

## Annexure – B

### **TECHNICAL REQUIREMENT FOR FINISH MACHINING OF IMPELLER BLADE CASTING**

| S.No. | BHEL Requirement                                                                                                                                                                                                                                                      | Vendor's Confirmation    |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 1.    | Blade should be machined as per the drawing 02040718403/M2 R00 and model file which shall be supplied by BHEL. Snapshot in the file "Blade P VI.jpg" is also attached for viewing the details.                                                                        | <i>Vendor to confirm</i> |
| 2.    | Blade castings to be machined all over as per the coordinates shown in the drawing 02040718403/M2 R00. 2 mm allowance to be left on pressure and suction surfaces of the blade. Tolerance on profile shall be 0.5 mm & surface finish shall be 3.2 microns or better. | <i>Vendor to confirm</i> |
| 3.    | Welding edges as shown are also to be made on both crown-blade and skirt-blade mating surface. Detail of welding edge is shown in the drawing.                                                                                                                        | <i>Vendor to confirm</i> |
| 4.    | After completion of machining, 0.3 mm deep line should be inscribed by machine tool at location of Section D and F, throughout the length of the blade on both suction and pressure surface.                                                                          | <i>Vendor to confirm</i> |
| 5.    | Machining allowance available for profile machining shall be around 20-25 mm.                                                                                                                                                                                         | <i>Vendor to Note</i>    |
| 6.    | Offered cast weight of blade:- 4000 kg (approx.)                                                                                                                                                                                                                      | <i>Vendor to Note</i>    |
| 7.    | Finish weight of blade:- 2075 kg (approx.)                                                                                                                                                                                                                            | <i>Vendor to Note</i>    |
| 8.    | Material of blade shall be : ASTM A743 Gr CA6NM (13%Cr-4%Ni Stainless Steel)                                                                                                                                                                                          | <i>Vendor to Note</i>    |
| 9.    | Complete Dimensional, Profile & Surface finish inspection shall be carried out by BHEL representative at Vendor's works.                                                                                                                                              | <i>Vendor to Note</i>    |
| 10.   | All required tools, instruments, jigs, fixtures, templates, gauges, material scanning, coordinate measuring facility etc. should be arranged by the vendor                                                                                                            | <i>Vendor to confirm</i> |
| 11.   | After machining, blade should be given identification details by Hard punched                                                                                                                                                                                         | <i>Vendor to confirm</i> |
| 12.   | Job to be suitably packed after machining to avoid any damage to machined surfaces during loading/unloading/transportation                                                                                                                                            | <i>Vendor to confirm</i> |
| 13.   | Vendor to submit following with the offer:-<br>a) Details of the Organization<br>b) Details of the machine tools and other facilities installed in the company                                                                                                        | <i>Vendor to submit</i>  |
| 14.   | Vendor to submit Filled Supplier Registration Form along with Requisite Documents to SDC Cell in MM Deptt. of CFFP, BHEL, Haridwar. If already registered at CFFP or any other unit of BHEL, then Vendor code may be furnished. Vendor may plan a visit to CFFP       | <i>Vendor to submit</i>  |
| 15.   | Vendor may plan a visit to CFFP for technical discussion.                                                                                                                                                                                                             | <i>Vendor to Note</i>    |
| 16.   | BHEL team may visit vendor's works for facility/capacity verification.                                                                                                                                                                                                | <i>Vendor to Note</i>    |

Tender No.:FF/SC/16027/201600671  
Opening Due Date: 21/06/2016

Name & Signature of Sub-contractor  
With date & Seal



0-204-07-18403/M2  
DRAWING NUMBER

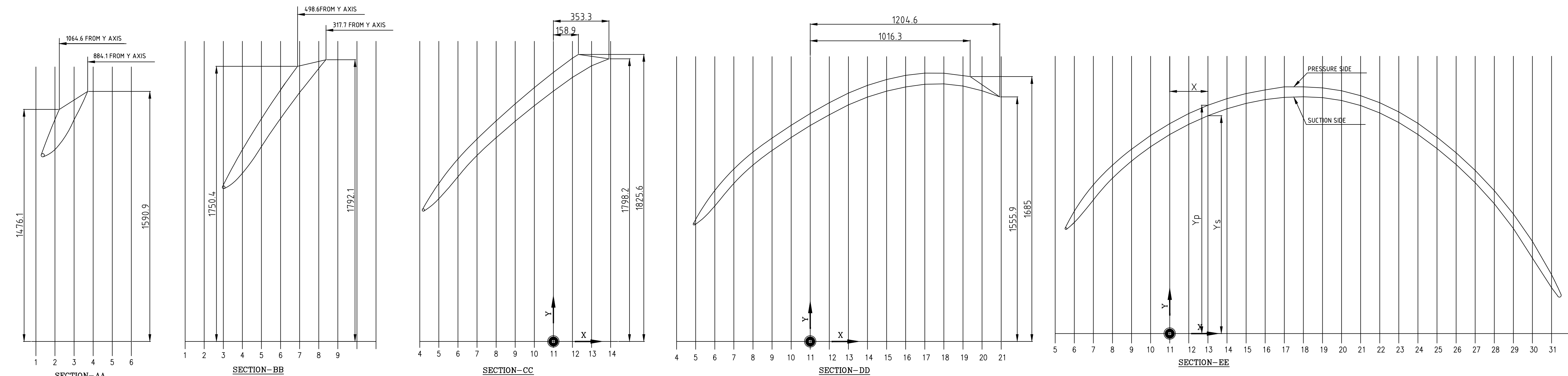


TABLE-3 TRAILING EDGE NOSE COORDINATES

| SECTION-E   |       |       |
|-------------|-------|-------|
| X           | YP    | YS    |
| 2488.7      | 242.7 | 242.7 |
| 2464.4      | 298.8 | 240.9 |
| 2440        | 348.8 | 273.4 |
| 2415.8      | 396.5 | 307.2 |
| 2391.5      | 441.5 | 342.2 |
| 2367.1      | 484.7 | 379   |
| 2342.9      | 526.1 | 417.5 |
| 2318.6      | 565.9 | 457.7 |
| 2294.2      | 604.2 | 499.3 |
| 2270        | 640.9 | 539.5 |
| NOSE RADIUS | 11.4  |       |

SECTION-F

| X           | YP    | YS    |
|-------------|-------|-------|
| 2496.3      | 143   | 143   |
| 2472.1      | 209.1 | 141.4 |
| 2447.8      | 267.8 | 177.6 |
| 2423.4      | 322.4 | 215.4 |
| 2399.2      | 373.4 | 255.1 |
| 2374.9      | 421.4 | 296.7 |
| 2350.5      | 467   | 340.6 |
| 2326.5      | 510.2 | 387.1 |
| 2302.2      | 551.4 | 432.9 |
| 2277.9      | 590.3 | 475.9 |
| NOSE RADIUS | 11.4  |       |

SECTION-G

| X           | YP    | YS    |
|-------------|-------|-------|
| 2500.4      | 18.3  | 18.3  |
| 2476.2      | 101.7 | 17.5  |
| 2452        | 173.1 | 60.3  |
| 2427.7      | 237.2 | 105.6 |
| 2403.4      | 295.7 | 153.7 |
| 2379.1      | 349.6 | 204.7 |
| 2354.8      | 400   | 259.7 |
| 2330.5      | 446.7 | 314.5 |
| 2306.2      | 491.1 | 365.1 |
| 2282.2      | 533.1 | 412.9 |
| NOSE RADIUS | 11.4  |       |

TABLE-2 LEADING EDGE NOSE COORDINATES

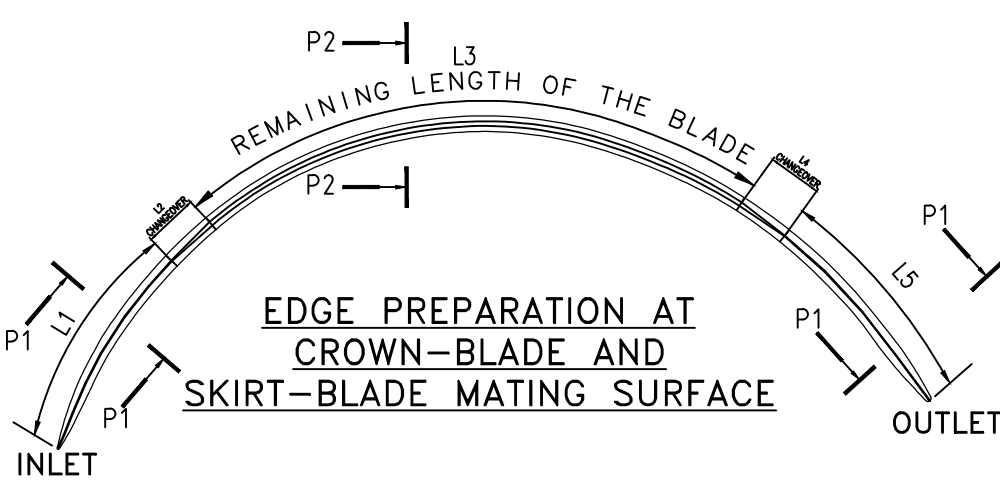
| X1        | YP1    | YS1    | YP1       | YS1    | YP1       | YS1    | YP1       | YS1    | YP1       | YS1   |
|-----------|--------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|-------|
| SECTION-A |        |        | SECTION-B |        | SECTION-C |        | SECTION-D |        | SECTION-E |       |
| 752.3     |        |        | 1568.8    | 1459.5 | 1248.7    | 1167.7 | 1084.8    | 1019.3 | 987.1     | 927   |
| 630.8     |        |        | 1546.8    | 1441.6 | 1252.8    | 1175.6 | 1104.6    | 1039.4 | 1004.4    | 944.9 |
| 509.8     |        |        | 1521.9    | 1420.9 | 1253.9    | 1180.1 | 1116.5    | 1052.7 | 1014.2    | 954.3 |
| 388.3     |        | 1712.3 | 1494.4    | 1397.6 | 1249.5    | 1176.6 | 1118.2    | 1055.1 | 1015.8    | 955.6 |
| 266.8     | 1787.3 | 1667.9 | 1464.5    | 1372.2 | 1236.9    | 1165.6 | 1109.7    | 1046.6 | 1006.2    | 945.5 |
| 242.5     | 1777.5 | 1660.2 | 1457.9    | 1367.9 | 1233.6    | 1163.5 | 1107      | 1043.8 | 1002.7    | 942.7 |
| 218.2     | 1767.4 | 1653.7 | 1451.4    | 1364.4 | 1229.7    | 1161.6 | 1103.7    | 1041.8 | 999       | 940.1 |
| 194.2     | 1757.4 | 1648   | 1444.3    | 1361.3 | 1225.6    | 1160   | 1099.7    | 1039.6 | 994.8     | 937.5 |
| 169.8     | 1747.1 | 1643.6 | 1437.5    | 1358.8 | 1221.2    | 1158.6 | 1095.5    | 1037.8 | 989.9     | 935.3 |
| 145.8     | 1736.8 | 1639.9 | 1430.5    | 1356.7 | 1216.3    | 1157.7 | 1090.9    | 1036.1 | 984.8     | 933.1 |
| 121.5     | 1726.1 | 1637.1 | 1423.3    | 1355   | 1211.2    | 1157   | 1085.9    | 1035   | 979.2     | 931   |
| 97.2      | 1715.5 | 1635.6 | 1415.8    | 1354.3 | 1206      | 1157   | 1080.3    | 1034.6 | 972.8     | 929.4 |
| 72.9      | 1704.6 | 1636.9 | 1407.8    | 1355.6 | 1200.2    | 1157.9 | 1074.5    | 1035.2 | 966.1     | 929   |
| 48.6      | 1693.6 | 1641   | 1400.1    | 1358.6 | 1194.1    | 1160.5 | 1068      | 1037.3 | 958.9     | 929.4 |
| 24.3      | 1682.3 | 1647.8 | 1392.2    | 1363.9 | 1187.6    | 1164.2 | 1061.2    | 1040.3 | 951.1     | 931   |
| 0.00      | 1664.4 | 1664.4 | 1377.7    | 1377.7 | 1175.2    | 1175.2 | 1049.7    | 1049.7 | 938.8     | 938.8 |
| NOSE RADI | 10     |        | 8.7       |        | 7.2       |        | 5.9       |        | 5.9       |       |

NOTES:

- Blade castings to be machined all over as per the coordinates shown in the drawing. 2 mm allowance to be left on pressure and suction surfaces of the blade. Tolerance on profile shall be 0.5 mm.
- Surface finish of machined blade shall be 3.2 micron or better.
- Additional section 'h' has been defined but blade is limited by the crown section.
- Crown and skirt profiles are shown in rotated elevation while section lines are shown in true elevation corresponding to plan.
- Sections 'f', 'g', & 'h' are defined further beyond the limits of the blade.
- Leading edge nose for all sections are tangential to the line marked at 135° from x-axis at origin.
- Welding edges as shown are also to be made on both crown-blade and skirt-blade mating surface. Details of welding edge is shown in the drawing.
- After completion of machining, 0.3 mm deep line should be inscribed by machining tool at location of Section D and F, throughout the length of the blade on both suction and pressure surface.
- Machining allowance available for profile machining shall be around 20-25 mm.
- Weight of casting in as-cast condition is estimated as 4000 kg
- Weight of casting after machining is estimated as 2075 kg
- Total surface area of blade is around 9.9 sqm
- Material of blade: 13Cr-4Ni Stainless steel to ASTM A743 Gr CA6NM

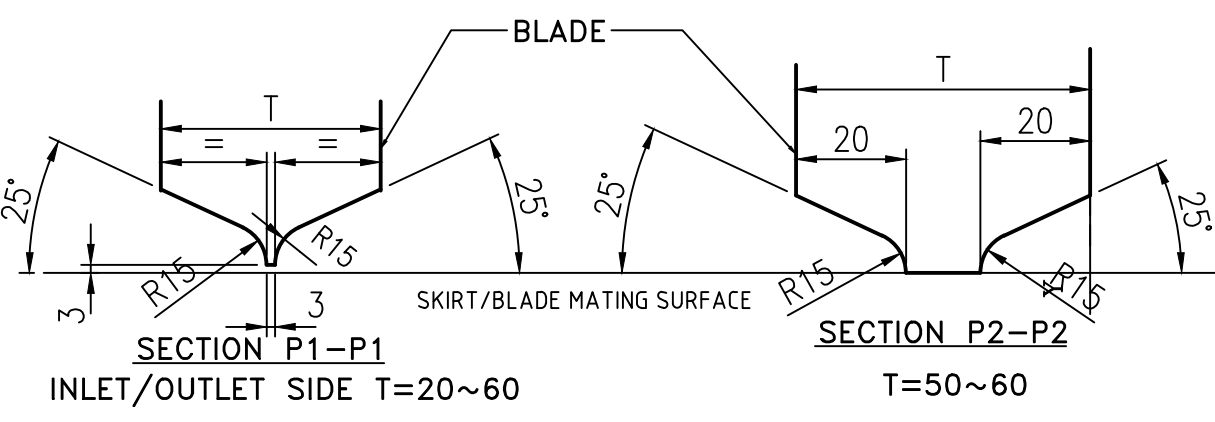
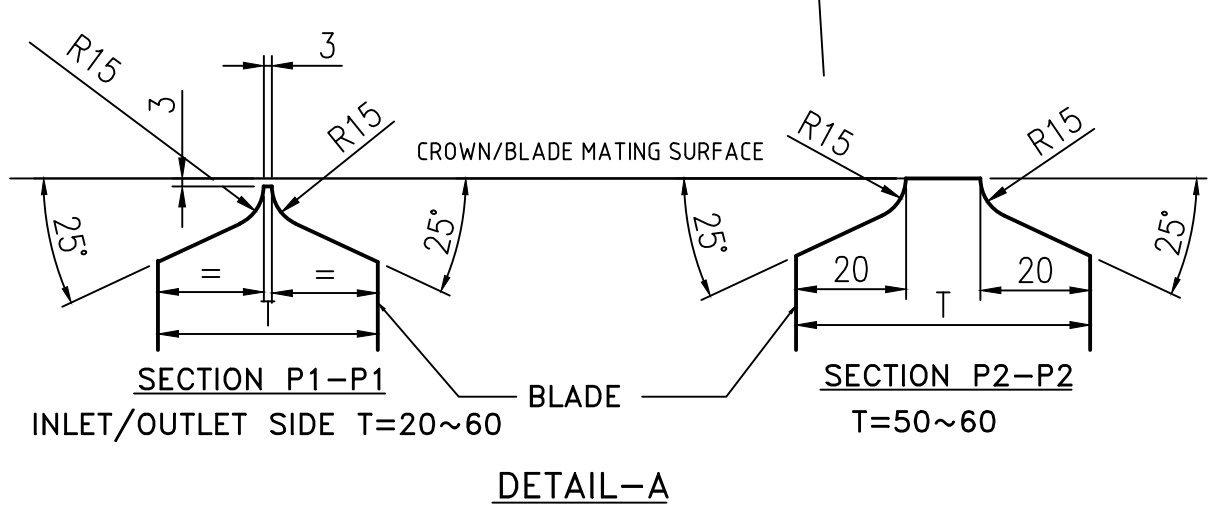
TABLE-1 'Y' COORDINATES OF GRID POINTS

| GRID | X-COORD | SEC-A  | SEC-B  | SEC-C  | SEC-D  | SEC-E  | SEC-F  | SEC-G  | SEC-H  |
|------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| 31   | 2426.5  |        |        |        |        | 375.2  | 315.6  | 239.4  | 160.2  |
| 30   | 2305.5  |        |        |        |        | 587.1  | 546    | 492.7  | 455.4  |
| 29   | 2184    |        |        |        |        | 761.2  | 728    | 682.9  | 654.2  |
| 28   | 2062.5  |        |        |        |        | 909.3  | 878.7  | 836.4  | 809.8  |
| 27   | 1941.5  |        |        |        |        | 1037.8 | 1006.9 | 963.5  | 935.9  |
| 26   | 1820    |        |        |        |        | 1150.4 | 1117.5 | 1070.6 | 1040.6 |
| 25   | 1698.5  |        |        |        |        | 1249.7 | 1213.1 | 1160.9 | 1128.2 |
| 24   | 1577.5  |        |        |        |        | 1337.1 | 1292.5 | 1237.8 | 1201.6 |
| 23   | 1456    |        |        |        |        | 1410   | 1357.2 | 1300.6 | 1263.1 |
| 22   | 1334.5  |        |        |        |        | 1468.6 | 1409.3 | 1350.4 | 1312.6 |
| 21   | 1213.5  |        |        |        |        | 1513.7 | 1449.7 | 1388.7 | 1350.4 |
| 20   | 1092    |        |        |        |        | 1544.8 | 1478.5 | 1415.8 | 1377.2 |
| 19   | 970.5   |        |        |        | 1691.9 | 1563.2 | 1496.6 | 1432.9 | 1394.1 |
| 18   | 849.5   |        |        |        | 1706.7 | 1569.3 | 1504.2 | 1440.1 | 1401.1 |
| 17   | 728     |        |        |        | 1706.9 | 1564.2 | 1501.6 | 1437.3 | 1398.3 |
| 16   | 606.5   |        |        |        | 1692.7 | 1549.9 | 1488.7 | 1425   | 1385.5 |
| 15   | 485.5   |        |        |        | 1666   | 1526.5 | 1465.4 | 1402.5 | 1362.8 |
| 14   | 364     |        |        |        | 1628.9 | 1494.4 | 1431.7 | 1369.6 | 1329.6 |
| 13   | 242.5   |        |        |        | 1579.8 | 1452.5 | 1388   | 1325.1 | 1284.9 |
| 12   | 121.5   |        |        | 1802.3 | 1518.6 | 1399.9 | 1333.1 | 1268.6 | 1228   |
| 11   | 0       |        |        | 1712   | 1449.9 | 1335.9 | 1265.5 | 1195.5 | 1157.2 |
| 10   | -121.5  |        |        | 1614.6 | 1375.2 | 1260.7 | 1184.7 | 1104   | 1069.8 |
| 9    | -242.5  |        |        | 1511.9 | 1293.9 | 1173   | 1089.2 | 989.2  | 961.4  |
| 8    | -364    |        |        | 1403   | 1204.6 | 1071.2 | 974    | 842.3  | 825.4  |
| 7    | -485.5  |        |        | 1287.8 | 1096.9 | 946.2  | 818.4  | 641.3  | 647    |
| 6    | -606.5  | 1599.4 | 1160.7 | 960    | 777.8  |        |        |        |        |
| 5    | -728    |        | 1417.6 | 1006   | 776.9  |        |        |        |        |
| 4    | -849.5  | 1219.3 |        |        |        |        |        |        |        |
| 3    | -970.5  |        | 994.8  |        |        |        |        |        |        |
| 2    | -1092   | 1412.3 |        |        |        |        |        |        |        |
| 1    | -1213.5 |        |        |        |        |        |        |        |        |
| 2    | -1092   | 1221.2 |        |        |        |        |        |        |        |
| 3    | -970.5  | 1410.9 | 972.2  |        |        |        |        |        |        |
| 4    | -849.5  |        | 1070.6 |        |        |        |        |        |        |
| 5    | -728    |        | 1240.8 | 908.3  | 746.3  |        |        |        |        |
| 6    | -606.5  | 1418.6 | 1048.8 | 862.4  | 707    |        |        |        |        |
| 7    | -485.5  | 1583.1 | 1183.4 | 1006   | 850.4  | 714    | 487.3  | 500.9  |        |
| 8    | -364    | 1736.4 | 1296.2 | 1121.9 | 988.5  | 880.8  | 733.2  | 715.6  |        |
| 9    | -242.5  |        | 1400.8 | 1214.9 | 1097.2 | 1006.9 | 898.3  | 869.6  |        |
| 10   | -121.5  |        | 1499.4 | 1298   | 1188.9 | 1108.6 | 1022.8 | 988.5  |        |
| 11   | 0       |        | 1592.2 | 1374   | 1266.3 | 1193.7 | 1120.5 | 1083.5 |        |
| 12   | 121.5   |        | 1679.9 | 1442.9 | 1331.4 | 1265.1 | 1198.1 | 1159.5 |        |
| 13   | 242.5   |        | 1753.4 | 1504.9 | 1385.7 | 1324   | 1259.3 | 1220.3 |        |
| 14   | 364     |        |        | 1554.4 | 1430.1 | 1370   | 1306.3 | 1267.5 |        |
| 15   | 485.5   |        |        | 1592.2 | 1464.7 | 1403.9 | 1341   | 1302.8 |        |
| 16   | 606.5   |        |        | 1619.3 | 1488.5 | 1426.8 | 1364.6 | 1326.8 |        |
| 17   | 728     |        |        | 1636.1 | 1502.5 | 1439.2 | 1377.9 | 1340.1 |        |
| 18   | 849.5   |        |        | 1638.5 | 1506.4 | 1441   | 1380.7 | 1343.4 |        |
| 19   | 970.5   |        |        | 1624.9 | 1500.9 | 1433.1 | 1373.3 | 1336.2 |        |
| 20   | 1092    |        |        | 1594.8 | 1483.1 | 1414.4 | 1355.6 | 1318.9 |        |
| 21   | 1213.5  |        |        |        | 1450.6 | 1385   | 1327   | 1290.6 |        |
| 22   | 1334.5  |        |        |        | 1403.2 | 1344.1 | 1286.9 | 1250.9 |        |
| 23   | 1456    |        |        |        | 1342.7 | 1291   | 1234.5 | 1199   |        |
| 24   | 1577.5  |        |        |        | 1266.8 | 1224.5 | 1168.4 | 1135.4 |        |
| 25   | 1698.5  |        |        |        | 1177.5 | 1142.2 | 1089.6 | 1059.1 |        |
| 26   | 1820    |        |        |        | 1075.9 | 1041.8 | 995.5  | 967    |        |
| 27   | 1941.3  |        |        |        | 959.8  | 924.4  | 883.4  | 856.3  |        |
| 28   | 2062.5  |        |        |        | 825.9  | 787.8  | 747    | 720.8  |        |
| 29   | 2184    |        |        |        | 668.9  | 625.7  | 579.4  | 550    |        |
| 30   | 2305.5  |        |        |        | 480.6  | 427.1  | 367    | 338.5  |        |
| 31   | 2426.5  |        |        |        | 291.8  | 210.5  | 107.4  | 20.3   |        |



| INLET | L1   | L2  | L3   | L4  | L5  | TOTAL |
|-------|------|-----|------|-----|-----|-------|
| CROWN | 900  | 150 | 2225 | 150 | 825 | 4250  |
| SKIRT | 1000 | 150 | 2575 | 150 | 825 | 4700  |

WELDING GROOVE AND LENGTH OF WELD SEAM



TRAILING EDGE PLAN VIEW (FROM TOP)

FOR DETAIL REF. TABLE-3

PLAN VIEW

