Gas Industry Standard

GIS/F11:2015

Specification for

the manufacture of grouted tee connections for metallic mains operating at pressures up to 7 bar

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Foreword

Gas Industry Standards (GIS) are revised, when necessary, by the issue of new editions. Users should ensure that they are in possession of the latest edition. Contractors and other users external to Gas Transporters should direct their requests for copies of a GIS to the department or group responsible for the initial issue of their contract documentation.

Comments and queries regarding the technical content of this document should be directed in the first instance to the contract department of the Gas Transporter responsible for the initial issue of their contract documentation.

This standard calls for the use of procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Compliance with this engineering document does not confer immunity from prosecution for breach of statutory or other legal obligations.

Mandatory and non-mandatory requirements

For the purposes of a GIS the following auxiliary verbs have the meanings indicated:

can indicates a physical possibility;

may indicates an option that is not mandatory;

shall indicates a GIS requirement;

should indicates best practice and is the preferred option. If an alternative method is used then a suitable and sufficient risk assessment needs to be completed to show that the alternative method delivers the same, or better, level of protection.

Disclaimer

This engineering document is provided for use by Gas Transporters and such of their contractors as are obliged by the terms of their contracts to comply with this engineering document. Where this engineering document is used by any other party, it is the responsibility of that party to ensure that the engineering document is correctly applied.

Brief history

First published as T/SP/F/11 to include editorial update to comply with GRM (EPSG/T04/1381)	November 2004
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1 Scope

This Gas Industry Standard specifies requirements for the manufacture of grouted tee connections. These are assembled and grouted onto cast or ductile iron gas pipes for the purposes of making hot tap or permanent connections and/or for stopping off, for operation at a maximum working pressure of 7 bar.

It applies to full encirclement grouted tees, attached to the pipeline by bolting together of split shells and then grouting the annular space between the assembled shells and outer surface of the pipeline.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Formal standards

BS 78-2:1917, *Specification for cast iron spigot and socket pipes (vertically cast) and spigot and socket fittings — Part 1: Fittings*.

BS 78-2:1938, *Specification for cast iron spigot and socket pipes (vertically cast) and spigot and socket fittings — Part 1: Fittings*.

BS 78-2:1961, *Specification for cast iron spigot and socket pipes (vertically cast) and spigot and socket fittings — Part 1: Fittings*.

BS 1211:1958, *Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage.*

BS 3692, *ISO metric precision hexagon bolts, screws and nuts — Specification*.

BS 4320, *Specification for metal washers for general engineering purposes — Metric series*.

BS 4772:1971, *Specification for ductile iron pipes and fittings.*

BS 4882, *Specification for bolting for flanges and pressure containing purposes*.

BS EN 1011-2, *Recommendations for welding of metallic materials — Part 2: Arc welding of ferritic steels*.

BS EN 1092-1, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*.

BS EN 10028-3, *Specification for flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*.

BS EN ISO 10642, *Hexagon socket countersunk head screws*.

BS EN 12068:1999, *Cathodic protection — External organic coatings for the corrosion protection of buried or immersed steel pipelines used in conjunction with cathodic protection — Tapes and shrinkable materials.*

BS EN ISO 12944 (all parts), *Paints and varnishes — Corrosion protection of steel structures by protective paint systems.*

PD 5500:2015, *Specification for unfired fusion welded pressure vessels*.

Gas Industry Standards

GIS/F12:2015, *Specification for grouted tee connections for metallic mains operating at pressures up to 7 bar.*

Gas Distribution Network standards

*/SP/CW5, *Specification for field applied external coatings for buried pipework and systems*.

*/SP/CW6-2, *Specification for the external protection of steel line pipe and fittings using fusion bonded powder and associated coating systems — Part 2: Factory applied coatings*.

*/SP/PA/10, *Specification for new and maintenance painting at works and site for above ground pipeline and plant installations*.

Where * denotes each gas distribution network reference

American Petroleum Institute standards

API 5L, *Specification for line pipe*.

3 Terms and definitions

For the purposes of this standard the following terms and definitions applies.

3.1
grouted tee connection
connection, including the saddle seal, grout containment seal , grout, and all fittings

3.2
body shell
top or bottom half shells, excluding the branch pipe

3.3
branch
branch connection pipe

4 Information to be supplied by the purchaser

The following information to be supplied by the purchaser shall be fully documented. For compliance with the specification both the definitive requirements specified throughout the specification and the following documented items shall be satisfied.

a) gas transporter enquiry/order number;

b) line pipe characteristics:

1) outside diameter of pipe (mm);

If the outside diameter of the pipe is not available, the nominal grouted tee connection size shall be based upon the nominal pipe sizes specified in Annex A for the particular size and material of the pipe.

c) branch line pipe characteristics:

1) outside diameter (mm);

2) wall thickness (mm);

d) grouted tee connection nominal size:

1) nominal shell diameter;

2) nominal branch diameter;

e) type of grouted tee connection required:

1) grouted tee stopple;

2) grouted tee offtake;

3) plug requirement;

4) working pressure (maximum) (bar);

f) type of branch flange:

1) flat face;

2) raised face;

3) weld neck;

4) slip on;

5) rating;

6) nominal size;

7) standard;

g) orientation of installation:

1) vertical tapping;

2) horizontal tapping.

5 Design

5.1 General

The grouted tee connection shall be suitable for operation at pressures up to 7 bar.

5.2 Service life and loads

Service life and loads shall conform to GIS/F12:2007, **4.5** and **4.6**.

5.3 Pipe diameters

The grouted tees shall be suitable for use on:

- carbon steel distribution pipes with diameters between 50 mm (2 in) to 1200 mm (48 in);
- cast iron pipe with diameters between 75 mm (3 in) to 1200 mm (48 in) in accordance with BS 78: 1917, 1938 and 1961;
- spun cast iron pipe with diameters between 75 mm (3 in) to 700 mm (27 in) in accordance with BS 1211: 1958;
- ductile iron pipe with diameters of 350 mm (14 in) to 600 mm (24 in).

5.4 Configuration

The branch shall be perpendicular to the body shell, and the grouted tee connection dimensions shall conform to Annex D.

5.5 Temperature range

The grouted tee connection shall be designed for use in the temperature range of −20 °C to 30 °C.

5.6 Tolerances

Fabrication tolerances shall be in accordance with Annex B.

5.7 Flanges

The flanges on the grouted tee connection branch shall conform to BS EN 1092-1 rated at PN16 and of the type designated by the gas transporter, see Clause **4**.

5.8 Bolt head and nut clearances

The grouted tee connection shall be designed to provide adequate clearance for ring spanners, socket spanners and torque wrenches used for assembly.

5.9 Stopping off plug

When specified by the gas transporter, a suitable stopping off plug in the branch flange shall be provided.

5.10 Tell-tale holes and grout feed riser

Tell-tale holes and grout feed riser positions shall be in accordance with Annex C.

6 Construction and materials

6.1 Grouted tee connection shell and branch

Body shells of grouted tees in the size range 2 in to 4 in shall conform to BS EN 10028-3, Grade P460 NL1. Dimensions shall be in accordance with Table D.4 and D.5 and Figures D.9 to D.14. The position of feeders and risers shall be in accordance with Figure D.15.

The steel plate used for the body shell, in the size range from 12 in to 48 in including its longitudinal flanges, but excluding the reinforcing ribs, shall conform to BS EN 10028-3, Grade P460 NL1. Dimensions shall be in accordance with Table D.1 and Figures D.1 to D.8. The position of feeders and risers shall be in accordance with Figure C.1.

The branch shall conform to API 5L Grade B.

If submerged-arc welded pipe is used, the seam weld shall be located away from the high-stress crotch area.

6.2 Branch flanges

The material, mechanical and (non-destructive testing) NDT requirements for branch flanges shall be in accordance with BS EN 1092-1.

6.3 Fasteners and jointing material

6.3.1 *Grouted tees in size range 2 in to 4 in*

The bolts for fastening the body shells together shall be M16 in accordance with BS 4882, Grade 12.9.

The washers for the above bolts shall be of M16 in accordance with BS 4320 BRT finish.

Spreader plates and shims shall be fastened using M6 × 25 hex socket head screws conforming to BS EN ISO 10642, Grade 12.9 and M6 nuts conforming to BS 3692, Grade 8, see Figure D.9 for details.

6.3.2 *Grouted tees in size range 12 in to 48 in*

The bolts for fastening the body shells together shall be M20 in accordance with BS 4882, Grade B7.

The nuts for fastening the body shells together shall be M20 in accordance with BS 4882, Grade 2H.

The washers for the above bolts shall be M20 in accordance with BS 4320 BRT finish.

Spreader plates and shims shall be fastened using M10 × 40 hex socket head screws conforming to BS EN ISO 10642, Grade 12.9 and M10 nuts conforming to BS 3692, Grade 8.8.

6.4 Branch seal

The material shall be nitrile based with a Shore hardness of 40. For size range 2 in to 4 in the branch seal shall conform to the dimensions specified in Table D.5.

For size range 12 in to 48 in the branch seal shall conform to the dimensions specified in Table D.2.

6.5 Grout

The grade of grout shall be as follows:

— SBD-DG 38 installation temperature range -5 ℃ to 20 ℃;

— SBD-DG 118 installation temperature range 15 ℃ to 35 ℃;

— SBD-DG 2088 installation temperature range 30 ℃ to 50 ℃.

NOTE The grout containment seal material can be rapid grade certite putty.

6.6 Stopping off plugs

The contractor shall use stopping off plugs approved by the gas transporter.

7 Manufacture

7.1 General

Grouted tee connections shall conform to GIS/F12.

7.2 Weld procedures

Welding procedure qualification tests shall be carried out in accordance with PD 5500:2003, **5.2**. Details of the welds shall be in accordance with Figure D.8.

Welders shall provide satisfactory test welds in accordance with PD 5500:2003, **5.3** before being allowed to commence production welding.

7.3 Backing strips

Permanent backing strips shall not be used.

7.4 Weld design

The weld design shall require that full penetration butt-welds are obtained in all cases, except if slip on flanges have been specified, where fillet welds shall be used. Where possible, back chipping of the weld root to sound metal and back filling shall be carried out.

All back chipping shall be proven sound by the use of magnetic particle inspection (MPI).

Weld root penetration in the bore of the grouted tee connection shall be carefully controlled and all welds shall be sufficiently ground to ensure satisfactory crack detection.

7.5 Stress relieving

All grouted tee connections shall be supplied in the stress relieved condition. The post-weld heat treatment (PWHT) shall be performed after all welding has been completed. Stress relief heat treatment shall be in accordance with PD 5500:2003, **4.4.5** for carbon and carbon manganese steels.

7.6 Manufacturing strategy

NOTE The contractor may opt to manufacture the body shells for a range of common linepipe sizes and then complete the manufacture of the branch and flange based upon the nominal size requested by the gas transporter.

In this instance the relevant parts of Clauses **7** to **10** inclusive shall be applicable after all manufacturing processes are completed.

8 Non-destructive testing procedures and acceptance levels

8.1 General requirements

Unless otherwise specified, all NDT shall be carried out after all processing and PWHT, including final stress relieving and machining where applicable.

The contractor shall use MPI and ultrasonic testing (UT) or x-radiography for all welds as required and agreed with the gas transporter.

All NDT carried out on the grouted tee connections shall be in accordance with PD 5500.

NOTE It is assumed in the drafting of a standard that the execution of its provisions is entrusted to appropriately qualified and competent people.

8.2 Acceptance levels

Defects disclosed by NDT shall not exceed the limits specified in Annex E.

9 Pressure testing

9.1 General

The branch, saddle seal and flange shall either be subjected to hydraulic pressure testing in accordance with **9.2** or the information specified in **9.3** shall be supplied to the purchaser in order to carry out a risk assessment.

9.2 Hydraulic pressure testing

Where hydrostatic pressure testing is to be carried out the branch, saddle seal and flange shall be subjected to testing, following completion of all machining, welding and stress relieving. The following conditions shall be adhered to:

- the pressure test shall be held for a period of not less than 30 min; the test pressure shall be 10.5 bar;
- all test instrumentation used shall be covered by approved calibration certificates issued within the previous six months;
- a test certificate shall accompany the fitting when supplied to the purchaser.

9.3 Quality assurance

Where the branch, saddle seal and flange have not been subjected to hydraulic pressure testing, then the following information shall be supplied with the fitting to the purchaser:

- a recorded summary of the results of the welder qualification test as specified in **7.2**;
- a statement confirming the status of any PWHT that has been carried out as specified in **7.5**;
- a recorded summary confirming the status of any defects found as specified in Table E.1, Table E.2 and Table E.3.

The information shall be used as part of any risk assessment carried out prior to any pneumatic or hydraulic testing of the branch, saddle seal and flange that the purchaser may carry out in accordance with its own installation procedures.

10 Corrosion protection

10.1 Grouted tee connections for buried installations

NOTE 1 Factory applied coatings for grouted tee connections for buried installations should conform to */SP/CW6-2.

NOTE 2 It is only necessary to protect external surfaces.

If grouted tee connections are not factory coated then they shall conform to */SPCW5 in order to protect all external surfaces of the installed grouted tee connection. The coatings shall also conform to BS EN 12068:1999. Furthermore, where the grouted tee connection is not factory coated it shall be supplied bare and free from oil and metal turnings.

10.2 Grouted tee connections for above ground installations

Grouted tee connections for above ground installations shall conform to PA10 and BS EN ISO 12944.

NOTE It is only necessary to protect external surfaces.

11 Protection and transport

The contractor shall provide adequate packaging of grouted tee connections to prevent damage by normal handling, transportation and storage.

All nuts, bolts and other loose items shall be parceled and tagged with appropriate information

12 Storage

Storage of grout and saddle seal shall conform to the manufacturer’s specifications.

Annex A (normative)
Determination of nominal pipe size

Table A.1 — Cast iron and ductile iron pipe diameters

Pipe nom size in	Pipe outside diameter										
	Ductile iron pipe to BS 4772:1971			Cast iron pipe to BS 78-2:1938 Class A and B				Cast iron pipe to BS 78-2:1938 Class C and D			
	Min mm	Nom mm	Max mm	Nom in	Min mm	Nom mm	Max mm	Nom in	Min mm	Nom mm	Max mm
12	332.23	334.01	335.79	13.14	332.76	333.76	334.76	13.60	344.44	345.44	346.44
14	—	—	—	15.22	385.59	386.59	387.59	15.72	398.29	399.29	400.29
15	411.48	413.26	415.04	16.26	412.00	413.00	414.00	16.78	425.21	426.21	427.21
16	425.50	427.65	429.80	17.30	438.42	439.42	440.42	17.84	452.14	453.14	454.14
18	490.73	491.75	492.76	19.38	491.25	492.25	493.25	19.96	505.98	506.98	507.98
20	528.30	530.55	532.80	21.46	544.08	545.08	546.08	22.06	559.32	560.32	561.32
21	569.98	571.76	573.53	22.50	570.50	571.50	572.50	23.12	586.25	587.25	588.25
22	—	—	—	23.54	596.92	597.92	598.92	24.16	612.66	613.66	614.66
24	648.72	650.50	652.27	25.60	649.24	650.24	651.24	26.26	666.00	667.00	668.00
26	—	—	—	27.66	701.56	702.56	703.56	28.36	719.34	720.34	721.34
27	—	—	—	28.70	727.98	728.98	729.98	29.40	745.76	746.76	747.76
28	—	—	—	29.72	753.89	754.89	755.89	30.44	772.18	773.18	774.18
30	—	—	—	31.78	806.21	807.21	808.21	32.52	825.01	826.01	827.01
32	—	—	—	33.84	858.54	859.54	860.54	34.62	878.35	879.35	880.35
33	—	—	—	34.88	884.95	885.95	886.95	35.66	904.76	905.76	906.76
36	—	—	—	37.96	963.18	964.18	965.18	38.76	983.50	984.50	985.50
38	—	—	—	40.02	1 015.51	1 016.51	1 017.51	40.84	1 036.34	1 037.34	1 038.34
39	—	—	—	41.04	1 041.42	1 042.42	1 043.42	41.88	1 062.75	1 063.75	1 064.75
40	—	—	—	42.06	1 067.32	1 068.32	1 069.32	42.92	1 089.17	1 090.17	1 091.17
42	—	—	—	44.12	1 119.65	1 120.65	1 121.65	45.00	1 142.00	1 143.00	1 144.00
44	—	—	—	46.16	1 171.46	1 172.46	1 173.46	47.06	1 194.32	1 195.32	1 196.32
45	—	—	—	47.18	1 197.37	1 198.37	1 199.37	48.10	1 220.74	1 221.74	1 222.74
46	—	—	—	48.22	1 223.79	1 224.79	1 225.79	49.14	1 247.16	1 248.16	1 249.16
48	—	—	—	50.26	1 275.60	1 276.60	1 277.60	51.20	1 299.48	1 300.48	1 301.48

NOTE In BS78:1961 Class A and B pipes 30 in and above were re-sized to be the same OD as Class C and D, and pipe sizes 22 in,26 in,28 in,32 in,38 in,39 in,44 in and 46 in were omitted.

Annex B (normative)
Grouted tee connection tolerances

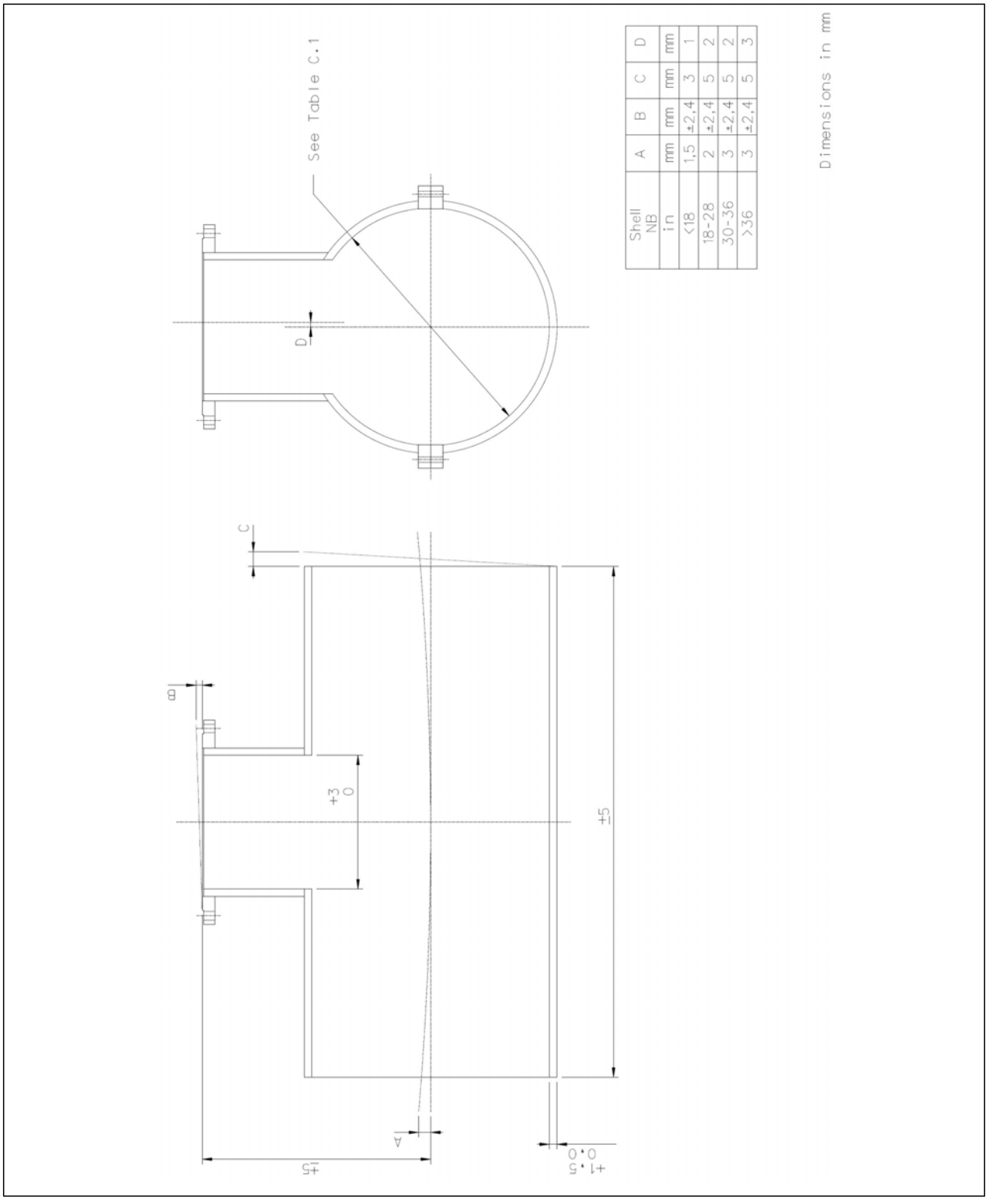


Figure B.1 — Dimensional tolerances (see 5.6)

Annex C (normative)
Grout feed riser and tell-tale holes

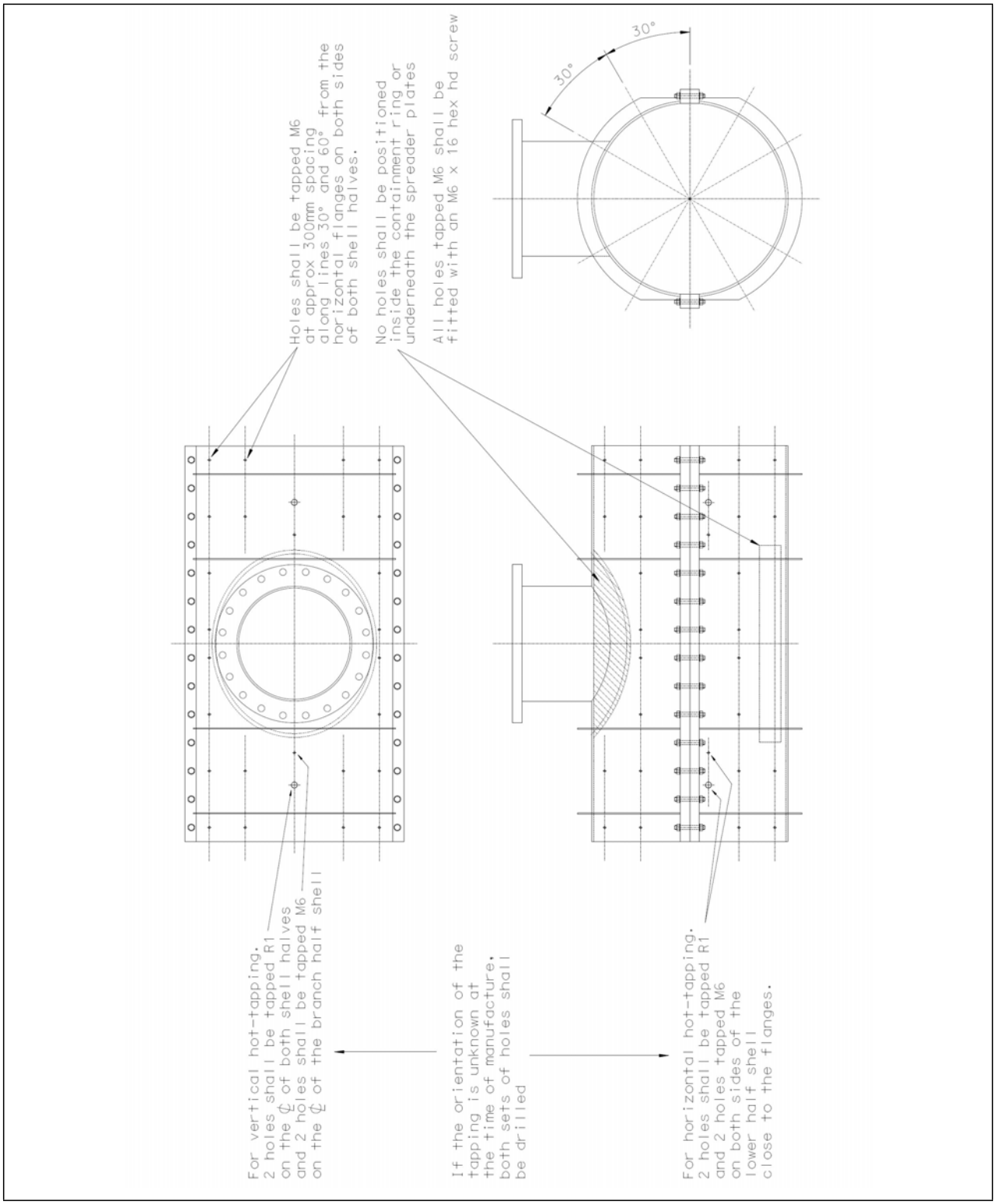


Figure C.1 — Grout feed, riser and tell-tale holes (see 5.10)

Annex D (normative)
Grouted tee connection dimensions

Table D.1 — Dimensions of grouted tee connections for vertically cast pipe to BS 78-2:1938, spun pipe to BS 1211 and ductile iron pipe to BS 4772:1971 in size range 12 in up to 48 in

Pipe nominal size in	Max. branch size, NB	Branch size for stoppling, NB	Shell dimensions (see Figures B.1, D.2, and D.4).										
			Shell length mm	Shell bore mm	Shell bore tolerance ±	Shell height mm	Flange spacing mm	No. of ribs	Rib diameter mm	Rib length mm	Spreader location	No. of holes mm	Hole centres mm
			A	B		C	D	G	H	J	K	L	M
12	12	12	900	380	2.0	190	366	2	504	426	0	6	446
14	14	12	1 200	434	2.0	217	422	2	558	482	0	8	502
15	14	12	1 200	461	2.0	231	450	2	585	510	0	8	530
16 [a)]	16	12	1 200	488	2.0	244	477	2	612	537	0	8	557
18	18	12	1 500	542	2.0	271	532	2	666	592	0	10	612
20 [a)]	20	12	1 500	595	2.0	298	586	2	719	646	0	10	666
21	20	16	1 500	622	2.0	311	613	2	746	673	30	10	693
22	22	16	1 800	649	2.0	325	641	2	773	701	30	12	721
24	24	—	1 800	702	2.0	351	694	2	826	754	30	12	774
—	16	16	1 200	—	—	—	—	2	—	—	—	8	—
26	26	—	2 100	755	2.5	378	748	4	929	808	30	14	828
—	16	16	1 200	—	—	—	—	2	—	—	—	8	—
27	24	20	2 100	782	2.5	391	775	4	956	835	30	14	855
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—
28	24	20	2 100	808	2.5	404	801	4	982	861	30	14	881
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—
30	24	24	2 100	859	2.5	430	853	4	1 033	913	30	14	933
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—
33	28	24	2 100	939	2.5	470	933	4	1 113	993	30	14	1 013
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—
36	28	24	2 100	1017	3.0	509	1012	4	1 197	1 072	30	14	1 092
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—
38	32 [b)]	36	2 700	1072 [b)]	3.0	536 [b)]	1067	4	1 252	1 127	30	18	1 147
—	28	—	2 100	—	—	—	—	4	—	—	—	14	—
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—
39	36 [b)]	36	2 700	1099 [b)]	3.0	550 [b)]	1094	4	1 279	1 154	30	18	1 174
—	28	—	2 100	—	—	—	—	4	—	—	—	14	—
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—
40	36 [b)]	36	2 700	1123 [b)]	3.0	562 [b)]	1118	4	1 303	1 178	30	18	1 198
—	28	—	2 100	—	—	—	—	4	—	—	—	14	—
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—

Table D.1 — Dimensions of grouted tee connections for vertically cast pipe to BS 78-2:1938, spun pipe to BS 1211 and ductile iron pipe to BS 4772:1971 in size range 12 in up to 48 in *(continued)*

Pipe nominal size in	Max. branch size, NB	Branch size for stoppling, NB	Shell dimensions (see Figures B.1, D.2, and D.4).										
			Shell length mm	Shell bore mm	Shell bore tolerance ±	Shell height mm	Flange spacing mm	No. of ribs	Rib diameter mm	Rib length mm	Spreader location	No. of holes mm	Hole centres mm
			A	B		C	D	G	H	J	K	L	M
42	36	36	2 700	1 177 [b)]	3.0	589 [b)]	1 172	4	1 357	1 232	30	18	1 252
—	28	—	2 100	—	—	—	—	4	—	—	—	14	—
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—
44	36	36	2 700	1 230 [b)]	3.0	615 [b)]	1 225	4	1 410	1 285	30	18	1 305
—	28	—	2 100	—	—	—	—	4	—	—	—	14	—
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—
45	36	36	2 700	1 255 [b)]	3.0	628 [b)]	1 251	4	1 435	1 311	30	18	1 331
—	28	—	2 100	—	—	—	—	4	—	—	—	14	—
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—
46	36	36	2 700	1 283 [b)]	3.0	642 [b)]	1 279	4	1 463	1 339	30	18	1 359
—	28	—	2 100	—	—	—	—	4	—	—	—	14	—
—	16	—	1 200	—	—		—	2	—	—	—	8	—
48	36	36	2 700	1 334 [b)]	3.0	667 [b)]	1 330	4	1 514	1 390	30	18	1 410
—	28	—	2 100	—	—	—	—	4	—	—	—	14	—
—	16	—	1 200	—	—	—	—	2	—	—	—	8	—
16	14	12	1 200	477	2.0	239	466	2	601	526	0	8	546
20	20	12	1 500	580	2.0	290	571	2	704	631	0	10	651

[a)] Dimensions for ductile iron pipe to BS 4771:1971

[b)] For Class A and B sizes 38 in and above, with branch sizes greater than 36 in, a pipe survey shall be undertaken. The shell bore (B) shall then be equal to the measured pipe diameter + 49 mm.

The shell height (C) shall be equal to the shell bore divided by 2.

The 35 mm seal as specified in Table D.2 shall be used .

NOTE 1 Where the number of ribs is 2, each rib is positioned at 150 mm from the end of the shell (see Figure D.2)

NOTE 2 Where lifting eyes are required, then 2 off 25 mm holes can be drilled through each rib. The holes should be located at the centre of gravity for horizontal and vertical lift of each shell

Table D.2 — Dimensions of grouted tee connections for vertically cast pipe to BS 78-2:1938, spun pipe to BS 1211 and ductile iron pipe to BS 4772:1971 in size range 12 in up to 48 in

Pipe nominal size, in	Max. branch size, NB	Containment ring (see Figure D.5) mm		Seal thickness (see Figure D.7) mm			Seal diameter (see Figure D.7) mm		Spreader plate and shims (see Figure D.6) mm			Assembly quantities (see Figure D.1) mm				
		Long' l ID	Lat' l ID	Class AB	Class CD	Ductile iron	Seal	OD	Length	Diameter	No. of holes	Flange bolts	Flange nuts	Spreader plates	Shims	C' sk screws
		Q	R	S				T	V	X	Y					
12	12	485	580	35	25	35	12	530	450	345	2	12	24	1	3	2
14	14	517	604	35	25	N/A	14	558	600	395	2	16	32	1	3	2
15	14	517	589	35	25	35	14	558	600	425	2	16	32	1	3	2
16 [a)]	16	567	668	35	25	N/A	16	616	600	450	2	16	32	1	3	2
18	18	618	732	35	25	35	18	674	600	505	2	20	40	1	3	2
20 [a)]	20	669	796	35	25	N/A	20	732	600	560	2	20	40	1	3	2
21	20	669	778	35	25	35	20	732	600	585	2	20	40	2	6	4
22	22	720	862	35	25	35	20	732	900	610	3	24	48	2	6	6
24	24	771	927	35	25	35	24	849	900	665	3	24	48	2	6	6
—	16	567	605	35	25	35	16	616	600		2	16	32	2	6	4
26	26	821	992	35	25	N/A	26	907	900	720	3	28	56	2	6	6
—	16	567	598	35	25	N/A	16	616	600		2	16	32	2	6	4
27	24	771	927	35	25	N/A	26	907	900	745	3	28	56	2	6	6
—	16	567	596	35	25	N/A	16	616	600		2	16	32	2	6	4
28	24	771	927	35	25	N/A	28	926	900	770	3	28	56	2	6	6
—	16	567	594	35	25	N/A	16	616	600		2	16	32	2	6	4
30	24	771	927	35	25	N/A	30	1025	900	825	3	28	56	2	6	6
—	16	567	589	35	25	N/A	16	616	600		2	16	32	2	6	4
33	28	872	981	35	25	N/A	28	926	900	905	3	28	56	2	6	6
—	16	567	585	35	25	N/A	16	616	600		2	16	32	2	6	4
36	28	872	958	35	25	N/A	28	926	900	980	3	28	56	2	6	6
—	16	567	581	35	25	N/A	16	616	600		2	16	32	2	6	4
38	32 [b)]	974	1 165	35	25	N/A	38	1 263	1 200	1 035	4	36	72	2	6	8
—	28	872	949	35	25	N/A	28	926	900		3	28	56	2	6	6
—	16	567	580	35	25	N/A	16	616	600		2	16	32	2	6	4

Table D.2 — Dimensions of grouted tee connections for vertically cast pipe to BS 78-2:1938, spun pipe to BS 1211 and ductile iron pipe to BS 4772:1971 in size range 12 in up to 48 in *(continued)*

Pipe nominal size, in	Max. branch size, NB	Containment ring (see Figure D.5) mm		Seal thickness (see Figure D.7) mm			Seal diameter (see Figure D.7) mm		Spreader plate and shims (see Figure D.6) mm			Assembly quantities (see Figure D.1) mm				
		Long' l ID	Lat' l ID	Class AB	Class CD	Ductile iron	Seal	OD	Length	Diameter	No. of holes	Flange bolts	Flange nuts	Spreader plates	Shims	C' sk screws
		Q	R	S				T	V	X	Y					
39	36 [b]	1 126	1392	35	25	N/A	39	1 263	1 200	1 060	4	36	72	2	6	8
—	28	872	949	35	25	N/A	28	926	900		3	28	56	2	6	6
—	16	567	580	35	25	N/A	16	616	600		2	16	32	2	6	4
40	36 [b]	1 075	1 223	35	25	N/A	40	1 321	1 200	1 090	4	36	72	2	6	8
—	28	872	939	35	25	N/A	28	926	900		3	28	56	2	6	6
—	16	567	578	35	25	N/A	16	616	600		2	16	32	2	6	4
42	36	1 075	1 223	35	25	N/A	36	1 202	1 200	1 140	4	36	72	2	6	8
—	28	872	932	35	25	N/A	28	926	900		3	28	56	2	6	6
—	16	567	577	35	25	N/A	16	616	600		2	16	32	2	6	4
44	36	1 075	1 196	35	25	N/A	36	1 202	1 200	1 195	4	36	72	2	6	8
—	28	872	923	35	25	N/A	28	926	900		3	28	56	2	6	6
—	16	567	575	35	25	N/A	16	616	600		2	16	32	2	6	4
45	36	1 075	1 196	35	25	N/A	36	1 202	1 200	1 220	4	36	72	2	6	8
—	28	872	923	35	25	N/A	28	926	900		3	28	56	2	6	6
—	16	567	575	35	25	N/A	16	616	600		2	16	32	2	6	4
46	36	1 075	1 196	35	25	N/A	36	1 202	1 200	1 245	4	36	72	2	6	8
—	28	872	923	35	25	N/A	28	926	900		3	28	56	2	6	6
—	16	567	575	35	25	N/A	16	616	600		2	16	32	2	6	4
48	36	1 075	1 178	35	25	N/A	36	1202	1 200	1 300	4	36	72	2	6	8
—	28	872	916	35	25	N/A	28	926	900		3	28	56	2	6	6
—	16	567	574	35	25	N/A	16	616	600		2	16	32	2	6	4
16	14	517	589	N/A	N/A	35	14	558	600	450	2	16	32	1	3	2
20	20	669	796	N/A	N/A	35	20	732	600	560	2	20	40	1	3	2

[a] Dimensions for ductile iron pipe to BS 4771:1971

[b] For Class A and B sizes 38 in and above, with branch sizes greater than 36 in, a pipe survey shall be undertaken. The shell bore (B) shall then be equal to the measured pipe diameter + 49 mm.

Table D.3 — Dimensions of branches on grouted tee connections in size range 12 in up to 36 in

Branch size in, NB	**Branch dimensions, see Figure D.3** mm		
	E	F	N
12	304	200	80
14	336	220	80
16	387	250	80
18	438	280	80
20	489	310	100
22	539	340	100
24	590	370	100
26	641	400	100
28	692	430	100
30	743	460	100
32	793	490	100
36	895	550	100
NOTE See Table D.1.			

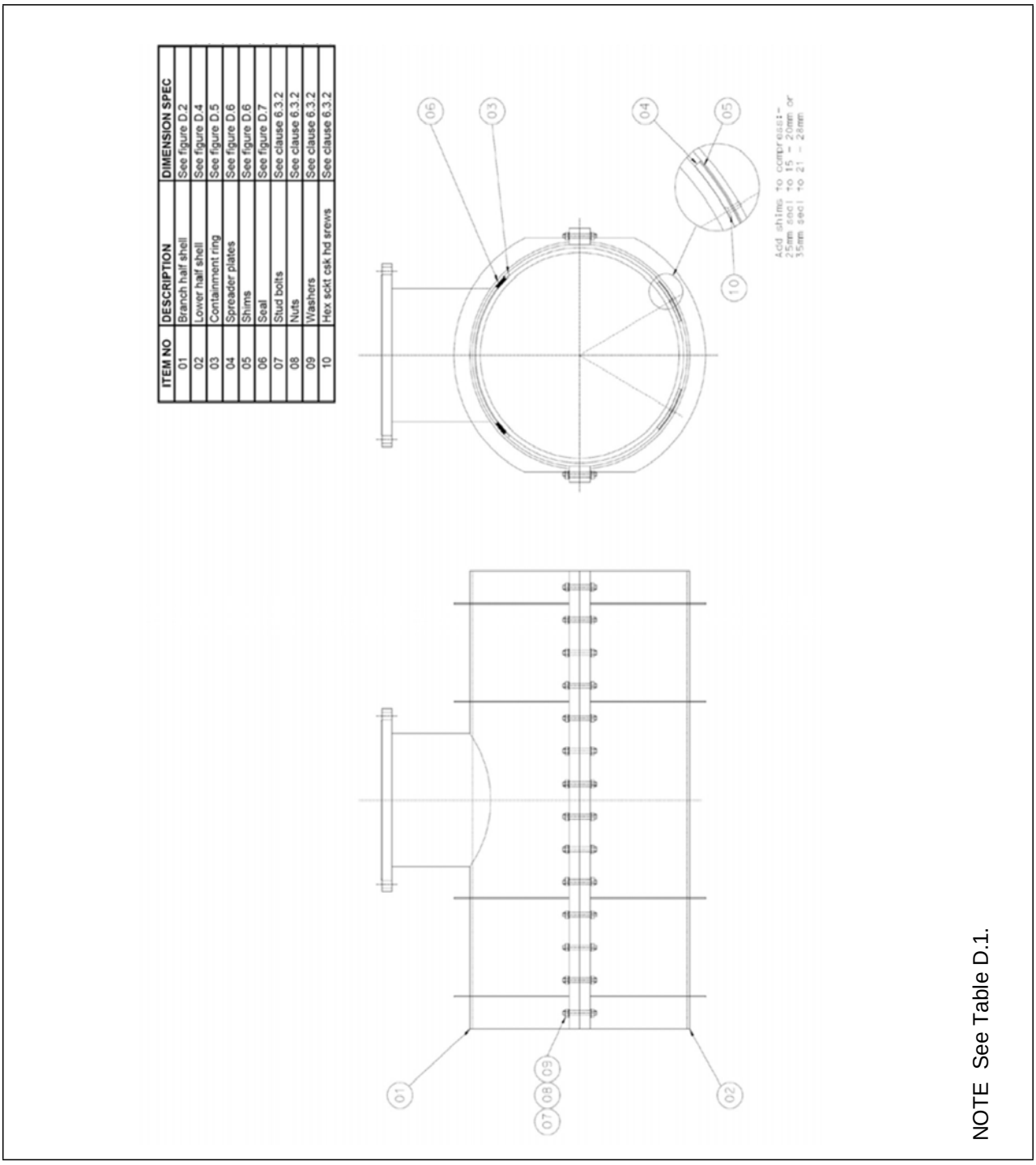


Figure D.1 — Grouted tee assembly

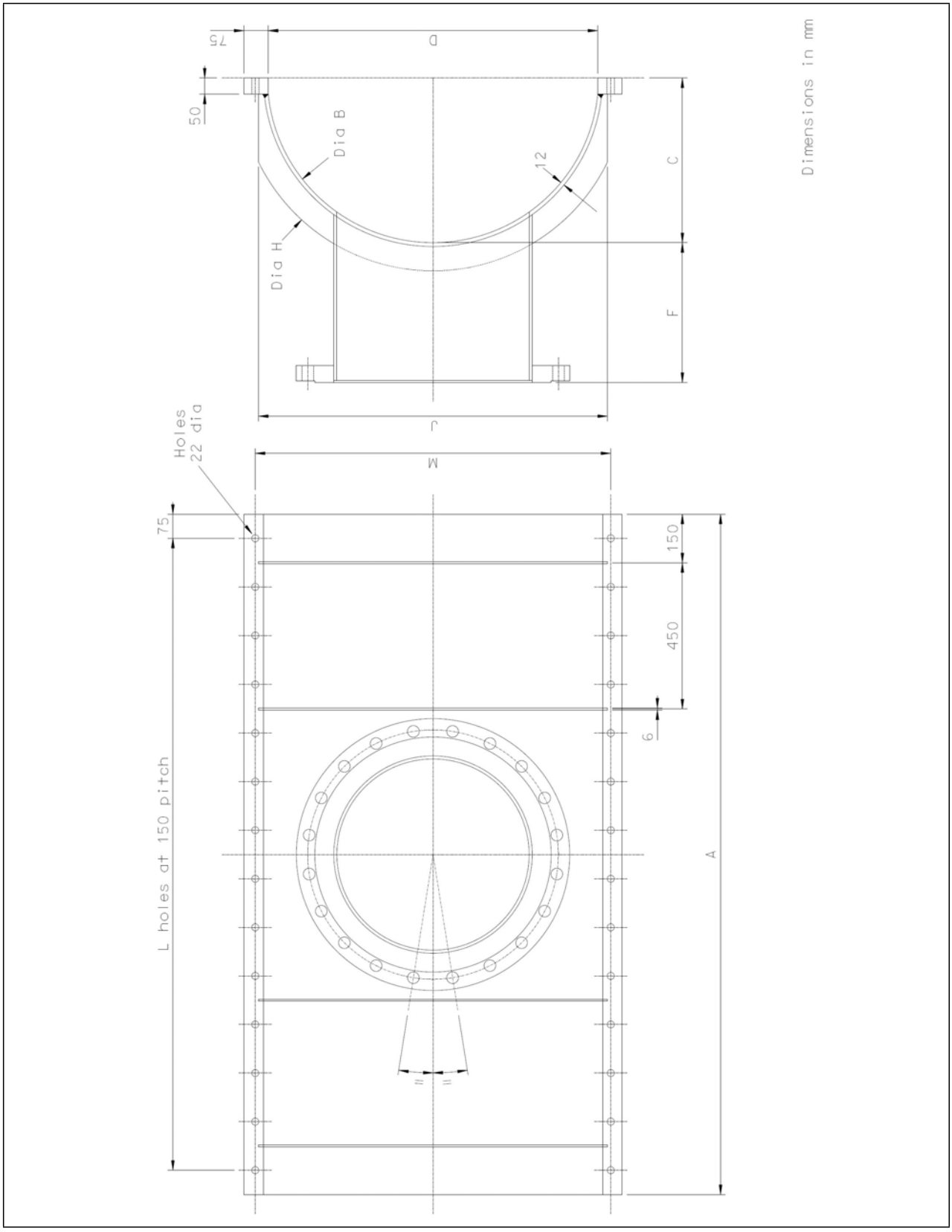


Figure D.2 — Branch half shell

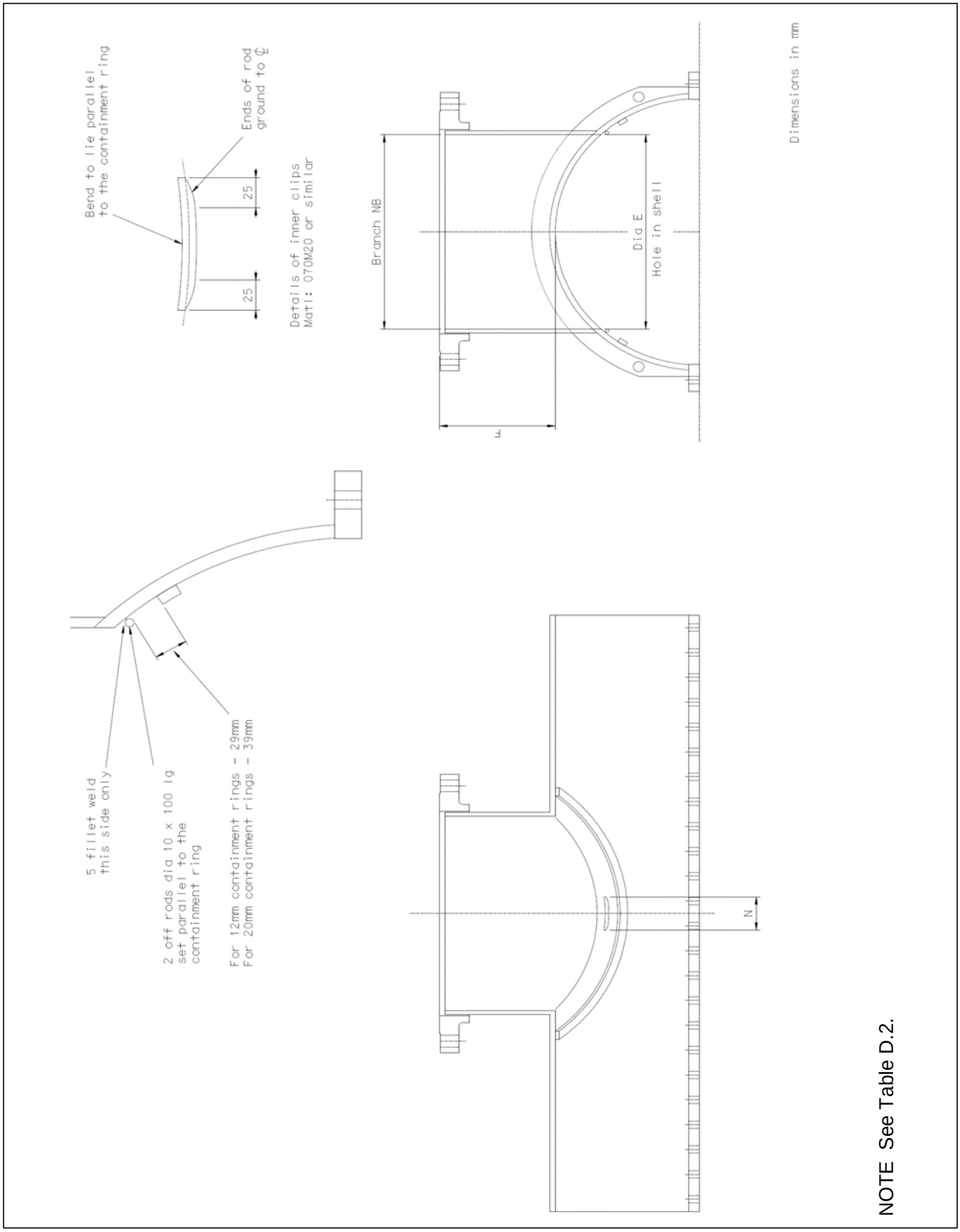


Figure D.3 — Branch and seal inner clip details

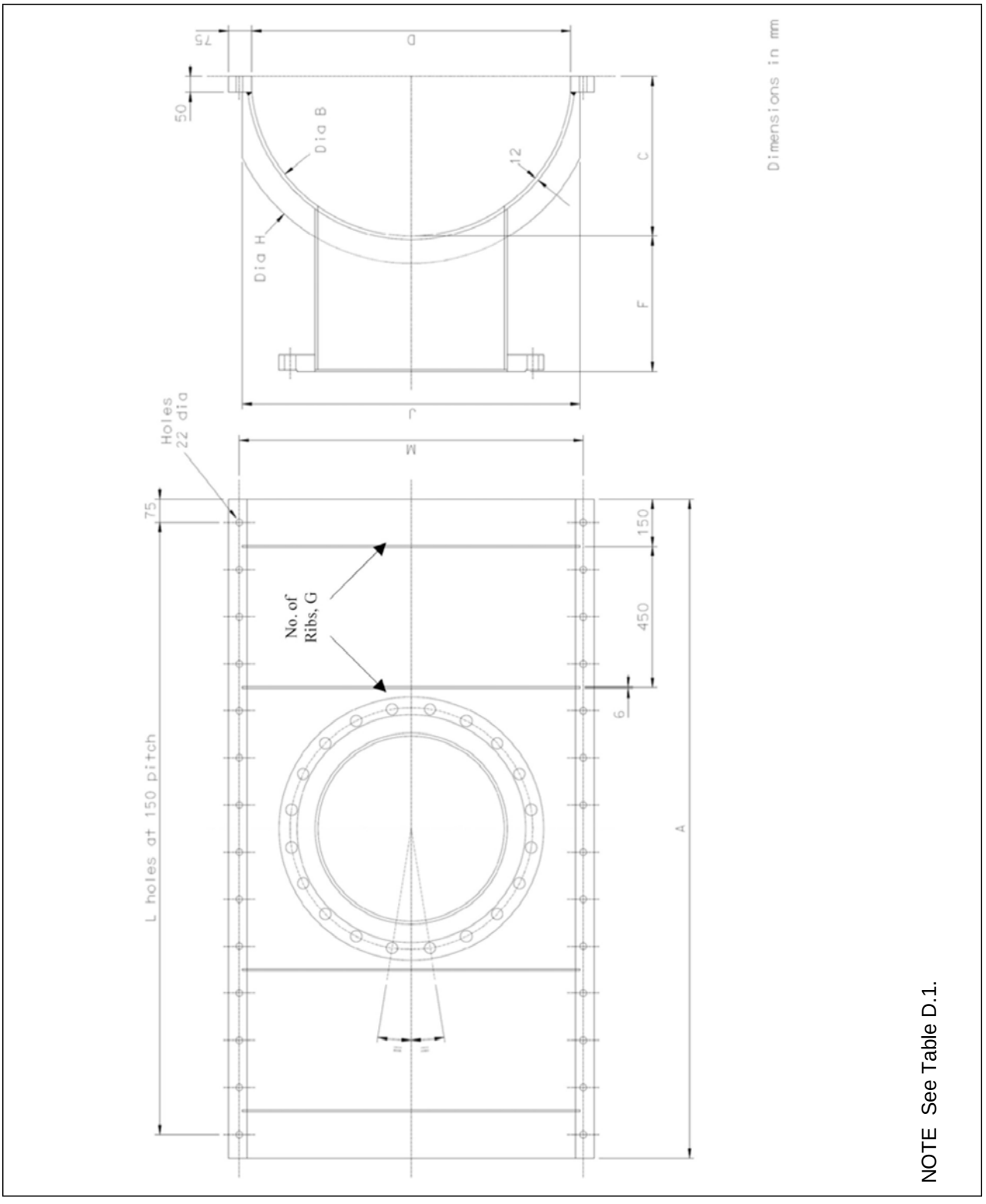


Figure D.4 — Lower half shell

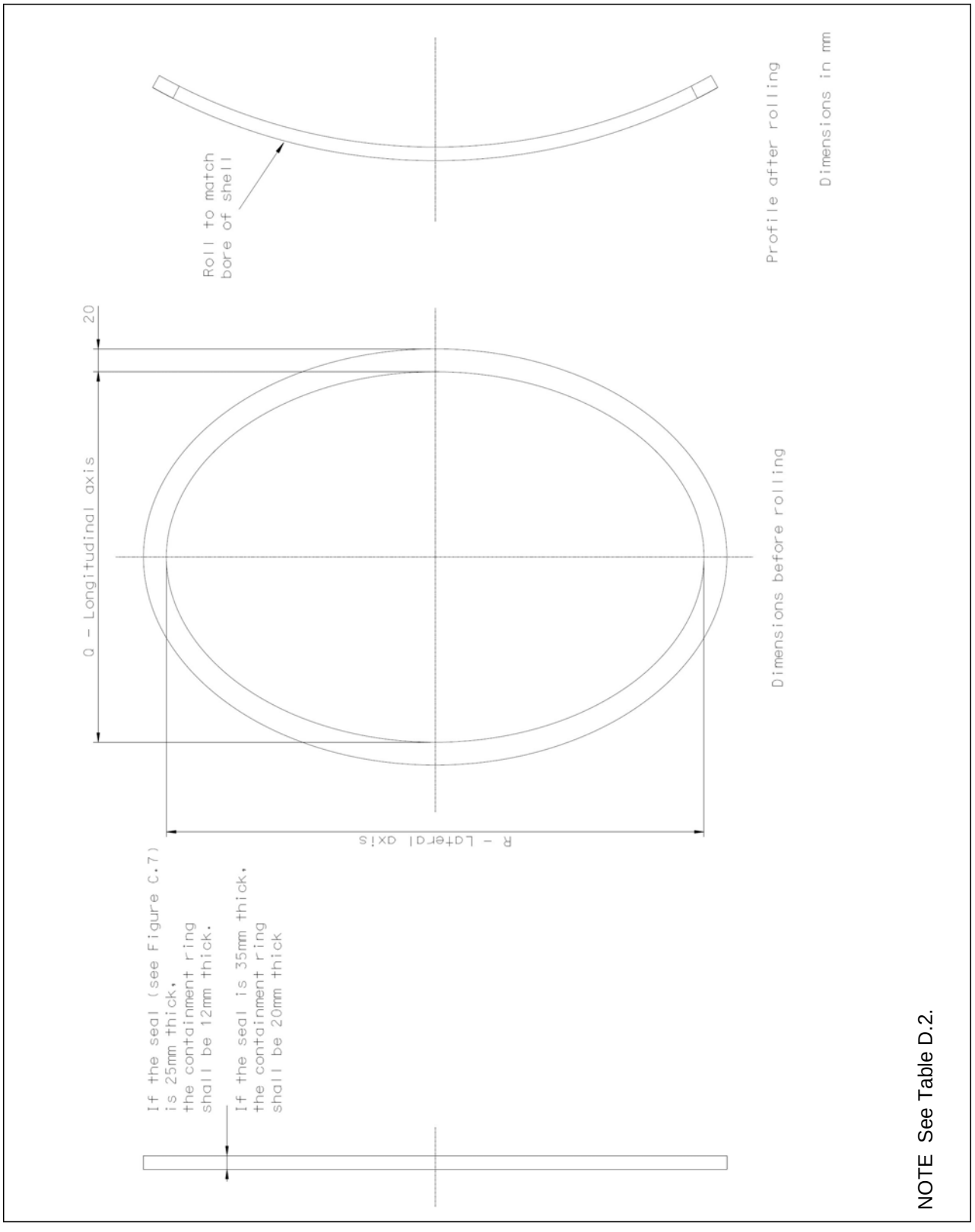


Figure D.5 —Containment ring

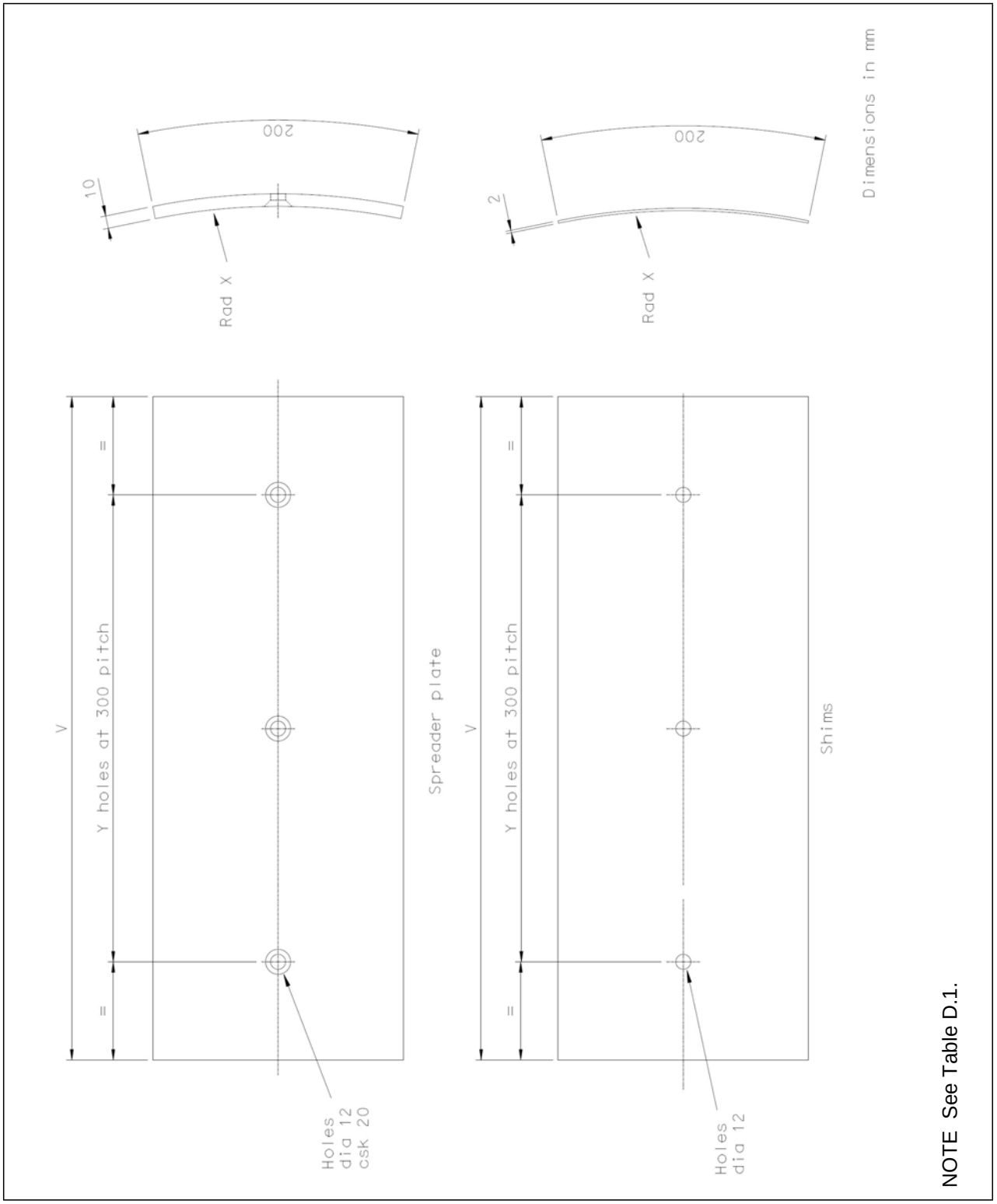


Figure D.6 — Spreader plate and shims

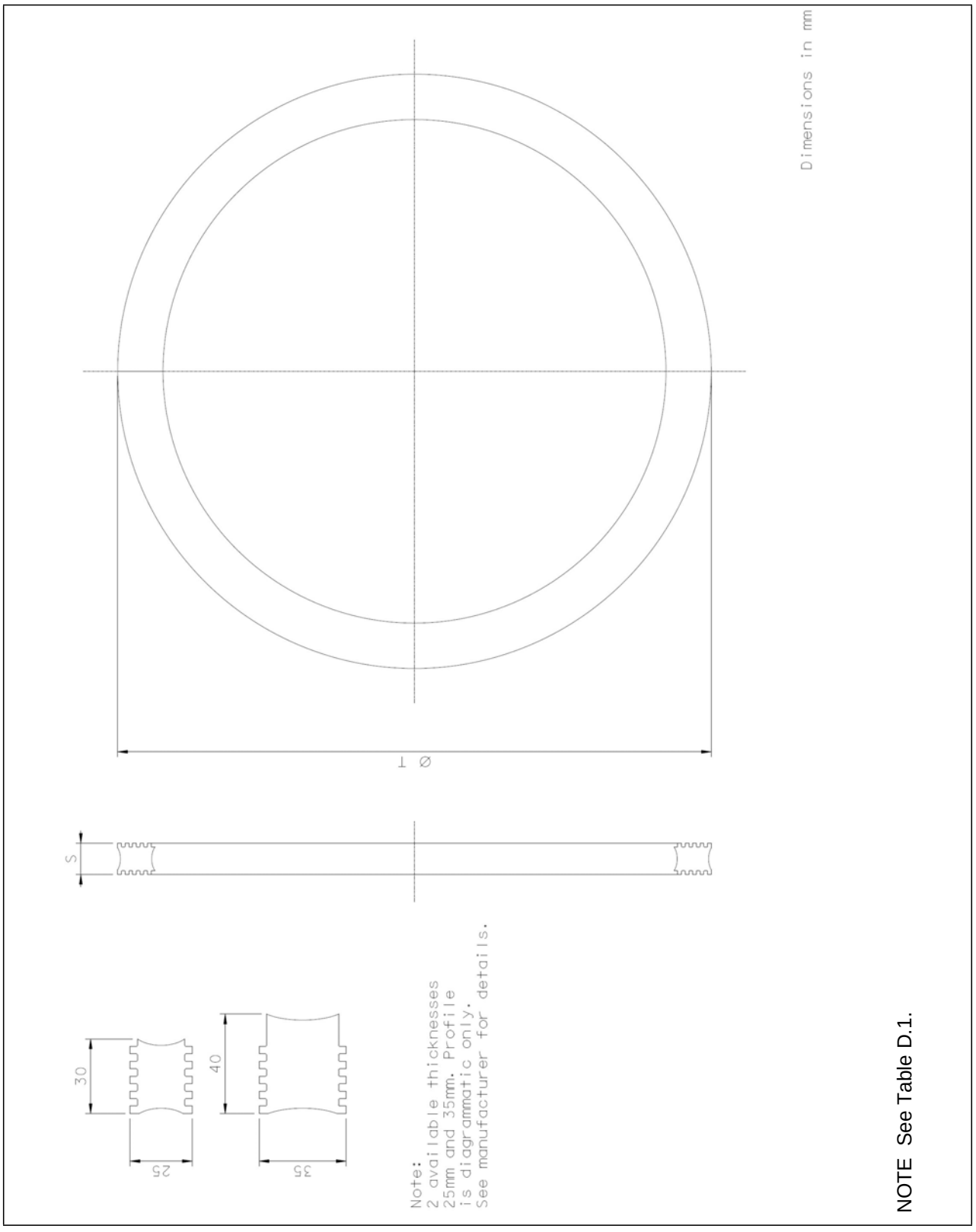


Figure D.7 — Seal

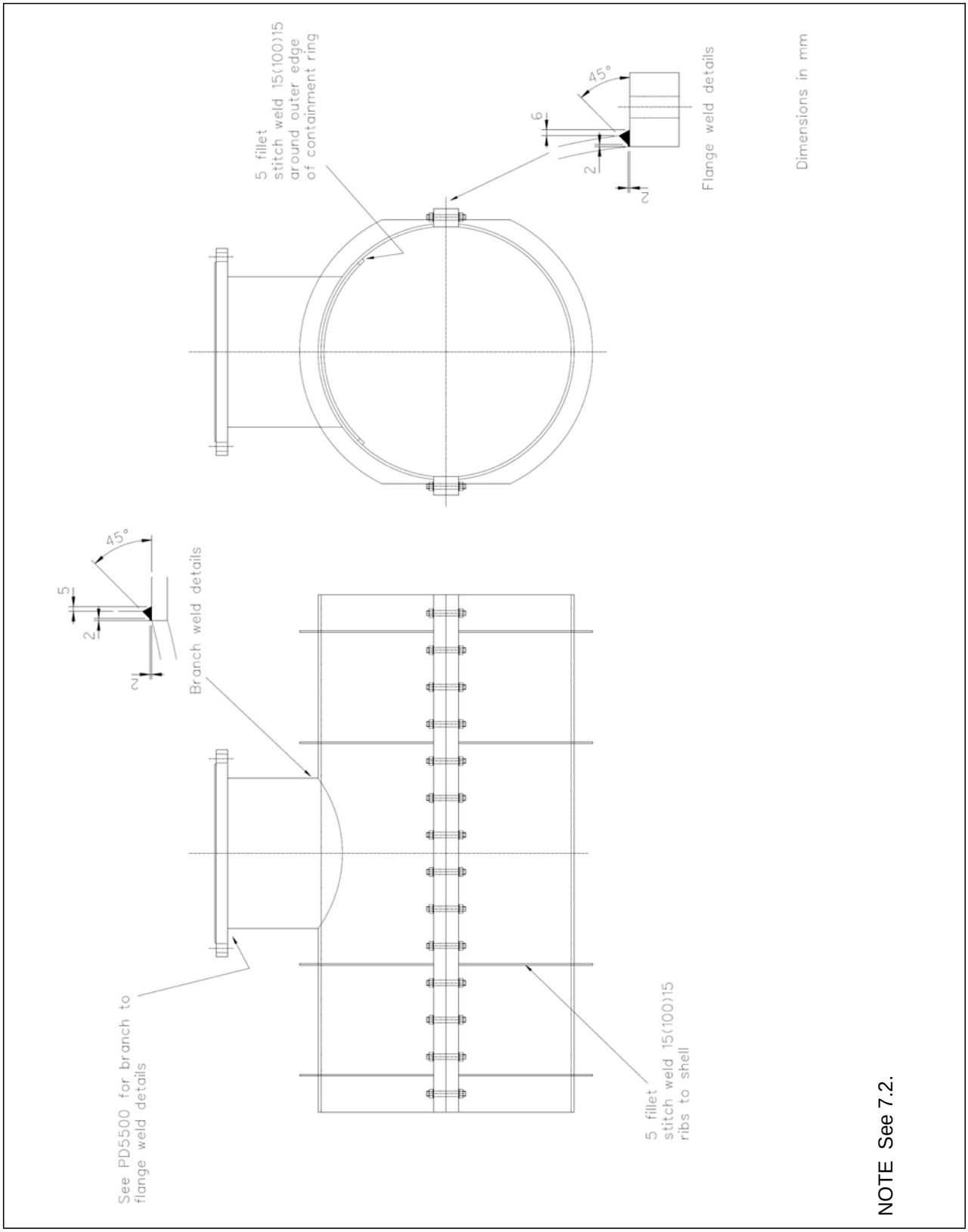


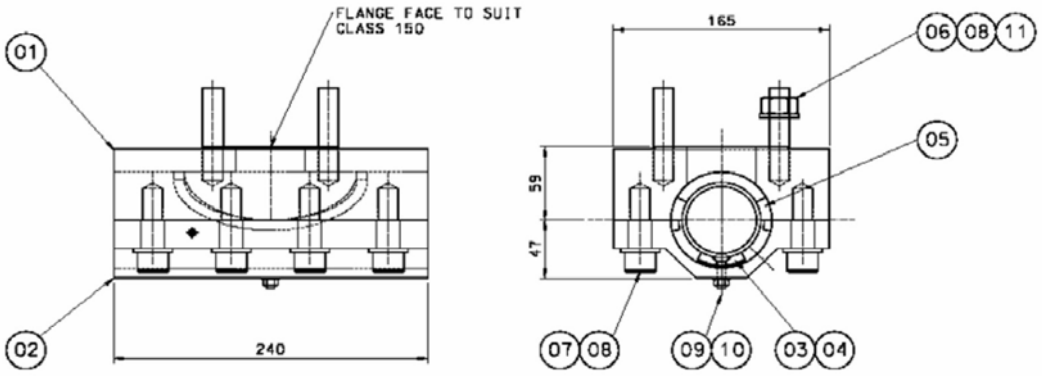
Figure D.8 — Weld details

Table D.4 — Dimensions of grouted tee connections in size range 2 in up to 4 in

Pipe nominal size	Max branch size	Branch size for stoppling	Shell length	Shell bore	Shell height		Spreader location	No. of holes each side	Hole centres
					Branch half	Lower half			
in	in	in	mm	mm					mm
			A	B	C	D	E	F	G
2	2	2	240	77.3	59	47	0	4	124
2.5	2.5	2.5	270	89.8	68	55	0	4	150
3	3	3	300	105.9	100.3	77.7	0	4	188
4	4	4	300	131.3	100.3	77.7	0	4	188
Fitting configurations shall conform to Figures D.9 to D.11.									

Table D.5 — Dimensions of grouted tee connections in size range 2 in up to 4 in

Pipe nominal size	Max branch size	Containment ring		Seal thickness	Seal diameter		Spreader plate and shims			
		Longitudinal ID	Latitudinal ID		ID	OD	Length	Width	Radius	No. of holes
in	in	mm	mm	mm	mm	mm	mm	mm	mm	
		H	I	J	K	L	M	N	O	P
2	2	112	132	12	94	118	120	35	37	1
2.5	2.5	112	132	12	94	118	120	40	43	1
3	3	146.3	180.4	12	137	161	120	50	51	1
4	4	146.3	180.4	12	137	161	120	63	64	1
Fitting configurations shall conform to Figures D.12 to D.14.										



ITEM No.	DESCRIPTION	DIMENSIONS	SPECIFICATION
01	Branch half shell assy		See figure D.10
02	Lower half shell		See figure D.11
03	Spreader plate		See figure D.13
04	Shim		See figure D.13
05	Seal		See figure D.14
06	Stud bolts	M16 x 75 LG	See clause 6.3.1
07	Hex sckt csk hd srews	M16 x 50 LG	See clause 6.3.1
08	Washers	M16	See clause 6.3.1
09	Hex sckt csk hd srews	M6 x 25 LG	See clause 6.3.1
10	Nut	M1	See clause 6.3.1
11	Nut	M16	See clause 6.3.1

Assembly Quantities				
Pipe Size	Flange Bolts	Spreader Plates	Standby Shims	C'sk screws
2"	8	1	2	1
2.5"	8	1	2	1
3"	8	1	2	1
4"	8	1	2	1

Figure D.9 — Schematic drawings and part list of small diameter grouted tee

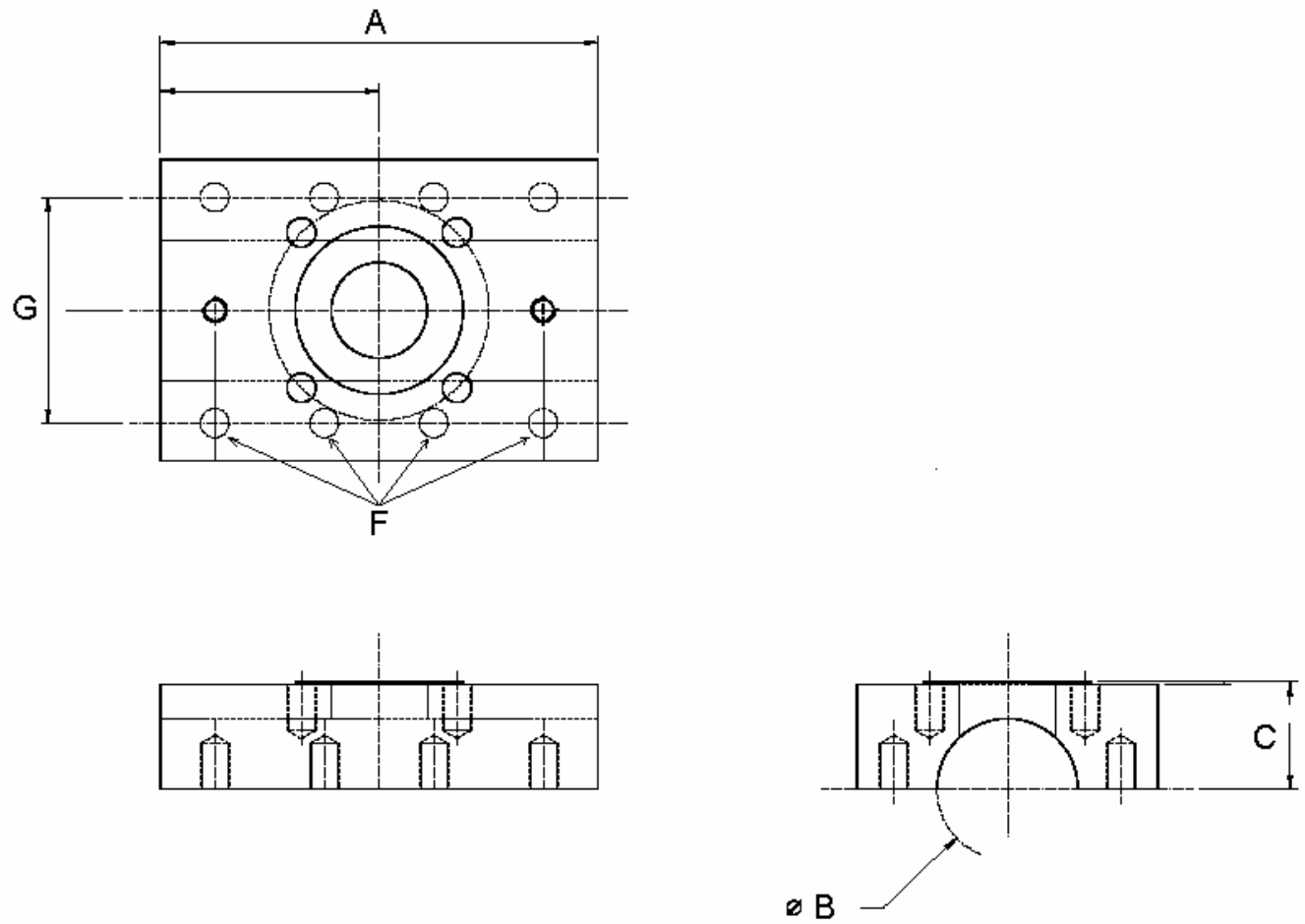


Figure D.10 — Branch half of shell

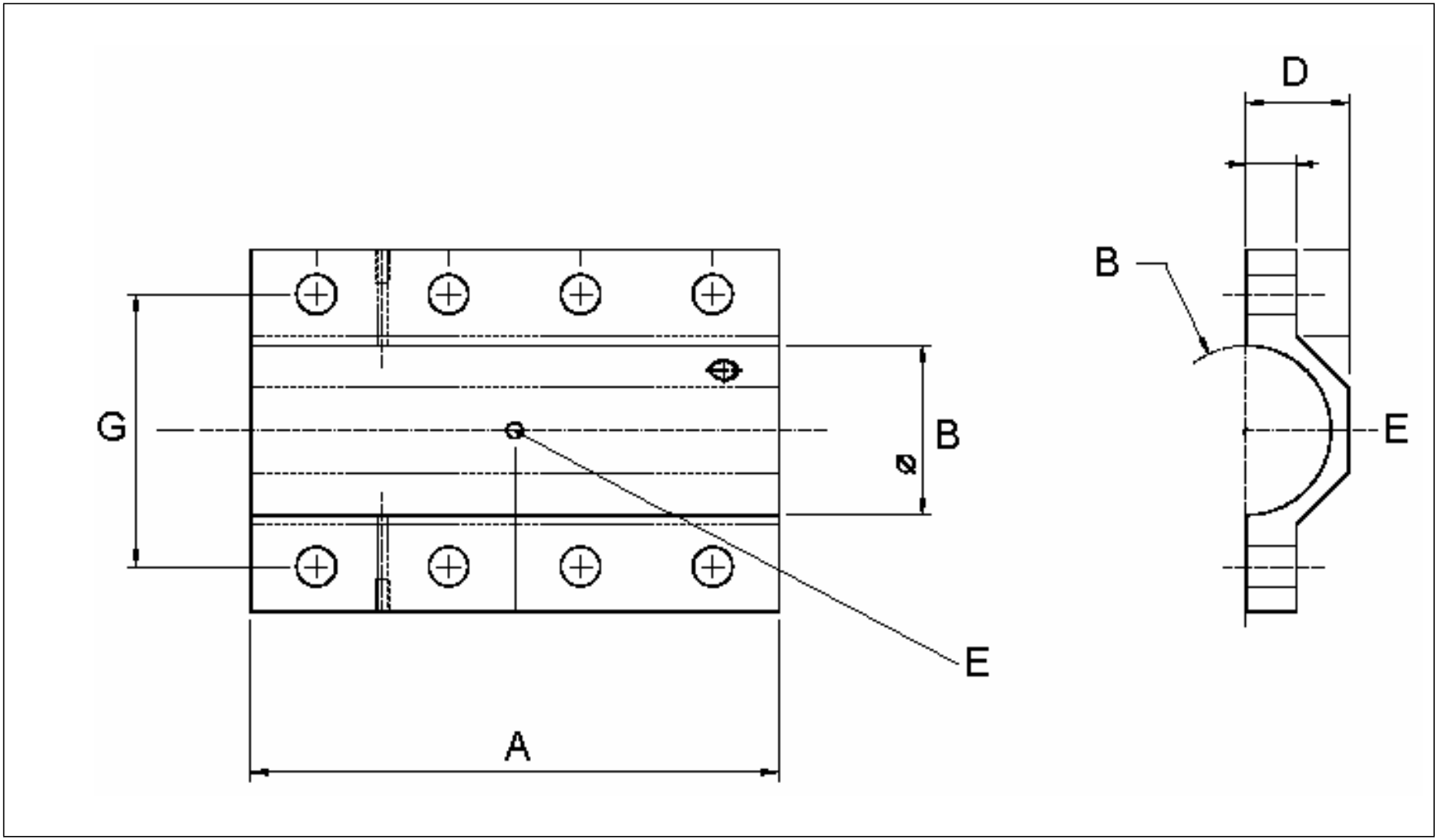


Figure D.11 — Bottom half of shell

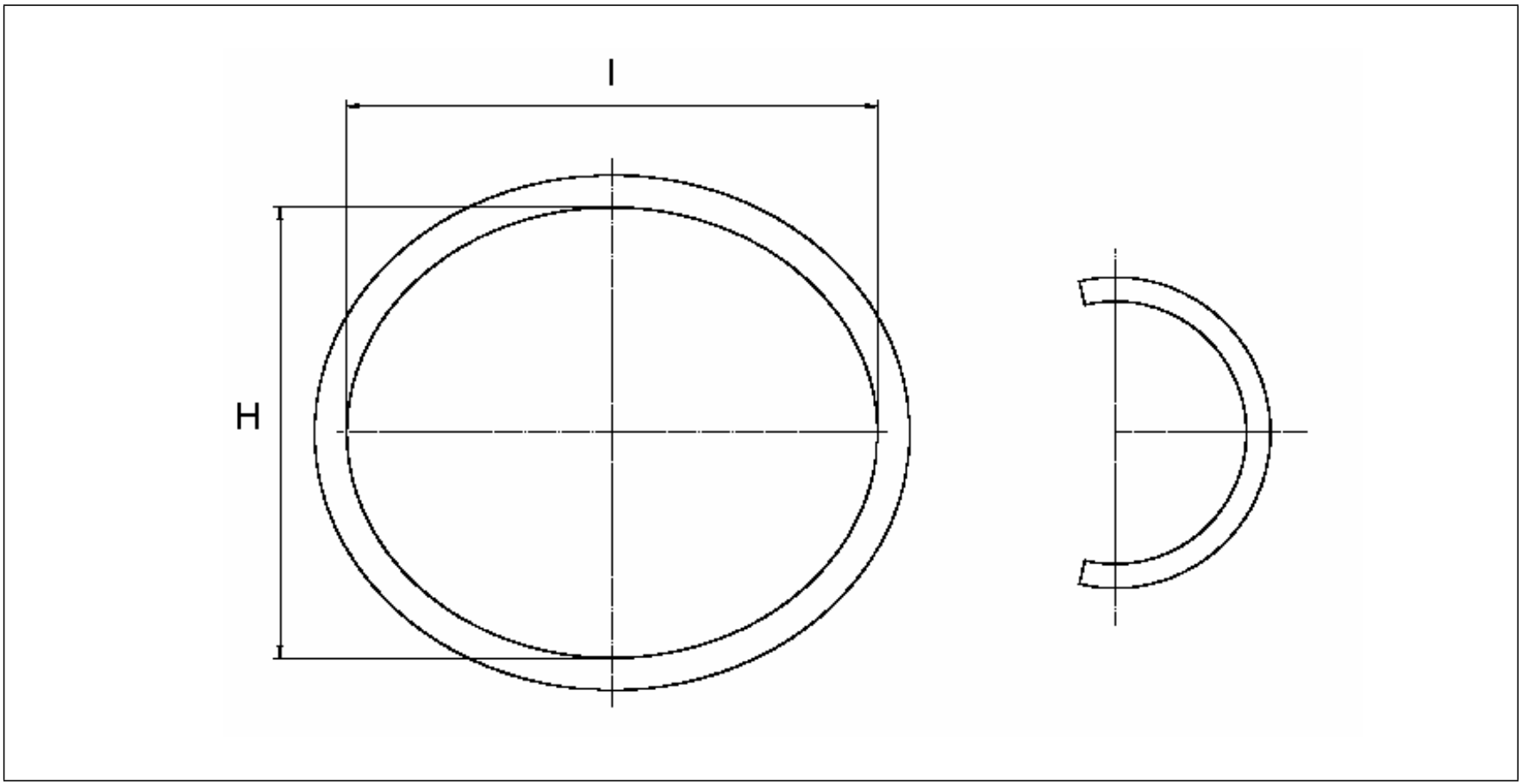


Figure D.12 — Dimension of containment ring

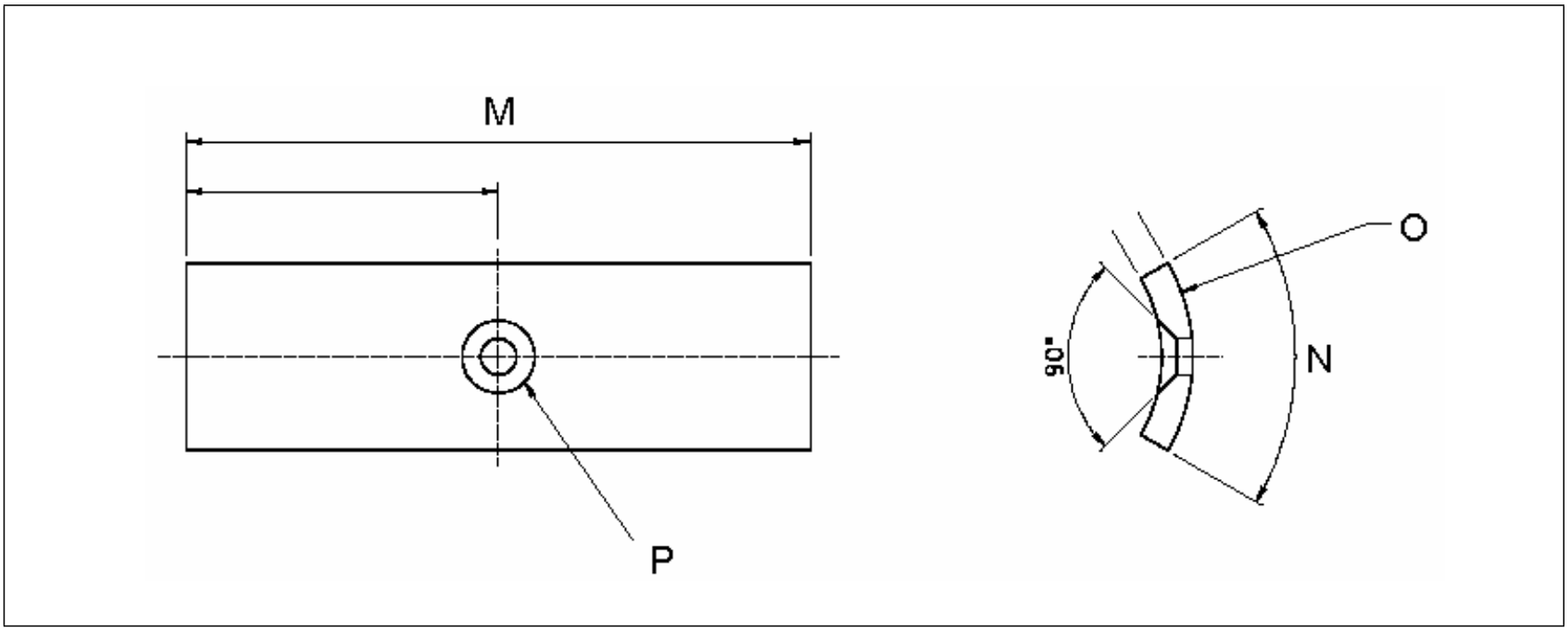


Figure D.13 — Dimension of spreader plates and shims

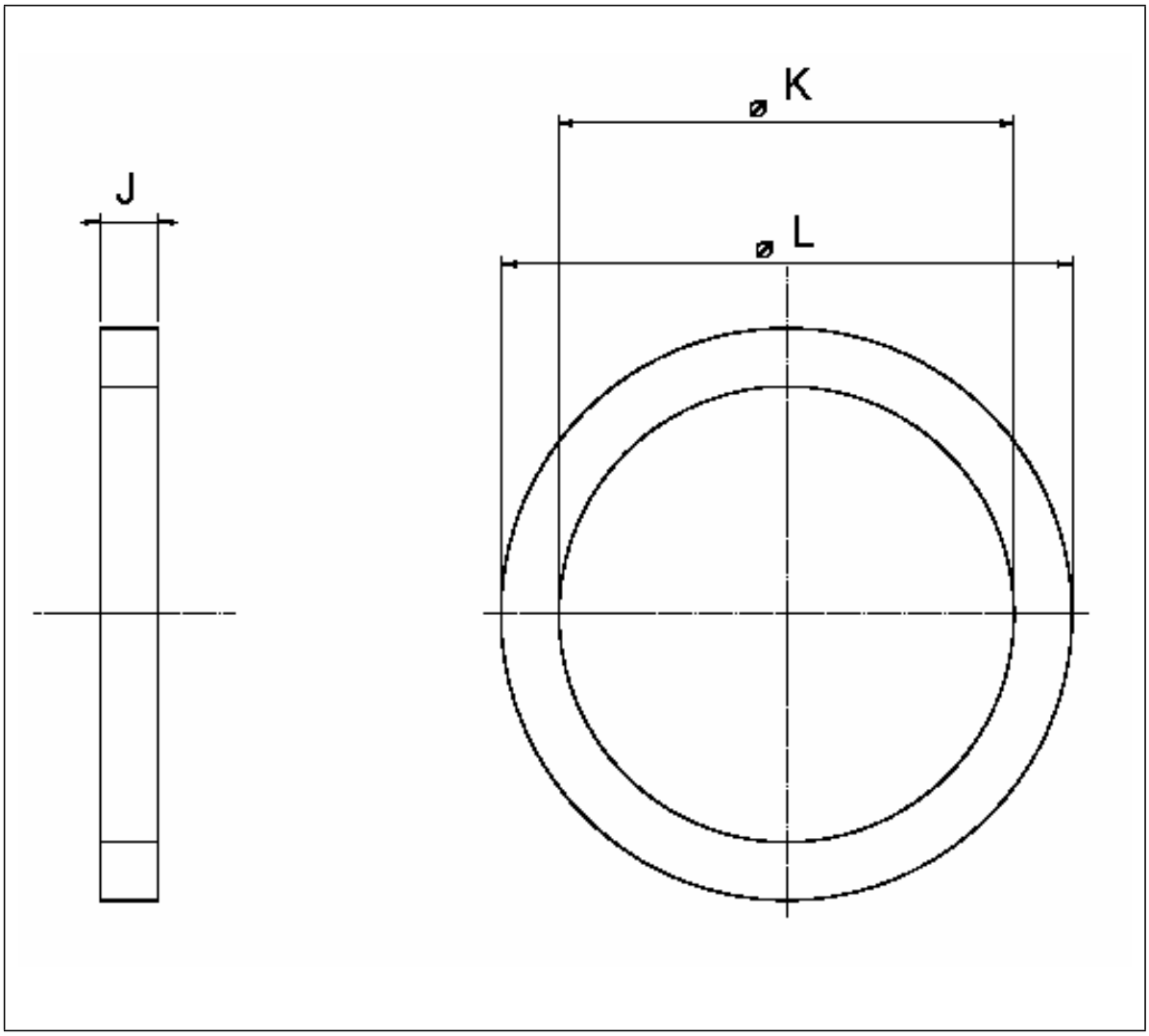


Figure D.14 — Dimension of main primary seal

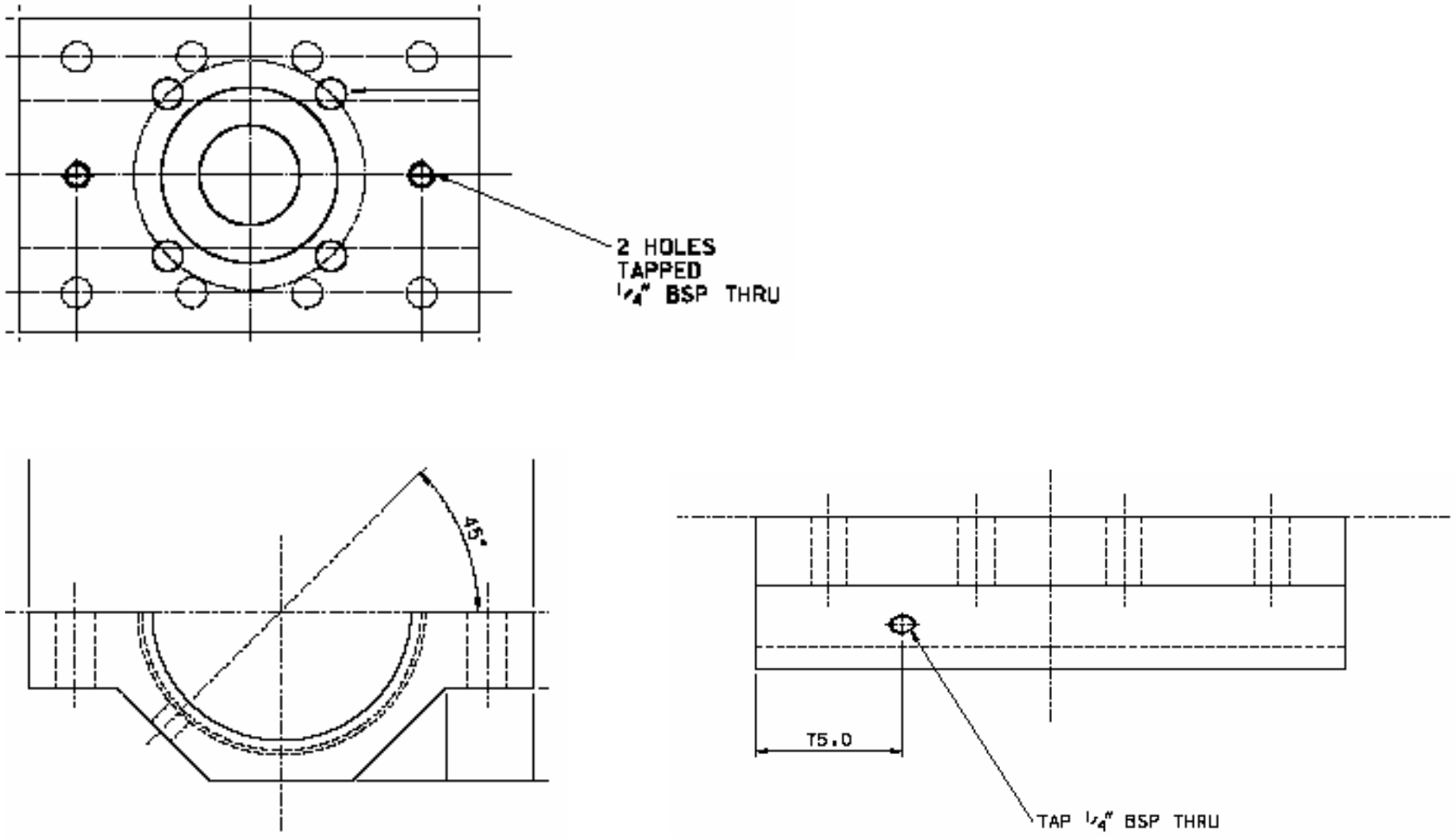


Figure D.15 — Position of feeders and risers

Annex E (normative)
Defect acceptance levels for the finished product

The defect acceptance levels for the finished product given in Tables E.1, E.2 and E.3 are generally in accordance with PD 5500:2015 but with certain alterations or additions.

Defects exceeding the limits, or different to types given, will be subject to agreement after due consideration of material, stress and environmental factors.

Table E.1 — Defects in welds

	Defect type	**Permitted maximum**
Planar defects	Surface breaking cracks and lamellar tears, lack of root, side, inter-run fusion and root penetration	Not permitted
	Isolated buried indications	1.25 m maximum length
Cavities	Isolated pores	Diameter 3mm but not more than 0.25 × parent metal thickness [a)]
	Uniform distributed localized porosity	2% by area as seen on radiograph
	Linear porosity (continuous)	Not permitted
Slag inclusions	Individual inclusions parallel to major weld axis of butt welds (separated from any other inclusion by a distance not less than 2 × length of longest of the two inclusions)	Length – less than parent metal thickness [a)] Width or depth – the lesser of 0.1 × parent metal thickness [a)] or 4 mm
	Groups of inclusions parallel to major axis of butt welds (separated from each other at different lengths)	The sum of individual lengths not to exceed 0.1 × weld length Where the separation of adjacent inclusions is less than 2 × length of longest inclusion total lengths of such pairs shall not exceed the parent metal thickness [a)]
	Random oriented individual or overlapping inclusions	To be contained within a cylindrical envelope of 3 mm diameter and separated from any other such envelope by at least 0.25 × parent metal thickness Cylindrical envelope length shall not exceed parent metal thickness [a)] Total projected area to be limited to 2% by area as seen on radiograph
Solid inclusions	Tungsten inclusions isolated or grouped	As for porosity
	Copper inclusions	Not permitted
[a)] In the case of dissimilar metal thickness, the applicable parent metal thickness shall be that of the thinner component.		

Table E.2 — Defects at weld end preparations and weld profiles

Location	Defect type	Permitted maximum
Weld end preparations	Lamination at weld end preparation individual or isolated	For fitting nominal sizes: ≤100 mm, 6 mm length > 100 mm, 12 mm length
	Laminations in line or separated	Separation between adjacent laminations to be not less than the longest lamination. The sum of lamination lengths to be less than 10% of total weld end preparation
	Weld end preparation shape and finish	To allow relevant NDT application
Weld	Undercut, shrinkage grooves, root concavity, excess penetration and overlap	Not permitted. Must be dressed smooth with parent plate (or forging) provided that the wall thickness is not reduced to below the specified minimum
	Reinforcement shape	It shall blend smoothly with the parent material. Dressing not necessary unless required by relevant NDT
	Linear misalignment	Accepted within the requirements of the specifications with correct tapering and blending

Table E.3 — Defects on finished products

Location	Defect type	Permitted maximum
At welded seams or body	Dents	Dents shall not be greater than 6.35 mm deep, measured as the gap between the lowest point of the dent and a prolongation of original contour of the pipe The length of the dent in any direction shall not exceed one half the pipe diameter
	Scores, pitting corrosion, finish and workmanship	Subject to Gas Transporter Inspector's discretion and evaluation, and not to affect the intended service duty within the specification
	Surface laps and gouges	Not permitted. Can be ground smooth provided that the wall thickness is not reduced to below the specified minimum