from heavy-wall welded or seamless pipe. A full circle water-stop plate acts as a positive water seal and anchor to prevent thrust movement. The 2in collar (water-stop) is continuously welded on both sides. Model WS is available in a wide range of diameters and any length. Sleeves are protected by a coating of red primer. Hot dip galvanizing is available on request.

Typical Applications - Precast Concrete Manufacturers * Perimeter Berm Installations Around Tank Farms * Flow Restrictors in Sewer Maintenance * Fluid Overflow Devices * Noise and Sway Dampener * Through Deck Fire Breaks * Parking Garage Column Protectors * Cable TV Installations * Bridge Construction * Septic Tank Installations * Coal Preparation Plants * Pile Driving Operations * Flag Pole Installations * Driving Contractors * Tunneling Operations

Link-Seal® Hardware and Seal Options

Model "C" or "L" Link-Seal Modular Seal

Suitable for use in water, direct ground burial and atmospheric conditions. Provides electrical insulation where cathodic protection is required.

Color: Black or Blue

Type: Standard
Seal Element:EPDM (Black), EPDM (Blue)
Pressure Plates: Reinforced Nylon Polymer
Bolts & Nuts: Steel with 2-part Zinc Dichromate & Proprietary Corrosion Inhibiting Coating
Temp. Range: -40 to +250F. (-40 to +121C.)*
* = Sustained operation near temperature limits may affect life expectancy.

Model "S-316" Link-Seal Modular Seal

For chemical processing waste water treatment. EPDM rubber is resistant to most inorganic acids and alkalis, some organic (chemicals acetone, alcohol, ketone).

Color: Black or Blue

Type: Stainless
Seal Element: EPDM (Black), EPDM (Blue)
Pressure Plates: Reinforced Nylon Polymer
Bolts & Nuts: 316 Stainless Steel
Temp. Range: -40 to +250F. (-40 to +121C.)*
* = Sustained operation near temperature limits may affect life expectancy.

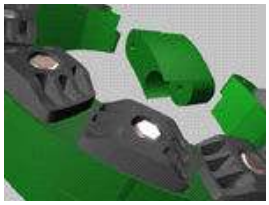
Model “S61” Link-Seal® Modular Seal

NSF 61 Certified for use in potable water (drinking water)

Color: Black

Type: Stainless
Seal Element:EPDM (Black)
Pressure Plates: Blue Reinforced Nylon Polymer
Bolts & Nuts: 316 Stainless Steel
Temp. Range: -40 to +250F. (-40 to +121C.)*
* = Sustained operation near temperature limits may affect life expectancy.

Model "OS-316" Link-Seal Modular Seal



Nitrile rubber is resistant to oils, fuel and many solvents (gasoline, motor oil, kerosene, methane, jet fuel, hydraulic fluid, water, etc.).

Color: Green

Type: Oil Resistant
Seal Element: Nitrile (Green)
Pressure Plates: Reinforced Nylon Polymer
Bolts & Nuts: 316 Stainless Steel
Temp. Range: -40 to +210F. (-40 to +99C.)*
* = Sustained operation near temperature limits may affect life expectancy.

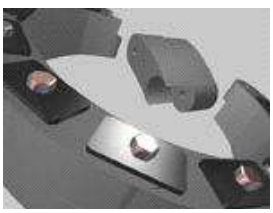
Model "T" Link-Seal Modular Seal

Silicone rubber is ideal for temperature extremes. "T" model is Factory Mutual approved.

Color: Grey

Type: High/Low Temperature
Seal Element: Silicone (Grey)
Pressure Plates: Steel Zinc Dichromate
Bolts & Nuts: Steel with 2-part Zinc Dichromate & Proprietary Corrosion Inhibiting Coating
Temp. Range: -67 to +400F. (-55 to +204C.)*
* = Sustained operation near temperature limits may affect

Model "FD/FS" Link-Seal Modular Seal

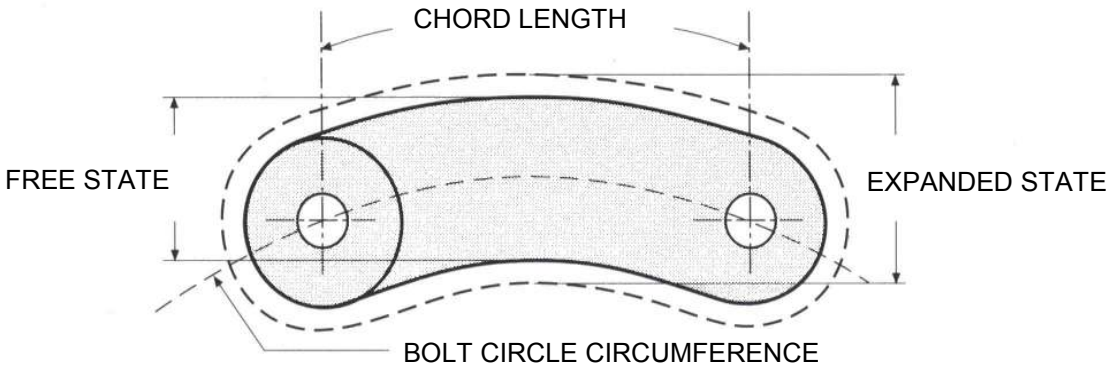


Double Seal for added protection.

Color: Grey

Type: Fire Seals
Seal Element: Silicone (Grey)
Pressure Plates: Steel Zinc Dichromate
Bolts & Nuts: Steel with 2-part Zinc Dichromate & Proprietary Corrosion Inhibiting Coating
Temp. Range: -67 to +400F. (-55 to +204C.)*
* = Sustained operation near temperature limits may affect life expectancy.

LINK SEAL® SELECTION TABLE



MODEL	SEALING RANGE (mm) [ANNULAR SPACE]		CHORD LENGTH (mm)
	FREE STATE	EXPANDED	
LS200	12.7	15.7	30.0
LS275	16.0	20.0	25.1
LS300	18.0	22.5	40.0
LS315	21.1	26.0	38.4
LS325	23.2	30.0	79.4
LS340	25.5	34.0	41.4
LS360	32.0	42.0	55.1
LS400	36.3	46.0	93.1
LS410	37.0	48.5	67.6
LS425	28.4	37.0	93.1
LS475	41.3	48.5	68.3
LS500	60.3	71.5	99.1
LS525	55.4	63.5	99.1
LS575	48.0	58.0	79.5
LS625	83.0	98.0	106.7

SEALING RANGE

This is size of the annular gap between the outer pipe inside diameter, and the outside diameter of the inner pipe or cable. From this you can determine which seal to use from the above table.

$$\text{Sealing Range (mm)} = \frac{\text{Inside Diameter (mm)} - \text{Pipe or Cable Outside Diameter (mm)}}{2}$$

BOLT CIRCLE CIRCUMFERENCE

Bolt Circle Circumference (mm) = [Sealing Range (mm) + Pipe OD (mm)] x 3.14

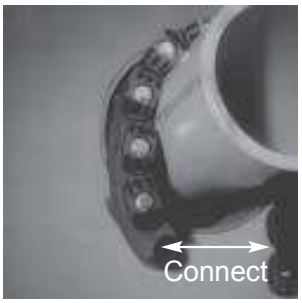
NUMBER OF LINKS

The number of links required is the bolt circle circumference divided by the link chord length. The chord length is taken from the above table (the same line as the chosen seal).

$$\text{Number of Links} = \frac{\text{Bolt Circle Circumference (mm)}}{\text{Chord Length (mm)}} \text{ (rounded to the nearest whole number)}$$

Installation Techniques - Link-Seal® Modular Seals

1. Center the pipe, cable or conduit in wall opening or casing. Make sure the pipe will be adequately supported on both ends. Link-Seal® modular seals are not intended to support the weight of the pipe.

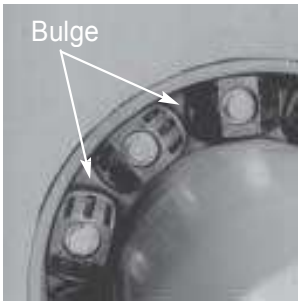


2. Loosen rear pressure plate with nut just enough so links move freely. Connect both ends of belt around the pipe.

3. Check to be sure all bolt heads are facing the installer. Extra slack or sag is normal. Do not remove links if extra slack exists. Note On smaller diameter pipe, links may need to be stretched.

4. Slide belt assembly into annular space. For larger size belts, start inserting Link-Seal modular seal assembly at the 6 O'Clock position and work both sides up toward the 12 O'Clock position in the annular space.

5. Start at 12'O Clock and tighten bolt until rubber begins to "bulge". Do not tighten any bolt more than 4 turns at a time. Continue in a clockwise manner until links have been uniformly compressed. (Approx. 2 or 3 rotations)



6. Make 2 or 3 more passes at 4 turns per bolt MAXIMUM, tightening all bolts clockwise until all sealing elements bulge

7. If the seal doesn't appear to be correct using the instructions provided, Call Pipe Equipment Specialists on 00 44 (0) 1642 769 789. Repeat Tightening after approx 2 hours.

Max. torque at 23°C			
For types C, S316 rubber black, O and OS316 rubber green, type T rubber grey Shore 50° ± 5°	For types BC and BS316 rubber blue Shore 40° ± 5°	For types LS version KTW/W270 Shore 50° ± 5°	Type
2 Nm	2 Nm	2 Nm	LS 2010 to LS275
8 Nm	6 Nm	8 Nm	LS 300 to LS 360
27 Nm	20 Nm	27 Nm	LS 400 to LS 475
65 Nm	50 Nm	65 Nm	LS 500 to LS 575
110 Nm	65 Nm	-	LS 615
65 Nm	50 Nm	65 Nm	LS 625 to LS 700

Always Wear Safety Equipment When Using Link-Seal® Modular Seals!

Link-Seal® Modular Seal - Do's

Make sure pipe is centered.

Install the belt with the pressure plates evenly spaced.

Install the exact number of links indicated in sizing charts.

Check to make sure pipe is supported properly during backfill operations.

Make sure seal assembly and pipe surfaces are free from dirt

Link-Seal® Modular Seal - Do Not's

Don't Install the belt with the pressure plates aimed in irregular directions. (Staggered)

Don't Install Link-Seal® modular seals with spiral weld pipe.

Don't torque each bolt completely before moving on to the next.

Don't use high speed power tools (450 rpm or less)

Do not use power tools with Link-Seal modular seal 316 stain- less steel bolts.

PIPE EQUIPMENT SPECIALISTS LTD
66 DUKESWAY, TEESSIDE INDUSTRIAL ESTATE, THORNABY, STOCKTON-ON-TEES, TS17 9LT, ENGLAND
TEL: +44 (0) 1642 769789 FAX: +44 (0) 1642 769456
www.pipe-equipment.co.uk Email: info@pipe-equipment.co.uk

OFFICIAL UK DISTRIBUTOR

Link-Seal® Modular Seal Model Properties

WITH EPDM SEAL ELEMENTS

EPDM (Black)

* = Sustained operation near temperature limits may affect life expectancy.

Model "C" Link-Seal® Modular Seal
Suitable for use in water, direct ground burial and atmospheric conditions. Provides electrical isolation where cathodic protection is required.
Type: Standard
Seal Element: EPDM (Black)
Pressure Plates: Reinforced Nylon Polymer
Bolts & Nuts: Steel with 2-part Zinc Dichromate & proprietary corrosion inhibiting coating.
Temp. Range: -40 to +250ºF (-40 to +121ºC)*

Model "S-316" Link-Seal® Modular Seal
For chemical processing & waste water treatment. EPDM rubber is resistant to most inorganic acids and alkalis, some organic chemicals (acetone, alcohol, ketones).
Type: Stainless
Seal Element: EPDM (Black)
Pressure Plates: Reinforced Nylon Polymer
Bolts & Nuts: 316 Stainless Steel
Temp. Range: -40 to +250ºF (-40 to +121ºC)*

WITH EPDM SEAL ELEMENTS

EPDM (Blue)
Low Durometer

* = Sustained operation near temperature limits may affect life expectancy.

Model "L" Link-Seal® Modular Seal
Low Durometer EPDM specifically designed for use with fragile pipe and tubing. Suitable for use in water, direct ground burial and atmospheric conditions. Provides electrical isolation where cathodic protection is required.
Type: Standard
Seal Element: EPDM (Blue)
Pressure Plates: Reinforced Nylon Polymer
Bolts & Nuts: Steel with 2-part Zinc Dichromate & proprietary corrosion inhibiting coating.
Temp. Range: -40 to +250ºF (-40 to +121ºC)*

Model "LS-316" Link-Seal® Modular Seal
Low Durometer EPDM specifically designed for use with fragile pipe and tubing. For chemical processing & waste water treatment. EPDM rubber is resistant to most inorganic acids and alkalis, some organic chemicals (acetone, alcohol, ketones).
Type: Stainless
Seal Element: EPDM (Blue)
Pressure Plates: Reinforced Nylon Polymer
Bolts & Nuts: 316 Stainless Steel
Temp. Range: -40 to +250ºF (-40 to +121ºC)*

WITH NITRILE SEAL ELEMENTS

Nitrile (Green)

* = Sustained operation near temperature limits may affect life expectancy.

Model "O" Link-Seal® Modular Seal
Nitrile rubber is resistant to oils, fuel and many solvents (gasoline, motor oil, kerosene, methane, jet fuel, hydraulic fluid, water, etc.)
Type: Oil Resistant
Seal Element: Nitrile (Green)
NOTE: *Not U.V resistant*
Pressure Plates: Reinforced Nylon Polymer
Bolts & Nuts: Steel with 2-part Zinc Dichromate & proprietary corrosion inhibiting coating
Temp. Range: -40 to +210ºF (-40 to +99ºC)*

Model "OS-316" Link-Seal® Modular Seal
Combination of oil resistant rubber and stainless steel hardware
Type: Oil Resistant
Seal Element: Nitrile (Green)
NOTE: *Not U.V resistant*
Pressure Plates: Reinforced Nylon Polymer
Bolts & Nuts: 316 Stainless Steel
Temp. Range: -40 to +210 ºF (-40 to +99ºC)*

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Link-Seal® Modular Seal Model Properties

WITH SILICONE SEAL ELEMENTS

Silicone (Grey)

* = Sustained operation near temperature limits may affect life expectancy.

NOTE: *Sustains a constant temp. of 325°F (163° C)*

Model "T" Link-Seal® Modular Seal
Silicone rubber is ideal for temperature extremes. The "T" model is one-hour Factory Mutual approved.
Type: High/Low Temperature
Seal Element: Silicone (Grey)
Pressure Plates: Steel Zinc Dichromate
Bolts: Steel with 2-part Zinc Dichromate & proprietary corrosion inhibiting coating.
Temp. Range: -67 to +400ºF (-55 to +204ºC)*

Model "FD/FS" Link-Seal® Modular Seal
Double seal for added protection
Type: Fire Seals
Seal Element: Silicone (Grey)
Pressure Plates: Steel zinc dichromate
Bolts: Steel with 2-part Zinc Dichromate & proprietary corrosion inhibiting coating.
Temp. Range: -67 to +400ºF (-55 to +204ºC)*

Link-Seal® NSF Certified Product

EPDM (Black)

* = Sustained operation near temperature limits may affect life expectancy.

Model "S61" Link-Seal® Modular Seal
NSF 61 Certified for use in potable water (drinking water)
Type: Stainless
Seal Element: EPDM (Black)
Pressure Plates: Blue Reinforced Nylon Polymer
Bolts & Nuts: 316 Stainless Steel
Temp. Range: -40 to +250ºF (-40 to +121ºC)*

NSF Certificate # C0162325-01

The Model "S61" is made from Black NSF 61 certified EPDM materials, with Blue reinforced Nylon Polymer Pressure plates and 316 Stainless Steel hardware. Each shipment is packaged with a defining "NSF 61" label and batch number for traceability.

SPECIFICTIONS:

» **Type:** Potable water
» **Seal Element:** Black EPDM NSF 61 Certified
» **Pressure Plates:** Blue Reinforced Nylon Polymer
» **Bolts & Nuts:** 316 Stainless Steel
» **Temperature Range:** -40˚F to 250˚F (-40˚C to 121˚C)
» Certified to NSF/ANSI Standard 61

IDEAL FOR:

» Hospital lines
» Laboratories
» Water treatment plants
» Processes where purity is important
» All potable water applications
» Process water for manufacturing operations
» Food service
» Food OEM's
» Sanitary milk service
» Food transportation

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MATERIAL PROPERTIES OF LINK-SEAL® MODULAR SEAL ELEMENTS

Property	ASTM Method	EPDM (EPDM L)	Nitrile	Silicone
Hardness (shore A)	D-2240	50 ±5 **(40 ±5)**	50 ±5	50 ±5
Tensile	D-412	1450 psi	1300 psi	860 psi
Elongation	D-412	400%	300%	250%
Compression Set	S-395	15% 22 hrs. @ 158° F (70° C)	45% 22 hrs. @ 212° F (100° C)	40% 22 hrs. @ 350° F (177° C)
Specific Gravity	D-297	1.10	1.15	1.40

MATERIAL PROPERTIES OF COMPOSITE PRESSURE PLATES

Property	ASTM Method	Value
Izod Impact - Notched	D-256	1.11 ft-lb/in
Tensile Strength @ Yield	D-638	20,000 psi
Tensile Strength - Break	D-638	20,250 psi
Flexural Strength @ Yield	D-790	30,750 psi
Flexural Modulus	D-790	1,124,000 psi
Elongation, Break	D-638	11.07%
Specific Gravity	D-792	1.38
Moisture Content	--	0.18%

BOLT & NUT SPECIFICATION

Carbon Steel

Carbon steel, zinc dichromated per ASTM B633, with an additional corrosion inhibiting proprietary organic coating. (passes 1470 hour salt spray test)
Tensile Strength = 60,000 psi, minimum.

An independent 1,470 hour salt spray test run in accordance to ASTM B117-97 has proven Link-Seal® modular seals' Zinc Dichromated Carbon Steel bolts, with proprietary corrosion inhibiting coating, to be superior when compared with competitive manufactures.

Stainless Steel

ANSI Type = 316, Per ASTM F593-95
Tensile Strength = 85,000 psi, average

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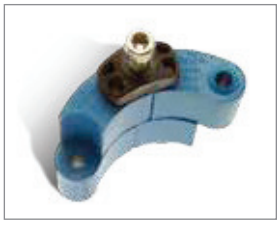
Link-Seal® Model	Tool Size/ Type Req.	Bolt Head Type
LS-200, LS-275	4mm, Allen	
LS-300, LS-315	6mm, Allen	
LS-325, LS-340, LS-360	13mm, Hex	
LS-400, LS-410, LS-425, LS-475	17mm, Hex	
LS-500, LS-525, LS-575	19mm, Hex	
LS-615	24mm, Hex	
LS-650	19mm, Hex	

To provide consistency and worldwide compatibility, GPT now offers all Link-Seal® Modular Seal sizes with metric bolts. The new bolts adhere to metric specifications as used by most all countries outside the U.S.A. Smaller Link-Seal® Modular Seals (sizes LS-200, LS-275, LS-300, and LS-315) will consist of metric Allen head or socket cap bolt heads while the balance of the line will use standard hex head metric bolts.

INDEPENDENT LABORATORY TEST

The Newly Engineered Force Dispersion Pressure Plates have been fully tested by an independent laboratory to ensure design theory translates into the capability to handle the rigors of real world applications.



In addition, the new design has an average of 15% more strength than previous Link-Seal® Modular Seal versions.

1,470 hour salt spray test run in accordance to ASTM B117-97 has proven Link-Seal® modular seals' Zinc Dichromated Carbon Steel bolts, with proprietary corrosion inhibiting coating, to be superior when compared with competitive manufactures. Test Results are available on request.

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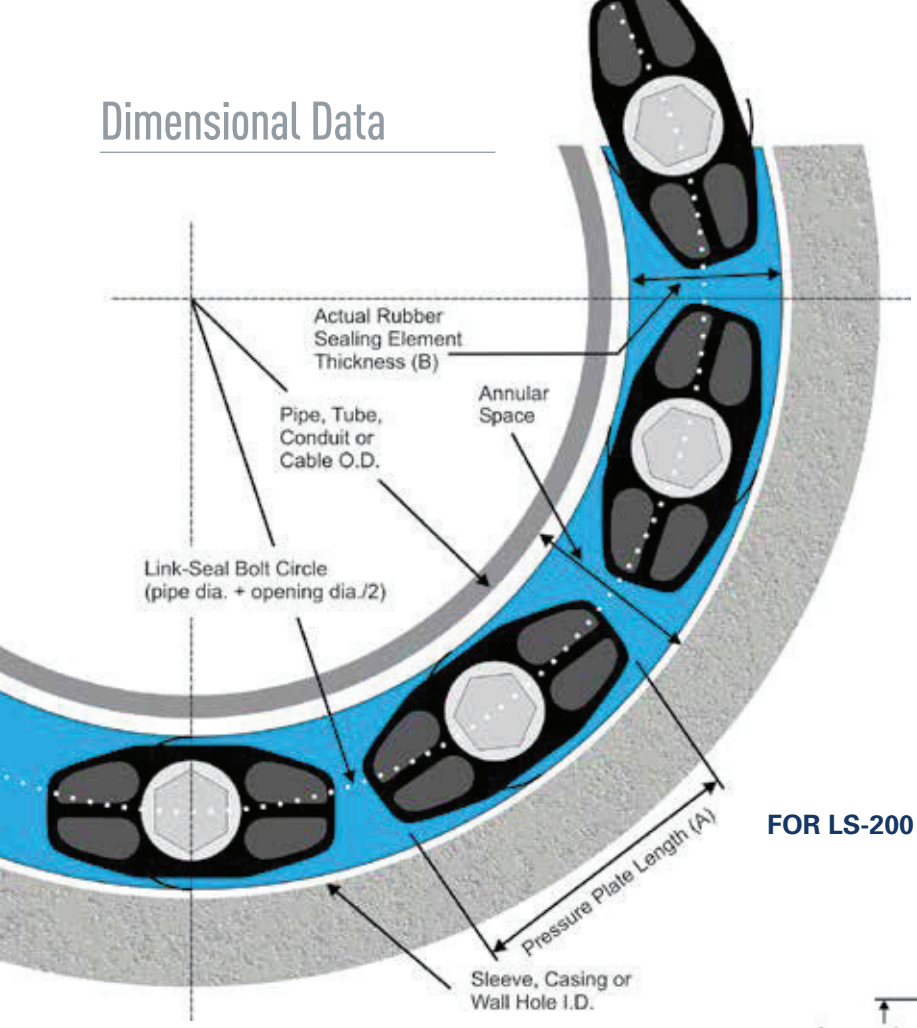
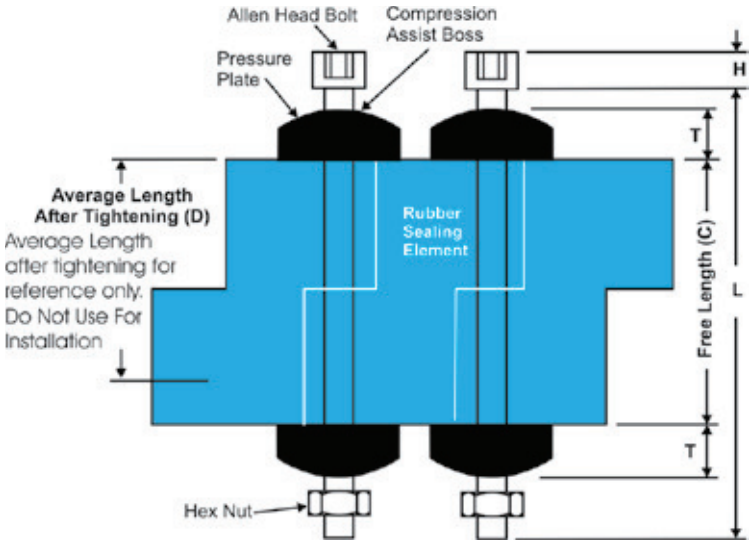
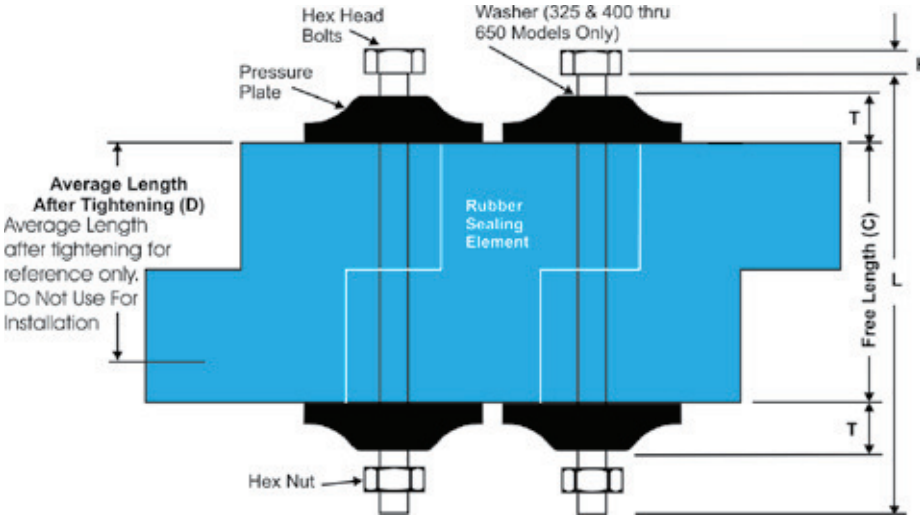
Dimensional Data



FOR LS-200 THROUGH LS-315



FOR LS-325 THROUGH LS-650



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* DIMENSIONAL DATA FOR MODELS C, L, O, S-316, S61, LS-316 & OS-316

Link-Seal Model No.	Rubber Sealing Elements			Pressure Plates		Bolts				Weight for 10 Link Sections (lbs)	Min. Required Seating Width
	Actual Thinckness (B)	Free Length (C)	Avg. Length After Tighening (D)	(A)	(T)	Allen Head Hex Across Flats	(H)	Thread Size	(L)		
LS-200-*	0.48″	1.75″	1.38″	1.06″	0.31″	4mm Allen (0.157″)	4.95mm (0.195″)	M5-0.8	65mm (2.559″)	0.70	2.25″
LS-275-*	0.61″	1.75″	1.38″	0.97″	0.31″	4mm Allen (0.157″)	4.95mm (0.195″)	M5-0.8	65mm (2.559″)	0.75	2.25″
LS-300-*	0.69″	2.37″	1.87″	1.56″	0.44″	6mm Allen (0.236″)	7.87mm (0.310″)	M8-1.25	90mm (3.543″)	2.15	3.00″
LS-315-*	0.81″	2.37″	1.87″	1.44″	0.44″	6mm Allen (0.236″)	7.87mm (0.310″)	M8-1.25	90mm (3.543″)	2.30	3.00″
LS-325-*	0.88″	2.63″	2.00″	3.13″	1.00″	13mm (0.511″)	5.30mm (0.215″)	M8-1.25	110mm (4.33″)	5.50	4.00″
LS-340-*	1.00″	2.70″	2.25″	1.48″	0.66″	13mm (0.511″)	5.30mm (0.215″)	M8-1.25	110mm (4.33″)	3.30	4.00″
LS-360-*	1.24″	2.70″	2.25″	2.05″	0.77″	13mm (0.511″)	5.30mm (0.215″)	M8-1.25	110mm (4.33″)	5.10	4.00″
LS-400-*	1.38″	3.50″	2.75″	3.50″	1.06″	17mm (0.669″)	6.40mm (0.250″)	M10-1.5	130mm (5.118″)	12.00	5.00″
LS-410-*	1.43″	3.37″	2.87″	2.52″	0.88″	17mm (0.669″)	6.40mm (0.250″)	M10-1.5	130mm (5.118″)	8.20	5.00″
LS-425-*	1.06″	3.00″	2.25″	3.50″	1.19″	17mm (0.669″)	6.40mm (0.250″)	M10-1.5	130mm (5.118″)	10.00	5.00″
LS-475-*	1.56″	3.38″	2.63″	2.63″	0.88″	17mm (0.669″)	6.40mm (0.250″)	M10-1.5	130mm (5.118″)	10.00	5.00″
LS-500-*	2.25″	3.75″	2.75″	3.63″	1.06″	19mm (0.748″)	7.50mm (0.300″)	M12-1.75	140mm (5.511″)	22.50	5.00″
LS-525-*	2.06″	3.75″	2.87″	3.63″	1.06″	19mm (0.748″)	7.50mm (0.300″)	M12-1.75	140mm (5.511″)	21.00	5.00″
LS-575-*	1.81″	3.75″	3.00″	3.00″	1.00″	19mm (0.748″)	7.50mm (0.300″)	M12-1.75	140mm (5.511″)	15.50	5.00″
LS-615-*	3.09″	4.00″	3.00″	6.00″	1.90″	24mm (0.944″)	10.57mm (0.416″)	5/8-11	185mm (7.280″)	60.60	6.00″
LS-650-*	2.71″	3.98″	3.00″	3.96″	1.19″	19mm (0.748″)	7.50mm (0.300″)	M12-1.75	140mm (5.511″)	26.10	6.00″

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