

### EC.1. Detailed Results for the Min–Max Regret Multidimensional Knapsack Problem

Tables EC.1–EC.3 show the results of the algorithms including the branch-and-cut algorithm (“B&C”), the fixed-scenario algorithm (“Fix”), the DS algorithm (“DS”), iDS using Hamming-distance constraints (“iDS-H”), and iDS using best-scenario constraints (“iDS-B”). An MMR-MKP instance denoted by “ $wxxxyy-zz$ ” is generated from the  $zz$ th MKP instance with  $m = ww$ ,  $n = xxx$ ,  $100\delta = yy$ . Concerning the branch-and-cut algorithm, each entry shows the best obtained solution value (“obj”), the CPU time in seconds required to obtain that solution (“time”), the lower-bound value obtained within the time limit (“LB”), and the optimality gap as a percentage (“%gap”), that is, the gap between the solution value and the best lower-bound values. Since the fixed-scenario approach under the median-value scenario provides a solution, half of whose maximum regret is a valid lower bound, the lower-bound value used to compute the percentage optimality gap was the best between such value and the lower bound produced by the branch-and-cut algorithm. For iDS-H and iDS-B, we provide the number of iterations (“iter”) required to obtain the best solution. Values in bold signify that the corresponding algorithm(s) obtained the smallest percentage optimality gap among the tested algorithms.

### EC.2. Detailed Results for the Min–Max Regret Knapsack Problem

Tables EC.4–EC.12 show the results of the branch-and-cut algorithm (“B&C”), the fixed-scenario algorithm (“Fix”), the DS algorithm (“DS”), and iDS algorithms using Hamming-distance constraints (“iDS-H”) and best-scenario constraints (“iDS-B”) for the MMR-SCP for each instance type. The MMR-KP instances are denoted by “ $v-ww-xx-yy-zz$ ,” where  $\text{type} = f$ ,  $n = ww$ ,  $\bar{R}/1000 = xx$ ,  $100\gamma = yy$ , and  $100\delta = zz$ . Best known lower-bound values (“LB”) and solution values (“UB”) are the best results as obtained from three heuristic algorithms and three exact algorithms by Furini et al. (2015). Concerning the best solution obtained by each algorithm for each instance, the table shows its objective value (“obj”), required CPU time in seconds (“time”), and optimality gap as a percentage (“%gap”). For the branch-and-cut algorithm, the table also shows the lower bound (“LB”) obtained within the time limit (3600 seconds). To compute the percentage optimality gap (“%gap”), we used the better lower bound value between the best known bound by Furini et al. (2015),

and the value produced by the branch-and-cut algorithm. For the best solution obtained by iDS, the table shows iteration index (“iter”) other than “obj,” “time” and “%gap.” Values in “obj” columns marked by “↓” (or “↑”) indicate instances whose objective function obtained by the proposed algorithm were better (or worse) than the best known solution values in “UB” columns. Bold values in “obj” columns indicate better objective values obtained within the time limit (3600 seconds) between iDS-H and iDS-B. Bold values in “iter” columns signify that fewer iterations were needed when iDS-H and iDS-B obtained solutions with the same objective value in “obj” columns.

### EC.3. Detailed Results for the Min–Max Regret Set Covering Problem

Tables EC.13–EC.15 show the results of the branch-and-cut algorithm (“B&C”), the fixed-scenario algorithm (“Fix”), the DS algorithm (“DS”), and iDS algorithms using Hamming-distance constraints (“iDS-H”) and best-scenario constraints (“iDS-B”) for MMR-SCP for each instance type. An MMR-SCP instance denoted by “ $Bxyyz$ ” indicates a Type-B instance whose corresponding SCP instance is the  $yy$ th instance in family  $x$  from the OR-Library with  $zz = 100\delta$ , while “ $Mxyy-z$ ” (or “ $Kxyy-z$ ”) stands for the  $z$ th Type-M (or Type-K) instance whose corresponding SCP instance is the  $yy$ th instance in family  $x$ . The best known lower-bound value (“LB”) and solution value (“UB”) are the results obtained from three heuristic algorithms and three exact algorithms by Pereira and Averbakh (2013). The notations “obj,” “time,” “ite,” “%gap,” “LB,” and “↓,” as well as the bold values in columns “obj” and columns “ite,” are the same as in Tables EC.4–EC.12 for the MMR-KP.

### EC.4. Detailed Results for the Min–Max Regret Generalized Assignment Problem

Tables EC.16–EC.19 show the results of the branch-and-cut algorithm (“B&C”), the fixed-scenario algorithm (“Fix”), the DS algorithm (“DS”), and iDS algorithms using Hamming-distance constraints (“iDS-H”) and best-scenario constraints (“iDS-B”) for the MMR-GAP for each instance type. An MMR-GAP instance denoted by “ $Txyyz-i$ ” indicates the  $i$ th instance of the  $(T, xx, yy, zz)$  combination, where type =  $T$ ,  $m = xx$ ,  $n = yy$ , and  $100\delta = zz$ . The best known lower-bound value (“LB”) and solution value (“UB”) are the results obtained from two heuristic algorithms and two exact algorithms by Wu et al. (2018a). The notations “obj,” “time,” “ite,” “%gap,” “LB,” “↓,” and “↑,” as well as the bold values in columns “obj” and “ite,” are the same as those in Tables EC.4–EC.12 for the MMR-KP.

**Table EC.1** MMR-MKP results with  $m = 5, n = 100$ 

| instance   | B&C  |        |      |      | Fix  |      |      | DS   |      |      | iDS-H |      |      |      | iDS-B |      |      |      |
|------------|------|--------|------|------|------|------|------|------|------|------|-------|------|------|------|-------|------|------|------|
|            | obj  | time   | LB   | %gap | obj  | time | %gap | obj  | time | %gap | obj   | time | iter | %gap | obj   | time | iter | %gap |
| 0510010-01 | 662  | 73.7   | 662  | 0.0  | 662  | 0.5  | 0.0  | 662  | 1.2  | 0.0  | 662   | 1.2  | 1    | 0.0  | 662   | 1.2  | 1    | 0.0  |
| 0510010-02 | 663  | 94.9   | 663  | 0.0  | 663  | 1.8  | 0.0  | 676  | 0.7  | 1.9  | 663   | 2.1  | 2    | 0.0  | 663   | 2.6  | 2    | 0.0  |
| 0510010-03 | 426  | 51.7   | 426  | 0.0  | 457  | 2.1  | 6.8  | 441  | 1.3  | 3.4  | 426   | 6.7  | 5    | 0.0  | 426   | 6.3  | 5    | 0.0  |
| 0510010-04 | 809  | 783.7  | 809  | 0.0  | 809  | 1.9  | 0.0  | 809  | 11.3 | 0.0  | 809   | 11.3 | 1    | 0.0  | 809   | 11.3 | 1    | 0.0  |
| 0510010-05 | 737  | 85.9   | 737  | 0.0  | 755  | 3.5  | 2.4  | 737  | 1.7  | 0.0  | 737   | 1.7  | 1    | 0.0  | 737   | 1.7  | 1    | 0.0  |
| 0510010-06 | 482  | 121.8  | 482  | 0.0  | 482  | 0.4  | 0.0  | 541  | 1.7  | 10.9 | 482   | 3.7  | 2    | 0.0  | 482   | 3.3  | 2    | 0.0  |
| 0510010-07 | 603  | 34.0   | 603  | 0.0  | 603  | 0.5  | 0.0  | 603  | 0.8  | 0.0  | 603   | 0.8  | 1    | 0.0  | 603   | 0.8  | 1    | 0.0  |
| 0510010-08 | 406  | 341.7  | 406  | 0.0  | 482  | 1.2  | 15.8 | 406  | 0.8  | 0.0  | 406   | 0.8  | 1    | 0.0  | 406   | 0.8  | 1    | 0.0  |
| 0510010-09 | 469  | 110.4  | 469  | 0.0  | 499  | 1.9  | 6.0  | 499  | 1.3  | 6.0  | 469   | 3.1  | 2    | 0.0  | 469   | 3.2  | 2    | 0.0  |
| 0510010-10 | 587  | 362.3  | 587  | 0.0  | 644  | 2.0  | 8.9  | 604  | 3.0  | 2.8  | 587   | 8.6  | 2    | 0.0  | 587   | 8.2  | 2    | 0.0  |
| 0510010-11 | 422  | 62.2   | 422  | 0.0  | 422  | 0.1  | 0.0  | 422  | 0.4  | 0.0  | 422   | 0.4  | 1    | 0.0  | 422   | 0.4  | 1    | 0.0  |
| 0510010-12 | 667  | 47.3   | 667  | 0.0  | 696  | 0.8  | 4.2  | 667  | 2.5  | 0.0  | 667   | 2.5  | 1    | 0.0  | 667   | 2.5  | 1    | 0.0  |
| 0510010-13 | 618  | 204.2  | 618  | 0.0  | 633  | 1.9  | 2.4  | 633  | 6.9  | 2.4  | 618   | 22.3 | 3    | 0.0  | 618   | 22.4 | 3    | 0.0  |
| 0510010-14 | 442  | 78.7   | 442  | 0.0  | 466  | 1.9  | 5.2  | 476  | 1.8  | 7.1  | 442   | 10.8 | 4    | 0.0  | 442   | 11.3 | 4    | 0.0  |
| 0510010-15 | 409  | 62.4   | 409  | 0.0  | 409  | 0.8  | 0.0  | 409  | 1.0  | 0.0  | 409   | 1.0  | 1    | 0.0  | 409   | 1.0  | 1    | 0.0  |
| 0510010-16 | 507  | 53.0   | 507  | 0.0  | 603  | 0.6  | 15.9 | 507  | 1.0  | 0.0  | 507   | 1.0  | 1    | 0.0  | 507   | 1.0  | 1    | 0.0  |
| 0510010-17 | 413  | 38.1   | 413  | 0.0  | 413  | 0.3  | 0.0  | 417  | 0.6  | 1.0  | 413   | 1.6  | 2    | 0.0  | 413   | 1.5  | 2    | 0.0  |
| 0510010-18 | 579  | 85.3   | 579  | 0.0  | 638  | 3.0  | 9.2  | 579  | 1.6  | 0.0  | 579   | 1.6  | 1    | 0.0  | 579   | 1.6  | 1    | 0.0  |
| 0510010-19 | 646  | 187.7  | 646  | 0.0  | 647  | 0.7  | 0.2  | 647  | 0.9  | 0.2  | 646   | 5.2  | 3    | 0.0  | 646   | 4.4  | 3    | 0.0  |
| 0510010-20 | 525  | 46.8   | 525  | 0.0  | 554  | 0.5  | 5.2  | 554  | 0.9  | 5.2  | 525   | 3.2  | 3    | 0.0  | 525   | 3.3  | 3    | 0.0  |
| 0510010-21 | 326  | 19.6   | 326  | 0.0  | 377  | 0.4  | 13.5 | 326  | 0.2  | 0.0  | 326   | 0.2  | 1    | 0.0  | 326   | 0.2  | 1    | 0.0  |
| 0510010-22 | 413  | 33.0   | 413  | 0.0  | 413  | 0.2  | 0.0  | 413  | 1.4  | 0.0  | 413   | 1.4  | 1    | 0.0  | 413   | 1.4  | 1    | 0.0  |
| 0510010-23 | 488  | 71.6   | 488  | 0.0  | 494  | 1.1  | 1.2  | 494  | 1.9  | 1.2  | 488   | 12.2 | 4    | 0.0  | 488   | 13.9 | 4    | 0.0  |
| 0510010-24 | 417  | 54.8   | 417  | 0.0  | 417  | 0.6  | 0.0  | 417  | 1.2  | 0.0  | 417   | 1.2  | 1    | 0.0  | 417   | 1.2  | 1    | 0.0  |
| 0510010-25 | 363  | 22.2   | 363  | 0.0  | 366  | 3.0  | 0.8  | 380  | 0.6  | 4.5  | 363   | 3.2  | 3    | 0.0  | 363   | 3.1  | 3    | 0.0  |
| 0510010-26 | 497  | 21.9   | 497  | 0.0  | 544  | 1.0  | 8.6  | 497  | 1.4  | 0.0  | 497   | 1.4  | 1    | 0.0  | 497   | 1.4  | 1    | 0.0  |
| 0510010-27 | 350  | 42.3   | 350  | 0.0  | 350  | 0.3  | 0.0  | 350  | 0.4  | 0.0  | 350   | 0.4  | 1    | 0.0  | 350   | 0.4  | 1    | 0.0  |
| 0510010-28 | 363  | 9.5    | 363  | 0.0  | 363  | 0.3  | 0.0  | 363  | 0.4  | 0.0  | 363   | 0.4  | 1    | 0.0  | 363   | 0.4  | 1    | 0.0  |
| 0510010-29 | 381  | 32.0   | 381  | 0.0  | 381  | 0.2  | 0.0  | 381  | 0.4  | 0.0  | 381   | 0.4  | 1    | 0.0  | 381   | 0.4  | 1    | 0.0  |
| 0510010-30 | 340  | 49.7   | 340  | 0.0  | 383  | 1.6  | 11.2 | 340  | 1.0  | 0.0  | 340   | 1.0  | 1    | 0.0  | 340   | 1.0  | 1    | 0.0  |
| 0510020-01 | 1963 | 764.6  | 1963 | 0.0  | 1968 | 1.7  | 0.3  | 1984 | 7.5  | 1.1  | 1963  | 45.3 | 4    | 0.0  | 1963  | 44.0 | 4    | 0.0  |
| 0510020-02 | 1434 | 465.5  | 1434 | 0.0  | 1434 | 1.0  | 0.0  | 1457 | 2.3  | 1.6  | 1434  | 8.6  | 3    | 0.0  | 1434  | 8.7  | 3    | 0.0  |
| 0510020-03 | 1363 | 81.7   | 1363 | 0.0  | 1474 | 2.4  | 7.5  | 1363 | 1.5  | 0.0  | 1363  | 1.5  | 1    | 0.0  | 1363  | 1.5  | 1    | 0.0  |
| 0510020-04 | 2190 | 3418.2 | 1987 | 9.3  | 2240 | 0.4  | 11.3 | 2190 | 11.1 | 9.3  | 2190  | 11.1 | 1    | 9.3  | 2190  | 11.1 | 1    | 9.3  |
| 0510020-05 | 1732 | 1906.1 | 1732 | 0.0  | 1732 | 2.6  | 0.0  | 1732 | 3.0  | 0.0  | 1732  | 3.0  | 1    | 0.0  | 1732  | 3.0  | 1    | 0.0  |
| 0510020-06 | 1364 | 178.8  | 1364 | 0.0  | 1364 | 0.5  | 0.0  | 1364 | 0.4  | 0.0  | 1364  | 0.4  | 1    | 0.0  | 1364  | 0.4  | 1    | 0.0  |
| 0510020-07 | 1679 | 882.1  | 1679 | 0.0  | 1742 | 1.8  | 3.6  | 1679 | 5.6  | 0.0  | 1679  | 5.6  | 1    | 0.0  | 1679  | 5.6  | 1    | 0.0  |
| 0510020-08 | 1577 | 274.9  | 1577 | 0.0  | 1577 | 0.5  | 0.0  | 1577 | 2.2  | 0.0  | 1577  | 2.2  | 1    | 0.0  | 1577  | 2.2  | 1    | 0.0  |
| 0510020-09 | 1393 | 457.5  | 1393 | 0.0  | 1424 | 0.5  | 2.2  | 1424 | 1.3  | 2.2  | 1393  | 2.6  | 2    | 0.0  | 1393  | 2.7  | 2    | 0.0  |
| 0510020-10 | 1707 | 940.0  | 1707 | 0.0  | 1707 | 0.5  | 0.0  | 1717 | 2.9  | 0.6  | 1707  | 5.8  | 2    | 0.0  | 1707  | 5.7  | 2    | 0.0  |
| 0510020-11 | 1615 | 2785.1 | 1301 | 19.4 | 1602 | 2.2  | 18.8 | 1574 | 8.1  | 17.3 | 1574  | 8.1  | 1    | 17.3 | 1574  | 8.1  | 1    | 17.3 |
| 0510020-12 | 1224 | 214.7  | 1224 | 0.0  | 1224 | 0.3  | 0.0  | 1224 | 1.8  | 0.0  | 1224  | 1.8  | 1    | 0.0  | 1224  | 1.8  | 1    | 0.0  |
| 0510020-13 | 1767 | 3286.1 | 1493 | 15.5 | 1767 | 0.5  | 15.5 | 1767 | 7.8  | 15.5 | 1767  | 7.8  | 1    | 15.5 | 1767  | 7.8  | 1    | 15.5 |
| 0510020-14 | 1109 | 484.6  | 1109 | 0.0  | 1123 | 1.2  | 1.2  | 1109 | 1.5  | 0.0  | 1109  | 1.5  | 1    | 0.0  | 1109  | 1.5  | 1    | 0.0  |
| 0510020-15 | 1272 | 990.9  | 1272 | 0.0  | 1272 | 0.8  | 0.0  | 1272 | 2.2  | 0.0  | 1272  | 2.2  | 1    | 0.0  | 1272  | 2.2  | 1    | 0.0  |
| 0510020-16 | 1229 | 191.3  | 1229 | 0.0  | 1346 | 0.7  | 8.7  | 1229 | 1.4  | 0.0  | 1229  | 1.4  | 1    | 0.0  | 1229  | 1.4  | 1    | 0.0  |
| 0510020-17 | 1420 | 100.8  | 1420 | 0.0  | 1446 | 0.2  | 1.8  | 1420 | 0.8  | 0.0  | 1420  | 0.8  | 1    | 0.0  | 1420  | 0.8  | 1    | 0.0  |
| 0510020-18 | 1743 | 791.5  | 1743 | 0.0  | 1761 | 1.1  | 1.0  | 1743 | 5.7  | 0.0  | 1743  | 5.7  | 1    | 0.0  | 1743  | 5.7  | 1    | 0.0  |
| 0510020-19 | 2175 | 299.1  | 1626 | 25.2 | 2135 | 3.6  | 23.8 | 2122 | 21.7 | 23.4 | 2122  | 21.7 | 1    | 23.4 | 2122  | 21.7 | 1    | 23.4 |
| 0510020-20 | 1592 | 746.0  | 1592 | 0.0  | 1592 | 0.4  | 0.0  | 1592 | 1.9  | 0.0  | 1592  | 1.9  | 1    | 0.0  | 1592  | 1.9  | 1    | 0.0  |
| 0510020-21 | 1055 | 137.0  | 1055 | 0.0  | 1055 | 0.3  | 0.0  | 1055 | 0.8  | 0.0  | 1055  | 0.8  | 1    | 0.0  | 1055  | 0.8  | 1    | 0.0  |
| 0510020-22 | 809  | 235.5  | 809  | 0.0  | 809  | 0.4  | 0.0  | 809  | 0.5  | 0.0  | 809   | 0.5  | 1    | 0.0  | 809   | 0.5  | 1    | 0.0  |
| 0510020-23 | 1143 | 245.5  | 1143 | 0.0  | 1143 | 0.4  | 0.0  | 1143 | 2.3  | 0.0  | 1143  | 2.3  | 1    | 0.0  | 1143  | 2.3  | 1    | 0.0  |
| 0510020-24 | 1011 | 287.9  | 1011 | 0.0  | 1011 | 0.1  | 0.0  | 1011 | 0.2  | 0.0  | 1011  | 0.2  | 1    | 0.0  | 1011  | 0.2  | 1    | 0.0  |
| 0510020-25 | 1232 | 79.2   | 1232 | 0.0  | 1354 | 0.8  | 9.0  | 1232 | 1.0  | 0.0  | 1232  | 1.0  | 1    | 0.0  | 1232  | 1.0  | 1    | 0.0  |
| 0510020-26 | 1428 | 343.6  | 1428 | 0.0  | 1428 | 0.4  | 0.0  | 1433 | 3.6  | 0.3  | 1428  | 10.2 | 2    | 0.0  | 1428  | 8.7  | 2    | 0.0  |
| 0510020-27 | 1122 | 1232.4 | 1122 | 0.0  | 1122 | 0.6  | 0.0  | 1122 | 4.8  | 0.0  | 1122  | 4.8  | 1    | 0.0  | 1122  | 4.8  | 1    | 0.0  |
| 0510020-28 | 1003 | 132.6  | 1003 | 0.0  | 1003 | 0.3  | 0.0  | 1003 | 1.0  | 0.0  | 1003  | 1.0  | 1    | 0.0  | 1003  | 1.0  | 1    | 0.0  |
| 0510020-29 | 1214 | 479.6  | 1214 | 0.0  | 1214 | 0.9  | 0.0  | 1214 | 1.1  | 0.0  | 1214  | 1.1  | 1    | 0.0  | 1214  | 1.1  | 1    | 0.0  |
| 0510020-30 | 1101 | 226.3  | 1101 | 0.0  | 1101 | 0.4  | 0.0  | 1101 | 1.0  | 0.0  | 1101  | 1.0  | 1    | 0.0  | 1101  | 1.0  | 1    | 0.0  |
| 0510030-01 | 2774 | 2476.9 | 2134 | 23.1 | 2672 | 0.6  | 20.1 | 2672 | 9.8  | 20.1 | 2666  | 21.9 | 2    | 20.0 | 2666  | 22.2 | 2    | 20.0 |
| 0510030-02 | 3187 | 784.4  | 2752 | 13.6 | 3327 | 2.4  | 17.3 | 3187 | 25.1 | 13.6 | 3187  | 25.1 | 1    | 13.6 | 3187  | 25.1 | 1    | 13.6 |
| 0510030-03 | 2912 | 1075.5 | 2912 | 0.0  | 2912 | 0.4. |      |      |      |      |       |      |      |      |       |      |      |      |

**Table EC.2** MMR-MKP results with  $m = 10, n = 100$ 

| instance   | B&C  |        |      |      | Fix  |      |      | DS   |      |      | iDS-H |       |      |      | iDS-B |       |      |      |
|------------|------|--------|------|------|------|------|------|------|------|------|-------|-------|------|------|-------|-------|------|------|
|            | obj  | time   | LB   | %gap | obj  | time | %gap | obj  | time | %gap | obj   | time  | iter | %gap | obj   | time  | iter | %gap |
| 1010010-01 | 798  | 872.3  | 798  | 0.0  | 847  | 15.1 | 5.8  | 798  | 21.1 | 0.0  | 798   | 21.1  | 1    | 0.0  | 798   | 21.1  | 1    | 0.0  |
| 1010010-02 | 474  | 1170.3 | 474  | 0.0  | 474  | 3.7  | 0.0  | 474  | 3.5  | 0.0  | 474   | 3.5   | 1    | 0.0  | 474   | 3.5   | 1    | 0.0  |
| 1010010-03 | 759  | 3600.0 | 492  | 35.2 | 789  | 9.4  | 37.6 | 759  | 15.3 | 35.2 | 759   | 15.3  | 1    | 35.2 | 759   | 15.3  | 1    | 35.2 |
| 1010010-04 | 1195 | 2648.4 | 650  | 45.6 | 1148 | 47.4 | 43.4 | 1093 | 69.6 | 40.5 | 1093  | 69.6  | 1    | 40.5 | 1093  | 69.6  | 1    | 40.5 |
| 1010010-05 | 753  | 3217.5 | 753  | 0.0  | 881  | 11.7 | 14.5 | 805  | 20.9 | 6.5  | 753   | 44.7  | 2    | 0.0  | 753   | 47.9  | 2    | 0.0  |
| 1010010-06 | 807  | 1633.0 | 451  | 44.1 | 807  | 10.9 | 44.1 | 807  | 33.7 | 44.1 | 807   | 33.7  | 1    | 44.1 | 807   | 33.7  | 1    | 44.1 |
| 1010010-07 | 640  | 515.2  | 640  | 0.0  | 699  | 7.5  | 8.4  | 666  | 10.5 | 3.9  | 640   | 117.0 | 8    | 0.0  | 640   | 113.4 | 8    | 0.0  |
| 1010010-08 | 684  | 1085.3 | 684  | 0.0  | 731  | 6.7  | 6.4  | 684  | 6.8  | 0.0  | 684   | 6.8   | 1    | 0.0  | 684   | 6.8   | 1    | 0.0  |
| 1010010-09 | 611  | 570.1  | 611  | 0.0  | 613  | 3.2  | 0.3  | 613  | 6.2  | 0.3  | 611   | 15.6  | 2    | 0.0  | 611   | 13.5  | 2    | 0.0  |
| 1010010-10 | 593  | 1057.0 | 593  | 0.0  | 593  | 3.5  | 0.0  | 593  | 5.9  | 0.0  | 593   | 5.9   | 1    | 0.0  | 593   | 5.9   | 1    | 0.0  |
| 1010010-11 | 552  | 1912.1 | 552  | 0.0  | 552  | 3.3  | 0.0  | 552  | 4.1  | 0.0  | 552   | 4.1   | 1    | 0.0  | 552   | 4.1   | 1    | 0.0  |
| 1010010-12 | 661  | 3115.1 | 661  | 0.0  | 661  | 1.6  | 0.0  | 661  | 3.0  | 0.0  | 661   | 3.0   | 1    | 0.0  | 661   | 3.0   | 1    | 0.0  |
| 1010010-13 | 523  | 1485.7 | 523  | 0.0  | 523  | 6.0  | 0.0  | 523  | 2.7  | 0.0  | 523   | 2.7   | 1    | 0.0  | 523   | 2.7   | 1    | 0.0  |
| 1010010-14 | 936  | 3445.7 | 305  | 61.0 | 729  | 9.8  | 49.9 | 729  | 10.6 | 58.2 | 729   | 10.6  | 1    | 49.9 | 729   | 10.6  | 1    | 49.9 |
| 1010010-15 | 724  | 3071.9 | 724  | 0.0  | 724  | 7.9  | 0.0  | 724  | 9.7  | 0.0  | 724   | 9.7   | 1    | 0.0  | 724   | 9.7   | 1    | 0.0  |
| 1010010-16 | 721  | 2072.1 | 721  | 0.0  | 774  | 10.5 | 6.8  | 722  | 11.2 | 0.1  | 721   | 23.4  | 2    | 0.0  | 721   | 22.5  | 2    | 0.0  |
| 1010010-17 | 694  | 3546.0 | 112  | 47.6 | 728  | 25.8 | 50.0 | 608  | 17.6 | 81.6 | 608   | 17.6  | 1    | 40.1 | 608   | 17.6  | 1    | 40.1 |
| 1010010-18 | 447  | 2487.3 | 447  | 0.0  | 447  | 9.1  | 0.0  | 447  | 5.6  | 0.0  | 447   | 5.6   | 1    | 0.0  | 447   | 5.6   | 1    | 0.0  |
| 1010010-19 | 553  | 531.1  | 553  | 0.0  | 651  | 8.8  | 15.1 | 553  | 10.0 | 0.0  | 553   | 10.0  | 1    | 0.0  | 553   | 10.0  | 1    | 0.0  |
| 1010010-20 | 768  | 3600.0 | 59   | 60.2 | 611  | 30.5 | 49.9 | 577  | 24.4 | 89.8 | 568   | 477.7 | 10   | 46.1 | 568   | 443.2 | 10   | 46.1 |
| 1010010-21 | 365  | 78.9   | 365  | 0.0  | 386  | 1.0  | 5.4  | 386  | 1.1  | 5.4  | 365   | 3.7   | 2    | 0.0  | 365   | 4.5   | 2    | 0.0  |
| 1010010-22 | 569  | 1834.2 | 569  | 0.0  | 572  | 5.4  | 0.5  | 572  | 13.2 | 0.5  | 569   | 79.5  | 4    | 0.0  | 569   | 77.5  | 4    | 0.0  |
| 1010010-23 | 371  | 714.5  | 371  | 0.0  | 371  | 3.7  | 0.0  | 371  | 3.0  | 0.0  | 371   | 3.0   | 1    | 0.0  | 371   | 3.0   | 1    | 0.0  |
| 1010010-24 | 449  | 527.1  | 449  | 0.0  | 449  | 2.7  | 0.0  | 449  | 3.9  | 0.0  | 449   | 3.9   | 1    | 0.0  | 449   | 3.9   | 1    | 0.0  |
| 1010010-25 | 280  | 183.7  | 280  | 0.0  | 337  | 1.6  | 16.9 | 280  | 1.1  | 0.0  | 280   | 1.1   | 1    | 0.0  | 280   | 1.1   | 1    | 0.0  |
| 1010010-26 | 466  | 1497.9 | 466  | 0.0  | 552  | 9.2  | 15.6 | 466  | 6.8  | 0.0  | 466   | 6.8   | 1    | 0.0  | 466   | 6.8   | 1    | 0.0  |
| 1010010-27 | 512  | 949.7  | 512  | 0.0  | 554  | 6.9  | 7.6  | 512  | 7.4  | 0.0  | 512   | 7.4   | 1    | 0.0  | 512   | 7.4   | 1    | 0.0  |
| 1010010-28 | 335  | 156.9  | 335  | 0.0  | 335  | 0.7  | 0.0  | 335  | 1.0  | 0.0  | 335   | 1.0   | 1    | 0.0  | 335   | 1.0   | 1    | 0.0  |
| 1010010-29 | 396  | 394.4  | 396  | 0.0  | 396  | 1.8  | 0.0  | 396  | 0.9  | 0.0  | 396   | 0.9   | 1    | 0.0  | 396   | 0.9   | 1    | 0.0  |
| 1010010-30 | 310  | 122.5  | 310  | 0.0  | 310  | 1.2  | 0.0  | 310  | 2.0  | 0.0  | 310   | 2.0   | 1    | 0.0  | 310   | 2.0   | 1    | 0.0  |
| 1010020-01 | 1990 | 2696.6 | 1230 | 38.2 | 1877 | 7.0  | 34.5 | 1883 | 36.4 | 34.7 | 1827  | 76.2  | 2    | 32.7 | 1827  | 76.3  | 2    | 32.7 |
| 1010020-02 | 1798 | 3240.1 | 1126 | 37.4 | 1746 | 4.9  | 35.5 | 1666 | 14.3 | 32.4 | 1666  | 14.3  | 1    | 32.4 | 1666  | 14.3  | 1    | 32.4 |
| 1010020-03 | 1671 | 1065.1 | 1671 | 0.0  | 1671 | 7.9  | 0.0  | 1671 | 5.6  | 0.0  | 1671  | 5.6   | 1    | 0.0  | 1671  | 5.6   | 1    | 0.0  |
| 1010020-04 | 2052 | 1063.6 | 1198 | 41.6 | 2074 | 31.3 | 42.2 | 2082 | 92.8 | 42.5 | 2023  | 461.8 | 4    | 40.8 | 2023  | 465.2 | 4    | 40.8 |
| 1010020-05 | 2213 | 1174.4 | 1209 | 45.4 | 1870 | 0.7  | 35.3 | 1870 | 4.9  | 35.3 | 1870  | 4.9   | 1    | 35.3 | 1870  | 4.9   | 1    | 35.3 |
| 1010020-06 | 2514 | 3600.0 | 1361 | 45.9 | 2282 | 7.5  | 40.4 | 2232 | 44.6 | 39.0 | 2232  | 44.6  | 1    | 39.0 | 2232  | 44.6  | 1    | 39.0 |
| 1010020-07 | 2019 | 2043.1 | 1481 | 26.6 | 2019 | 3.8  | 26.6 | 2019 | 7.9  | 26.6 | 1969  | 22.9  | 2    | 24.8 | 1969  | 21.9  | 2    | 24.8 |
| 1010020-08 | 2243 | 2544.7 | 1490 | 33.6 | 1997 | 5.0  | 25.4 | 1997 | 18.4 | 25.4 | 1997  | 18.4  | 1    | 25.4 | 1997  | 18.4  | 1    | 25.4 |
| 1010020-09 | 1652 | 2510.8 | 1652 | 0.0  | 1687 | 1.2  | 2.1  | 1687 | 2.8  | 2.1  | 1652  | 10.4  | 2    | 0.0  | 1652  | 10.1  | 2    | 0.0  |
| 1010020-10 | 2424 | 3276.4 | 1279 | 47.2 | 2318 | 8.8  | 44.8 | 2230 | 27.8 | 42.6 | 2230  | 27.8  | 1    | 42.6 | 2230  | 27.8  | 1    | 42.6 |
| 1010020-11 | 2042 | 2556.9 | 810  | 54.3 | 1866 | 23.3 | 50.0 | 1795 | 74.9 | 54.9 | 1753  | 450.4 | 5    | 46.8 | 1753  | 437.2 | 5    | 46.8 |
| 1010020-12 | 1916 | 3088.7 | 804  | 56.3 | 1675 | 7.8  | 50.0 | 1643 | 63.3 | 51.1 | 1636  | 198.4 | 3    | 48.8 | 1636  | 203.0 | 3    | 48.8 |
| 1010020-13 | 1519 | 3171.3 | 565  | 60.2 | 1210 | 2.3  | 50.0 | 1210 | 2.9  | 53.3 | 1210  | 2.9   | 1    | 50.0 | 1210  | 2.9   | 1    | 50.0 |
| 1010020-14 | 2659 | 3098.9 | 976  | 59.6 | 2148 | 21.6 | 50.0 | 2152 | 71.8 | 54.6 | 2148  | 287.7 | 3    | 50.0 | 2148  | 261.4 | 3    | 50.0 |
| 1010020-15 | 1902 | 1672.3 | 1041 | 45.3 | 1793 | 7.9  | 41.9 | 1656 | 11.0 | 37.1 | 1656  | 11.0  | 1    | 37.1 | 1656  | 11.0  | 1    | 37.1 |
| 1010020-16 | 1892 | 3510.8 | 759  | 54.4 | 1725 | 9.9  | 50.0 | 1595 | 4.8  | 52.4 | 1595  | 4.8   | 1    | 45.9 | 1595  | 4.8   | 1    | 45.9 |
| 1010020-17 | 2583 | 5901.5 | 1063 | 58.8 | 2005 | 2.2  | 47.0 | 1954 | 6.7  | 45.6 | 1954  | 6.7   | 1    | 45.6 | 1954  | 6.7   | 1    | 45.6 |
| 1010020-18 | 1866 | 1591.0 | 1133 | 39.3 | 1826 | 6.5  | 38.0 | 1718 | 6.6  | 34.1 | 1718  | 6.6   | 1    | 34.1 | 1718  | 6.6   | 1    | 34.1 |
| 1010020-19 | 1519 | 4972.5 | 564  | 56.4 | 1324 | 6.9  | 50.0 | 1293 | 7.8  | 56.4 | 1293  | 7.8   | 1    | 48.8 | 1293  | 7.8   | 1    | 48.8 |
| 1010020-20 | 1628 | 5876.1 | 562  | 57.0 | 1399 | 19.7 | 50.0 | 1389 | 10.2 | 59.5 | 1389  | 10.2  | 1    | 49.6 | 1389  | 10.2  | 1    | 49.6 |
| 1010020-21 | 942  | 2277.9 | 789  | 16.2 | 949  | 2.6  | 16.9 | 942  | 3.6  | 16.2 | 942   | 3.6   | 1    | 16.2 | 942   | 3.6   | 1    | 16.2 |
| 1010020-22 | 1625 | 2786.9 | 861  | 47.0 | 1609 | 23.6 | 46.5 | 1540 | 77.6 | 44.1 | 1528  | 169.8 | 2    | 43.7 | 1528  | 169.6 | 2    | 43.7 |
| 1010020-23 | 1045 | 2962.4 | 779  | 25.5 | 1042 | 3.0  | 25.2 | 988  | 3.9  | 21.2 | 988   | 3.9   | 1    | 21.2 | 988   | 3.9   | 1    | 21.2 |
| 1010020-24 | 1563 | 3515.6 | 1081 | 30.8 | 1489 | 1.0  | 27.4 | 1489 | 12.9 | 27.4 | 1489  | 12.9  | 1    | 27.4 | 1489  | 12.9  | 1    | 27.4 |
| 1010020-25 | 901  | 522.9  | 901  | 0.0  | 901  | 0.7  | 0.0  | 901  | 1.1  | 0.0  | 901   | 1.1   | 1    | 0.0  | 901   | 1.1   | 1    | 0.0  |
| 1010020-26 | 1408 | 3237.9 | 1039 | 26.2 | 1352 | 4.9  | 23.2 | 1354 | 4.7  | 23.3 | 1352  | 11.3  | 2    | 23.2 | 1352  | 10.5  | 2    | 23.2 |
| 1010020-27 | 1376 | 1086.5 | 813  | 40.9 | 1235 | 4.0  | 34.2 | 1227 | 8.6  | 33.7 | 1227  | 8.6   | 1    | 33.7 | 1227  | 8.6   | 1    | 33.7 |
| 1010020-28 | 924  | 1032.3 | 924  | 0.0  | 963  | 1.8  | 4.0  | 924  | 2.0  | 0.0  | 924   | 2.0   | 1    | 0.0  | 924   | 2.0   | 1    | 0.0  |
| 1010020-29 | 1396 | 1786.9 | 1396 | 0.0  | 1396 | 1.6  | 0.0  | 1396 | 2.9  | 0.0  | 1396  | 2.9   | 1    | 0.0  | 1396  | 2.9   | 1    | 0.0  |
| 1010020-30 | 981  | 406.6  | 981  | 0.0  | 988  | 1.6  | 0.7  | 988  | 0.9  | 0.7  | 981   | 2.2   | 2    | 0.0  | 981   | 2.1   | 2    | 0.0  |
| 1010030-01 | 3218 | 2668.4 | 2137 | 33.6 | 3027 | 0.8  | 29.4 | 3027 | 16.1 | 29.4 | 3027  | 16.1  | 1    | 29.4 | 3027  | 16.1  |      |      |

Table EC.3 MMR-MKP results with  $m = 5, n = 250$ 

| instance   | B&C  |        |      |      | Fix  |       |      | DS   |        |      | iDS-H |        |      |      | iDS-B |        |      |      |
|------------|------|--------|------|------|------|-------|------|------|--------|------|-------|--------|------|------|-------|--------|------|------|
|            | obj  | time   | LB   | %gap | obj  | time  | %gap | obj  | time   | %gap | obj   | time   | iter | %gap | obj   | time   | iter | %gap |
| 0525010-01 | 1176 | 3284.8 | 481  | 58.6 | 973  | 9.4   | 49.9 | 976  | 71.8   | 50.7 | 940   | 145.4  | 2    | 48.2 | 940   | 144.1  | 2    | 48.2 |
| 0525010-02 | 1378 | 3600.0 | 501  | 63.6 | 993  | 25.4  | 49.5 | 993  | 59.1   | 49.5 | 978   | 123.6  | 2    | 48.8 | 978   | 129.8  | 2    | 48.8 |
| 0525010-03 | 1288 | 1073.5 | 353  | 62.7 | 959  | 8.3   | 49.9 | 959  | 110.9  | 63.2 | 956   | 530.2  | 4    | 49.8 | 956   | 529.3  | 4    | 49.8 |
| 0525010-04 | 1943 | 574.9  | 600  | 66.0 | 1321 | 121.2 | 50.0 | 1321 | 575.0  | 54.6 | 1321  | 575.0  | 1    | 50.0 | 1321  | 575.0  | 1    | 50.0 |
| 0525010-05 | 1203 | 3133.8 | 311  | 61.0 | 937  | 17.0  | 49.9 | 919  | 65.7   | 66.2 | 919   | 65.7   | 1    | 49.0 | 919   | 65.7   | 1    | 49.0 |
| 0525010-06 | 1554 | 466.3  | 645  | 58.5 | 1209 | 18.1  | 46.7 | 1209 | 202.1  | 46.7 | 1209  | 202.1  | 1    | 46.7 | 1209  | 202.1  | 1    | 46.7 |
| 0525010-07 | 1472 | 1959.1 | 696  | 52.7 | 1263 | 63.8  | 44.9 | 1218 | 298.1  | 42.9 | 1218  | 298.1  | 1    | 42.9 | 1218  | 298.1  | 1    | 42.9 |
| 0525010-08 | 1580 | 3221.4 | 534  | 66.0 | 1073 | 10.5  | 50.0 | 1073 | 88.3   | 50.2 | 1067  | 302.9  | 3    | 49.7 | 1067  | 282.4  | 3    | 49.7 |
| 0525010-09 | 1480 | 2924.7 | 661  | 55.3 | 1154 | 7.6   | 42.7 | 1154 | 97.8   | 42.7 | 1154  | 97.8   | 1    | 42.7 | 1154  | 97.8   | 1    | 42.7 |
| 0525010-10 | 1342 | 3600.0 | 635  | 52.7 | 1086 | 11.2  | 41.5 | 1086 | 84.9   | 41.5 | 1086  | 84.9   | 1    | 41.5 | 1086  | 84.9   | 1    | 41.5 |
| 0525010-11 | 1750 | 3600.0 | 644  | 63.2 | 1240 | 42.7  | 48.1 | 1233 | 347.3  | 47.8 | 1233  | 347.3  | 1    | 47.8 | 1233  | 347.3  | 1    | 47.8 |
| 0525010-12 | 1046 | 2894.1 | 573  | 45.2 | 947  | 7.3   | 39.5 | 947  | 79.7   | 39.5 | 947   | 79.7   | 1    | 39.5 | 947   | 79.7   | 1    | 39.5 |
| 0525010-13 | 1854 | 3600.0 | 504  | 72.8 | 1004 | 9.2   | 49.8 | 1004 | 110.9  | 49.8 | 1004  | 110.9  | 1    | 49.8 | 1004  | 110.9  | 1    | 49.8 |
| 0525010-14 | 1658 | 3600.0 | 535  | 67.7 | 1021 | 7.9   | 47.6 | 1021 | 83.8   | 47.6 | 1021  | 83.8   | 1    | 47.6 | 1021  | 83.8   | 1    | 47.6 |
| 0525010-15 | 2845 | 1111.0 | 531  | 79.6 | 1162 | 19.3  | 50.0 | 1135 | 671.2  | 53.2 | 1135  | 671.2  | 1    | 48.8 | 1135  | 671.2  | 1    | 48.8 |
| 0525010-16 | 1653 | 1389.0 | 581  | 64.9 | 1072 | 50.8  | 45.8 | 1072 | 481.9  | 45.8 | 1061  | 983.6  | 2    | 45.2 | 1061  | 1003.1 | 2    | 45.2 |
| 0525010-17 | 1397 | 3285.8 | 573  | 59.0 | 1103 | 17.1  | 48.1 | 1099 | 155.0  | 47.9 | 1099  | 155.0  | 1    | 47.9 | 1099  | 155.0  | 1    | 47.9 |
| 0525010-18 | 2622 | 942.6  | 648  | 71.5 | 1496 | 82.3  | 50.0 | 1476 | 1028.9 | 56.1 | 1476  | 1028.9 | 1    | 49.3 | 1476  | 1028.9 | 1    | 49.3 |
| 0525010-19 | 2819 | 3600.0 | 311  | 85.3 | 828  | 4.3   | 50.0 | 828  | 33.6   | 62.4 | 828   | 33.6   | 1    | 50.0 | 828   | 33.6   | 1    | 50.0 |
| 0525010-20 | 1355 | 3600.0 | 448  | 66.3 | 911  | 15.7  | 49.9 | 921  | 84.2   | 51.4 | 904   | 311.0  | 3    | 49.6 | 904   | 302.8  | 3    | 49.6 |
| 0525010-21 | 1407 | 3600.0 | 487  | 64.5 | 999  | 79.1  | 49.9 | 968  | 315.2  | 49.7 | 968   | 315.2  | 1    | 48.3 | 968   | 315.2  | 1    | 48.3 |
| 0525010-22 | 579  | 3455.3 | 376  | 35.1 | 543  | 1.2   | 30.8 | 543  | 10.5   | 30.8 | 543   | 10.5   | 1    | 30.8 | 543   | 10.5   | 1    | 30.8 |
| 0525010-23 | 1169 | 2469.9 | 511  | 56.3 | 919  | 36.6  | 44.4 | 919  | 226.3  | 44.4 | 919   | 226.3  | 1    | 44.4 | 919   | 226.3  | 1    | 44.4 |
| 0525010-24 | 908  | 3169.6 | 345  | 61.1 | 706  | 18.5  | 50.0 | 708  | 41.6   | 51.3 | 706   | 208.8  | 3    | 50.0 | 706   | 197.2  | 3    | 50.0 |
| 0525010-25 | 1123 | 5206.2 | 387  | 65.5 | 749  | 13.3  | 48.3 | 749  | 27.4   | 48.3 | 749   | 27.4   | 1    | 48.3 | 749   | 27.4   | 1    | 48.3 |
| 0525010-26 | 959  | 2131.1 | 437  | 54.4 | 712  | 3.3   | 38.6 | 712  | 14.2   | 38.6 | 712   | 14.2   | 1    | 38.6 | 712   | 14.2   | 1    | 38.6 |
| 0525010-27 | 667  | 3167.1 | 242  | 60.0 | 533  | 5.2   | 49.9 | 532  | 34.4   | 54.5 | 532   | 34.4   | 1    | 49.8 | 532   | 34.4   | 1    | 49.8 |
| 0525010-28 | 790  | 3103.4 | 550  | 30.4 | 766  | 3.4   | 28.2 | 790  | 25.4   | 30.4 | 766   | 62.7   | 2    | 28.2 | 766   | 58.0   | 2    | 28.2 |
| 0525010-29 | 771  | 3050.9 | 442  | 42.7 | 703  | 7.4   | 37.1 | 685  | 9.0    | 35.5 | 669   | 24.7   | 2    | 33.9 | 669   | 23.8   | 2    | 33.9 |
| 0525010-30 | 639  | 1752.0 | 543  | 15.0 | 696  | 7.5   | 22.0 | 639  | 12.4   | 15.0 | 639   | 12.4   | 1    | 15.0 | 639   | 12.4   | 1    | 15.0 |
| 0525020-01 | 4758 | 2158.3 | 2057 | 56.8 | 3404 | 3.6   | 39.6 | 3404 | 818.9  | 39.6 | 3404  | 818.9  | 1    | 39.6 | 3404  | 818.9  | 1    | 39.6 |
| 0525020-02 | 4977 | 1013.2 | 1728 | 64.9 | 3492 | 7.7   | 50.0 | 3492 | 1509.9 | 50.5 | 3492  | 1509.9 | 1    | 50.0 | 3492  | 1509.9 | 1    | 50.0 |
| 0525020-03 | 5207 | 1686.4 | 2445 | 53.0 | 4253 | 17.6  | 42.5 | 4205 | 2243.5 | 41.9 | 4205  | 2243.5 | 1    | 41.9 | 4205  | 2243.5 | 1    | 41.9 |
| 0525020-04 | 6016 | 2642.2 | 3034 | 49.6 | 5025 | 50.5  | 39.6 | 5043 | 3600.0 | 39.8 | 5043  | 3600.0 | 1    | 39.8 | 5043  | 3600.0 | 1    | 39.8 |
| 0525020-05 | 6697 | 468.7  | 1720 | 74.3 | 3317 | 7.0   | 48.1 | 3317 | 709.1  | 48.1 | 3302  | 1258.0 | 2    | 47.9 | 3302  | 1181.1 | 2    | 47.9 |
| 0525020-06 | 5263 | 2611.0 | 2316 | 56.0 | 4020 | 83.7  | 42.4 | 3962 | 3600.0 | 41.5 | 3962  | 3600.0 | 1    | 41.5 | 3962  | 3600.0 | 1    | 41.5 |
| 0525020-07 | 4810 | 842.4  | 1605 | 65.5 | 3318 | 12.0  | 50.0 | 3289 | 1888.1 | 51.2 | 3289  | 1888.1 | 1    | 49.6 | 3289  | 1888.1 | 1    | 49.6 |
| 0525020-08 | 4773 | 2593.0 | 2237 | 53.1 | 3837 | 59.4  | 41.7 | 3813 | 3600.0 | 41.3 | 3813  | 3600.0 | 1    | 41.3 | 3813  | 3600.0 | 1    | 41.3 |
| 0525020-09 | 4079 | 3600.0 | 1808 | 55.7 | 3324 | 6.7   | 45.6 | 3288 | 637.7  | 45.0 | 3288  | 637.7  | 1    | 45.0 | 3288  | 637.7  | 1    | 45.0 |
| 0525020-10 | 3805 | 3600.0 | 1770 | 53.5 | 3104 | 9.1   | 43.0 | 3104 | 1457.5 | 43.0 | 3104  | 1457.5 | 1    | 43.0 | 3104  | 1457.5 | 1    | 43.0 |
| 0525020-11 | 7673 | 1684.9 | 2155 | 71.3 | 4408 | 20.3  | 50.0 | 4467 | 3600.0 | 51.8 | 4467  | 3600.0 | 1    | 50.7 | 4467  | 3600.0 | 1    | 50.7 |
| 0525020-12 | 4635 | 387.8  | 2045 | 55.9 | 3477 | 14.5  | 41.2 | 3427 | 2635.2 | 40.3 | 3427  | 2635.2 | 1    | 40.3 | 3427  | 2635.2 | 1    | 40.3 |
| 0525020-13 | 4583 | 3600.0 | 1937 | 57.7 | 3323 | 5.6   | 41.7 | 3346 | 3600.0 | 42.1 | 3346  | 3600.0 | 1    | 42.1 | 3346  | 3600.0 | 1    | 42.1 |
| 0525020-14 | 4671 | 3379.2 | 2406 | 48.5 | 4134 | 16.1  | 41.8 | 4093 | 3600.0 | 41.2 | 4093  | 3600.0 | 1    | 41.2 | 4093  | 3600.0 | 1    | 41.2 |
| 0525020-15 | 5615 | 3600.0 | 2386 | 57.5 | 4390 | 42.0  | 45.6 | 4365 | 3600.0 | 45.3 | 4365  | 3600.0 | 1    | 45.3 | 4365  | 3600.0 | 1    | 45.3 |
| 0525020-16 | 4905 | 3310.5 | 2220 | 54.7 | 3816 | 7.5   | 41.8 | 3774 | 3600.0 | 41.2 | 3774  | 3600.0 | 1    | 41.2 | 3774  | 3600.0 | 1    | 41.2 |
| 0525020-17 | 6666 | 615.2  | 1651 | 75.2 | 3161 | 16.0  | 47.8 | 3161 | 778.0  | 47.8 | 3161  | 778.0  | 1    | 47.8 | 3161  | 778.0  | 1    | 47.8 |
| 0525020-18 | 5722 | 3600.0 | 2398 | 58.1 | 4061 | 18.5  | 41.0 | 4034 | 3600.0 | 40.6 | 4034  | 3600.0 | 1    | 40.6 | 4034  | 3600.0 | 1    | 40.6 |
| 0525020-19 | 7501 | 449.4  | 1770 | 76.4 | 3371 | 4.2   | 47.5 | 3362 | 2077.0 | 47.4 | 3362  | 2077.0 | 1    | 47.4 | 3362  | 2077.0 | 1    | 47.4 |
| 0525020-20 | 6733 | 817.7  | 1661 | 75.3 | 3315 | 2.1   | 49.9 | 3315 | 2196.7 | 49.9 | 3315  | 2196.7 | 1    | 49.9 | 3315  | 2196.7 | 1    | 49.9 |
| 0525020-21 | 4950 | 2804.3 | 2088 | 57.8 | 3516 | 21.1  | 40.6 | 3543 | 3600.0 | 41.1 | 3543  | 3600.0 | 1    | 41.1 | 3543  | 3600.0 | 1    | 41.1 |
| 0525020-22 | 3559 | 2303.4 | 1366 | 61.6 | 2435 | 13.2  | 43.9 | 2411 | 179.0  | 43.3 | 2411  | 179.0  | 1    | 43.3 | 2411  | 179.0  | 1    | 43.3 |
| 0525020-23 | 3593 | 2388.0 | 1708 | 52.5 | 2786 | 7.3   | 38.7 | 2776 | 1204.1 | 38.5 | 2776  | 1204.1 | 1    | 38.5 | 2776  | 1204.1 | 1    | 38.5 |
| 0525020-24 | 3556 | 3390.4 | 1420 | 60.1 | 2405 | 7.5   | 41.0 | 2405 | 1607.5 | 41.0 | 2405  | 1607.5 | 1    | 41.0 | 2405  | 1607.5 | 1    | 41.0 |
| 0525020-25 | 4129 | 3001.2 | 1795 | 56.5 | 3023 | 17.2  | 40.6 | 3023 | 3600.0 | 40.6 | 3023  | 3600.0 | 1    | 40.6 | 3023  | 3600.0 | 1    | 40.6 |
| 0525020-26 | 4075 | 3046.0 | 1578 | 61.3 | 2785 | 50.4  | 43.3 | 2772 | 3600.0 | 43.1 | 2772  | 3600.0 | 1    | 43.1 | 2772  | 3600.0 | 1    | 43.1 |
| 0525020-27 | 3005 | 3057.1 | 1328 | 55.8 | 2254 | 2.6   | 41.1 | 2252 | 338.5  | 41.0 | 2247  | 1622.3 | 5    | 40.9 | 2247  | 1589.9 | 5    | 40.9 |
| 0525020-28 | 2999 | 3541.9 | 1594 | 46.8 |      |       |      |      |        |      |       |        |      |      |       |        |      |      |

**Table EC.4** MMR-KP results for type-1 instances

| instance      | Best Known |      | B&C  |      |      |      | Fix  |      |      | DS    |      |      | iDS-H |      |      |      | iDS-B |      |      |      |
|---------------|------------|------|------|------|------|------|------|------|------|-------|------|------|-------|------|------|------|-------|------|------|------|
|               | LB         | UB   | obj  | time | LB   | %gap | obj  | time | %gap | obj   | time | %gap | obj   | time | iter | %gap | obj   | time | iter | %gap |
| 1-50-01-45-10 | 15         | 15   | 15   | 0.0  | 15   | 0.0  | 15   | 0.0  | 0.0  | 15    | 0.0  | 0.0  | 15    | 0.0  | 1    | 0.0  | 15    | 0.0  | 1    | 0.0  |
| 1-50-01-50-10 | 0          | 0    | 0    | 0.0  | 0    | 0.0  | 0    | 0.0  | 0.0  | 0     | 0.0  | 0.0  | 0     | 0.0  | 1    | 0.0  | 0     | 0.0  | 1    | 0.0  |
| 1-50-01-55-10 | 114        | 114  | 114  | 0.0  | 114  | 0.0  | 124↑ | 0.0  | 8.1  | 114   | 0.0  | 0.0  | 114   | 0.0  | 1    | 0.0  | 114   | 0.0  | 1    | 0.0  |
| 1-60-01-45-10 | 91         | 91   | 91   | 0.0  | 91   | 0.0  | 91   | 0.0  | 0.0  | 91    | 0.0  | 0.0  | 91    | 0.0  | 1    | 0.0  | 91    | 0.0  | 1    | 0.0  |
| 1-60-01-50-10 | 111        | 111  | 111  | 0.0  | 111  | 0.0  | 111  | 0.0  | 0.0  | 111   | 0.0  | 0.0  | 111   | 0.0  | 1    | 0.0  | 111   | 0.0  | 1    | 0.0  |
| 1-60-01-55-10 | 64         | 64   | 64   | 0.0  | 64   | 0.0  | 64   | 0.0  | 0.0  | 64    | 0.0  | 0.0  | 64    | 0.0  | 1    | 0.0  | 64    | 0.0  | 1    | 0.0  |
| 1-70-01-45-10 | 32         | 32   | 32   | 0.0  | 32   | 0.0  | 32   | 0.0  | 0.0  | 32    | 0.0  | 0.0  | 32    | 0.0  | 1    | 0.0  | 32    | 0.0  | 1    | 0.0  |
| 1-70-01-50-10 | 44         | 44   | 44   | 0.0  | 44   | 0.0  | 44   | 0.0  | 0.0  | 44    | 0.0  | 0.0  | 44    | 0.0  | 1    | 0.0  | 44    | 0.0  | 1    | 0.0  |
| 1-70-01-55-10 | 118        | 118  | 118  | 0.0  | 118  | 0.0  | 118  | 0.0  | 0.0  | 127↑  | 0.0  | 7.1  | 118   | 0.1  | 5    | 0.0  | 118   | 0.0  | 4    | 0.0  |
| 1-50-01-45-20 | 198        | 198  | 198  | 0.0  | 198  | 0.0  | 198  | 0.0  | 0.0  | 198   | 0.0  | 0.0  | 198   | 0.0  | 1    | 0.0  | 198   | 0.0  | 1    | 0.0  |
| 1-50-01-50-20 | 129        | 129  | 129  | 0.0  | 129  | 0.0  | 129  | 0.0  | 0.0  | 129   | 0.0  | 0.0  | 129   | 0.0  | 1    | 0.0  | 129   | 0.0  | 1    | 0.0  |
| 1-50-01-55-20 | 239        | 239  | 239  | 0.0  | 239  | 0.0  | 242↑ | 0.0  | 1.2  | 242↑  | 0.0  | 1.2  | 239   | 0.0  | 3    | 0.0  | 239   | 0.0  | 3    | 0.0  |
| 1-60-01-45-20 | 273        | 273  | 273  | 0.1  | 273  | 0.0  | 327↑ | 0.0  | 16.5 | 273   | 0.0  | 0.0  | 273   | 0.0  | 1    | 0.0  | 273   | 0.0  | 1    | 0.0  |
| 1-60-01-50-20 | 211        | 211  | 211  | 0.0  | 211  | 0.0  | 211  | 0.0  | 0.0  | 211   | 0.0  | 0.0  | 211   | 0.0  | 1    | 0.0  | 211   | 0.0  | 1    | 0.0  |
| 1-60-01-55-20 | 244        | 244  | 244  | 0.1  | 244  | 0.0  | 262↑ | 0.0  | 6.9  | 244   | 0.0  | 0.0  | 244   | 0.0  | 1    | 0.0  | 244   | 0.0  | 1    | 0.0  |
| 1-70-01-45-20 | 109        | 109  | 109  | 0.0  | 109  | 0.0  | 109  | 0.0  | 0.0  | 109   | 0.0  | 0.0  | 109   | 0.0  | 1    | 0.0  | 109   | 0.0  | 1    | 0.0  |
| 1-70-01-50-20 | 239        | 239  | 239  | 0.0  | 239  | 0.0  | 239  | 0.0  | 0.0  | 239   | 0.0  | 0.0  | 239   | 0.0  | 1    | 0.0  | 239   | 0.0  | 1    | 0.0  |
| 1-70-01-55-20 | 297        | 297  | 297  | 0.1  | 297  | 0.0  | 297  | 0.0  | 0.0  | 297   | 0.0  | 0.0  | 297   | 0.0  | 1    | 0.0  | 297   | 0.0  | 1    | 0.0  |
| 1-50-01-45-30 | 445        | 445  | 445  | 0.0  | 445  | 0.0  | 509↑ | 0.0  | 12.6 | 445   | 0.0  | 0.0  | 445   | 0.0  | 1    | 0.0  | 445   | 0.0  | 1    | 0.0  |
| 1-50-01-50-30 | 442        | 442  | 442  | 0.0  | 442  | 0.0  | 442  | 0.0  | 0.0  | 442   | 0.0  | 0.0  | 442   | 0.0  | 1    | 0.0  | 442   | 0.0  | 1    | 0.0  |
| 1-50-01-55-30 | 605        | 605  | 605  | 0.1  | 605  | 0.0  | 606↑ | 0.0  | 0.2  | 606↑  | 0.0  | 0.2  | 605   | 0.0  | 2    | 0.0  | 605   | 0.0  | 2    | 0.0  |
| 1-60-01-45-30 | 596        | 596  | 596  | 0.1  | 596  | 0.0  | 602↑ | 0.0  | 1.0  | 596   | 0.0  | 0.0  | 596   | 0.0  | 1    | 0.0  | 596   | 0.0  | 1    | 0.0  |
| 1-60-01-50-30 | 604        | 604  | 604  | 0.0  | 604  | 0.0  | 604  | 0.0  | 0.0  | 604   | 0.0  | 0.0  | 604   | 0.0  | 1    | 0.0  | 604   | 0.0  | 1    | 0.0  |
| 1-60-01-55-30 | 668        | 668  | 668  | 0.1  | 668  | 0.0  | 668  | 0.0  | 0.0  | 668   | 0.0  | 0.0  | 668   | 0.0  | 1    | 0.0  | 668   | 0.0  | 1    | 0.0  |
| 1-70-01-45-30 | 434        | 434  | 434  | 0.0  | 434  | 0.0  | 434  | 0.0  | 0.0  | 434   | 0.0  | 0.0  | 434   | 0.0  | 1    | 0.0  | 434   | 0.0  | 1    | 0.0  |
| 1-70-01-50-30 | 606        | 606  | 606  | 0.1  | 606  | 0.0  | 632↑ | 0.0  | 4.1  | 606   | 0.0  | 0.0  | 606   | 0.0  | 1    | 0.0  | 606   | 0.0  | 1    | 0.0  |
| 1-70-01-55-30 | 770        | 770  | 770  | 0.1  | 770  | 0.0  | 775↑ | 0.0  | 0.6  | 770   | 0.0  | 0.0  | 770   | 0.0  | 1    | 0.0  | 770   | 0.0  | 1    | 0.0  |
| 1-50-10-45-10 | 225        | 225  | 225  | 0.0  | 225  | 0.0  | 225  | 0.0  | 0.0  | 225   | 0.0  | 0.0  | 225   | 0.0  | 1    | 0.0  | 225   | 0.0  | 1    | 0.0  |
| 1-50-10-50-10 | 0          | 0    | 0    | 0.0  | 0    | 0.0  | 0    | 0.0  | 0.0  | 0     | 0.0  | 0.0  | 0     | 0.0  | 1    | 0.0  | 0     | 0.0  | 1    | 0.0  |
| 1-50-10-55-10 | 0          | 0    | 0    | 0.0  | 0    | 0.0  | 0    | 0.0  | 0.0  | 0     | 0.0  | 0.0  | 0     | 0.0  | 1    | 0.0  | 0     | 0.0  | 1    | 0.0  |
| 1-60-10-45-10 | 159        | 159  | 159  | 0.0  | 159  | 0.0  | 159  | 0.0  | 0.0  | 159   | 0.0  | 0.0  | 159   | 0.0  | 1    | 0.0  | 159   | 0.0  | 1    | 0.0  |
| 1-60-10-50-10 | 0          | 0    | 0    | 0.0  | 0    | 0.0  | 0    | 0.0  | 0.0  | 0     | 0.0  | 0.0  | 0     | 0.0  | 1    | 0.0  | 0     | 0.0  | 1    | 0.0  |
| 1-60-10-55-10 | 216        | 216  | 216  | 0.0  | 216  | 0.0  | 216  | 0.0  | 0.0  | 216   | 0.0  | 0.0  | 216   | 0.0  | 1    | 0.0  | 216   | 0.0  | 1    | 0.0  |
| 1-70-10-45-10 | 54         | 54   | 54   | 0.1  | 54   | 0.0  | 54   | 0.0  | 0.0  | 54    | 0.0  | 0.0  | 54    | 0.0  | 1    | 0.0  | 54    | 0.0  | 1    | 0.0  |
| 1-70-10-50-10 | 112        | 112  | 112  | 0.0  | 112  | 0.0  | 112  | 0.0  | 0.0  | 112   | 0.0  | 0.0  | 112   | 0.0  | 1    | 0.0  | 112   | 0.0  | 1    | 0.0  |
| 1-70-10-55-10 | 275        | 275  | 275  | 0.0  | 275  | 0.0  | 275  | 0.0  | 0.0  | 275   | 0.0  | 0.0  | 275   | 0.0  | 1    | 0.0  | 275   | 0.0  | 1    | 0.0  |
| 1-50-10-45-20 | 1902       | 1902 | 1902 | 0.0  | 1902 | 0.0  | 1902 | 0.0  | 0.0  | 1902  | 0.0  | 0.0  | 1902  | 0.0  | 1    | 0.0  | 1902  | 0.0  | 1    | 0.0  |
| 1-50-10-50-20 | 1392       | 1392 | 1392 | 0.0  | 1392 | 0.0  | 1392 | 0.0  | 0.0  | 1392  | 0.0  | 0.0  | 1392  | 0.0  | 1    | 0.0  | 1392  | 0.0  | 1    | 0.0  |
| 1-50-10-55-20 | 0          | 0    | 0    | 0.0  | 0    | 0.0  | 0    | 0.0  | 0.0  | 0     | 0.0  | 0.0  | 0     | 0.0  | 1    | 0.0  | 0     | 0.0  | 1    | 0.0  |
| 1-60-10-45-20 | 2106       | 2106 | 2106 | 0.0  | 2106 | 0.0  | 2106 | 0.0  | 0.0  | 2106  | 0.0  | 0.0  | 2106  | 0.0  | 1    | 0.0  | 2106  | 0.0  | 1    | 0.0  |
| 1-60-10-50-20 | 1165       | 1165 | 1165 | 0.0  | 1165 | 0.0  | 1165 | 0.0  | 0.0  | 1165  | 0.0  | 0.0  | 1165  | 0.0  | 1    | 0.0  | 1165  | 0.0  | 1    | 0.0  |
| 1-60-10-55-20 | 324        | 324  | 324  | 0.0  | 324  | 0.0  | 324  | 0.0  | 0.0  | 324   | 0.0  | 0.0  | 324   | 0.0  | 1    | 0.0  | 324   | 0.0  | 1    | 0.0  |
| 1-70-10-45-20 | 2561       | 2561 | 2561 | 0.0  | 2561 | 0.0  | 2561 | 0.0  | 0.0  | 2561  | 0.0  | 0.0  | 2561  | 0.0  | 1    | 0.0  | 2561  | 0.0  | 1    | 0.0  |
| 1-70-10-50-20 | 147        | 147  | 147  | 0.0  | 147  | 0.0  | 147  | 0.0  | 0.0  | 147   | 0.0  | 0.0  | 147   | 0.0  | 1    | 0.0  | 147   | 0.0  | 1    | 0.0  |
| 1-70-10-55-20 | 954        | 954  | 954  | 0.0  | 954  | 0.0  | 954  | 0.0  | 0.0  | 954   | 0.0  | 0.0  | 954   | 0.0  | 1    | 0.0  | 954   | 0.0  | 1    | 0.0  |
| 1-50-10-45-30 | 2778       | 2778 | 2778 | 0.0  | 2778 | 0.0  | 2778 | 0.0  | 0.0  | 2778  | 0.0  | 0.0  | 2778  | 0.0  | 1    | 0.0  | 2778  | 0.0  | 1    | 0.0  |
| 1-50-10-50-30 | 3284       | 3284 | 3284 | 0.0  | 3284 | 0.0  | 3284 | 0.0  | 0.0  | 3284  | 0.0  | 0.0  | 3284  | 0.0  | 1    | 0.0  | 3284  | 0.0  | 1    | 0.0  |
| 1-50-10-55-30 | 1043       | 1043 | 1043 | 0.0  | 1043 | 0.0  | 1043 | 0.0  | 0.0  | 1043  | 0.0  | 0.0  | 1043  | 0.0  | 1    | 0.0  | 1043  | 0.0  | 1    | 0.0  |
| 1-60-10-45-30 | 3393       | 3393 | 3393 | 0.0  | 3393 | 0.0  | 3393 | 0.0  | 0.0  | 3393  | 0.0  | 0.0  | 3393  | 0.0  | 1    | 0.0  | 3393  | 0.0  | 1    | 0.0  |
| 1-60-10-50-30 | 2636       | 2636 | 2636 | 0.0  | 2636 | 0.0  | 2636 | 0.0  | 0.0  | 2636  | 0.0  | 0.0  | 2636  | 0.0  | 1    | 0.0  | 2636  | 0.0  | 1    | 0.0  |
| 1-60-10-55-30 | 2090       | 2090 | 2090 | 0.0  | 2090 | 0.0  | 2090 | 0.0  | 0.0  | 2116↑ | 0.0  | 1.2  | 2090  | 0.0  | 2    | 0.0  | 2090  | 0.0  | 2    | 0.0  |
| 1-70-10-45-30 | 4103       | 4103 | 4103 | 0.1  | 4103 | 0.0  | 4103 | 0.0  | 0.0  | 4103  | 0.0  | 0.0  | 4103  | 0.0  | 1    | 0.0  | 4103  | 0.0  | 1    | 0.0  |
| 1-70-10-50-30 | 2632       | 2632 | 2632 | 0.0  | 2632 | 0.0  | 2632 | 0.0  | 0.0  | 2754↑ | 0.0  | 4.4  | 2632  | 0.0  | 2    | 0.0  | 2632  | 0.0  | 2    | 0.0  |
| 1-70-10-55-30 | 2176       | 2176 | 2176 | 0.0  | 2176 | 0.0  | 2176 | 0.0  | 0.0  | 2176  | 0.0  | 0.0  | 2176  | 0.0  | 1    | 0.0  | 2176  | 0.0  | 1    | 0.0  |

**Table EC.5** MMR-KP results for type-2 instances

| instance      | Best Known |       | B&C   |        |       |      | Fix    |      |      | DS     |      |      | iDS-H |      |      |      | iDS-B |      |          |      |
|---------------|------------|-------|-------|--------|-------|------|--------|------|------|--------|------|------|-------|------|------|------|-------|------|----------|------|
|               | LB         | UB    | obj   | time   | LB    | %gap | obj    | time | %gap | obj    | time | %gap | obj   | time | iter | %gap | obj   | time | iter     | %gap |
| 2-50-01-45-10 | 231        | 231   | 231   | 0.0    | 231   | 0.0  | 231    | 0.0  | 0.0  | 231    | 0.0  | 0.0  | 231   | 0.0  | 1    | 0.0  | 231   | 0.0  | 1        | 0.0  |
| 2-50-01-50-10 | 164        | 164   | 164   | 0.1    | 164   | 0.0  | 164    | 0.0  | 0.0  | 164    | 0.0  | 0.0  | 164   | 0.0  | 1    | 0.0  | 164   | 0.0  | 1        | 0.0  |
| 2-50-01-55-10 | 194        | 194   | 194   | 0.1    | 194   | 0.0  | 194    | 0.0  | 0.0  | 194    | 0.0  | 0.0  | 194   | 0.0  | 1    | 0.0  | 194   | 0.0  | 1        | 0.0  |
| 2-60-01-45-10 | 272        | 272   | 272   | 0.2    | 272   | 0.0  | 272    | 0.0  | 0.0  | 278↑   | 0.0  | 2.2  | 272   | 0.1  | 2    | 0.0  | 272   | 0.0  | 2        | 0.0  |
| 2-60-01-50-10 | 240        | 240   | 240   | 0.1    | 240   | 0.0  | 243↑   | 0.0  | 1.2  | 243↑   | 0.0  | 1.2  | 240   | 0.0  | 2    | 0.0  | 240   | 0.0  | 2        | 0.0  |
| 2-60-01-55-10 | 237        | 237   | 237   | 0.0    | 237   | 0.0  | 237    | 0.0  | 0.0  | 237    | 0.0  | 0.0  | 237   | 0.0  | 1    | 0.0  | 237   | 0.0  | 1        | 0.0  |
| 2-70-01-45-10 | 272        | 272   | 272   | 0.2    | 272   | 0.0  | 274↑   | 0.0  | 0.7  | 274↑   | 0.0  | 0.7  | 272   | 0.1  | 4    | 0.0  | 272   | 0.0  | <b>2</b> | 0.0  |
| 2-70-01-50-10 | 242        | 242   | 242   | 0.2    | 242   | 0.0  | 242    | 0.0  | 0.0  | 242    | 0.0  | 0.0  | 242   | 0.0  | 1    | 0.0  | 242   | 0.0  | 1        | 0.0  |
| 2-70-01-55-10 | 289        | 289   | 289   | 0.2    | 289   | 0.0  | 290↑   | 0.0  | 0.3  | 289    | 0.0  | 0.0  | 289   | 0.0  | 1    | 0.0  | 289   | 0.0  | 1        | 0.0  |
| 2-50-01-45-20 | 886        | 886   | 886   | 0.3    | 886   | 0.0  | 886    | 0.0  | 0.0  | 886    | 0.0  | 0.0  | 886   | 0.0  | 1    | 0.0  | 886   | 0.0  | 1        | 0.0  |
| 2-50-01-50-20 | 870        | 870   | 870   | 0.3    | 870   | 0.0  | 870    | 0.0  | 0.0  | 870    | 0.0  | 0.0  | 870   | 0.0  | 1    | 0.0  | 870   | 0.0  | 1        | 0.0  |
| 2-50-01-55-20 | 880        | 880   | 880   | 2.5    | 880   | 0.0  | 908↑   | 0.0  | 3.1  | 880    | 0.1  | 0.0  | 880   | 0.1  | 1    | 0.0  | 880   | 0.1  | 1        | 0.0  |
| 2-60-01-45-20 | 1151       | 1151  | 1151  | 5.1    | 1151  | 0.0  | 1184↑  | 0.0  | 2.8  | 1151   | 0.1  | 0.0  | 1151  | 0.1  | 1    | 0.0  | 1151  | 0.1  | 1        | 0.0  |
| 2-60-01-50-20 | 1128       | 1128  | 1128  | 1.3    | 1128  | 0.0  | 1128   | 0.0  | 0.0  | 1128   | 0.1  | 0.0  | 1128  | 0.1  | 1    | 0.0  | 1128  | 0.1  | 1        | 0.0  |
| 2-60-01-55-20 | 1131       | 1131  | 1131  | 18.3   | 1131  | 0.0  | 1154↑  | 0.0  | 2.0  | 1131   | 0.1  | 0.0  | 1131  | 0.1  | 1    | 0.0  | 1131  | 0.1  | 1        | 0.0  |
| 2-70-01-45-20 | 1272       | 1272  | 1272  | 82.5   | 1272  | 0.0  | 1286↑  | 0.0  | 1.1  | 1272   | 0.1  | 0.0  | 1272  | 0.1  | 1    | 0.0  | 1272  | 0.1  | 1        | 0.0  |
| 2-70-01-50-20 | 1274       | 1274  | 1274  | 5.5    | 1274  | 0.0  | 1274   | 0.0  | 0.0  | 1274   | 0.1  | 0.0  | 1274  | 0.1  | 1    | 0.0  | 1274  | 0.1  | 1        | 0.0  |
| 2-70-01-55-20 | 1243       | 1243  | 1243  | 17.4   | 1243  | 0.0  | 1243   | 0.0  | 0.0  | 1243   | 0.1  | 0.0  | 1243  | 0.1  | 1    | 0.0  | 1243  | 0.1  | 1        | 0.0  |
| 2-50-01-45-30 | 2050       | 2050  | 2050  | 35.2   | 2050  | 0.0  | 2050   | 0.0  | 0.0  | 2050   | 0.1  | 0.0  | 2050  | 0.1  | 1    | 0.0  | 2050  | 0.1  | 1        | 0.0  |
| 2-50-01-50-30 | 2090       | 2090  | 2090  | 10.2   | 2090  | 0.0  | 2090   | 0.0  | 0.0  | 2090   | 0.1  | 0.0  | 2090  | 0.1  | 1    | 0.0  | 2090  | 0.1  | 1        | 0.0  |
| 2-50-01-55-30 | 2041       | 2041  | 2041  | 9.3    | 2041  | 0.0  | 2041   | 0.0  | 0.0  | 2041   | 0.1  | 0.0  | 2041  | 0.1  | 1    | 0.0  | 2041  | 0.1  | 1        | 0.0  |
| 2-60-01-45-30 | 2467       | 2467  | 2467  | 258.1  | 2467  | 0.0  | 2467   | 0.0  | 0.0  | 2467   | 0.2  | 0.0  | 2467  | 0.2  | 1    | 0.0  | 2467  | 0.2  | 1        | 0.0  |
| 2-60-01-50-30 | 2505       | 2505  | 2505  | 1437.1 | 2505  | 0.0  | 2508↑  | 0.0  | 0.1  | 2505   | 0.3  | 0.0  | 2505  | 0.3  | 1    | 0.0  | 2505  | 0.3  | 1        | 0.0  |
| 2-60-01-55-30 | 2270       | 2425  | 2425  | 7.0    | 2425  | 0.0  | 2425   | 0.0  | 0.0  | 2425   | 0.1  | 0.0  | 2425  | 0.1  | 1    | 0.0  | 2425  | 0.1  | 1        | 0.0  |
| 2-70-01-45-30 | 2801       | 2801  | 2801  | 2549.2 | 2620  | 0.0  | 2818↑  | 0.0  | 0.6  | 2801   | 0.1  | 0.0  | 2801  | 0.1  | 1    | 0.0  | 2801  | 0.1  | 1        | 0.0  |
| 2-70-01-50-30 | 2814       | 2814  | 2814  | 3171.8 | 2651  | 0.0  | 2827↑  | 0.0  | 0.5  | 2827↑  | 0.1  | 0.5  | 2814  | 0.2  | 2    | 0.0  | 2814  | 0.2  | 2        | 0.0  |
| 2-70-01-55-30 | 2698       | 2698  | 2698  | 9.7    | 2636  | 0.0  | 2698   | 0.0  | 0.0  | 2698   | 0.1  | 0.0  | 2698  | 0.1  | 1    | 0.0  | 2698  | 0.1  | 1        | 0.0  |
| 2-50-10-45-10 | 2678       | 2678  | 2678  | 0.1    | 2678  | 0.0  | 2678   | 0.0  | 0.0  | 2678   | 0.0  | 0.0  | 2678  | 0.0  | 1    | 0.0  | 2678  | 0.0  | 1        | 0.0  |
| 2-50-10-50-10 | 2716       | 2716  | 2716  | 0.2    | 2716  | 0.0  | 2716   | 0.0  | 0.0  | 2716   | 0.0  | 0.0  | 2716  | 0.0  | 1    | 0.0  | 2716  | 0.0  | 1        | 0.0  |
| 2-50-10-55-10 | 2444       | 2444  | 2444  | 0.1    | 2444  | 0.0  | 2444   | 0.0  | 0.0  | 2444   | 0.0  | 0.0  | 2444  | 0.0  | 1    | 0.0  | 2444  | 0.0  | 1        | 0.0  |
| 2-60-10-45-10 | 2694       | 2694  | 2694  | 0.3    | 2694  | 0.0  | 2694   | 0.0  | 0.0  | 2694   | 0.0  | 0.0  | 2694  | 0.0  | 1    | 0.0  | 2694  | 0.0  | 1        | 0.0  |
| 2-60-10-50-10 | 2604       | 2604  | 2604  | 0.3    | 2604  | 0.0  | 2674↑  | 0.0  | 0.0  | 2652↑  | 0.0  | 0.0  | 2604  | 0.1  | 2    | 0.0  | 2604  | 0.1  | 2        | 0.0  |
| 2-60-10-55-10 | 2125       | 2125  | 2125  | 0.1    | 2125  | 0.0  | 2125   | 0.0  | 0.0  | 2125   | 0.0  | 0.0  | 2125  | 0.0  | 1    | 0.0  | 2125  | 0.0  | 1        | 0.0  |
| 2-70-10-45-10 | 3984       | 3984  | 3984  | 0.6    | 3984  | 0.0  | 4062↑  | 0.0  | 1.9  | 4062↑  | 0.1  | 1.9  | 3984  | 0.1  | 2    | 0.0  | 3984  | 0.1  | 2        | 0.0  |
| 2-70-10-50-10 | 3558       | 3558  | 3558  | 0.5    | 3558  | 0.0  | 3702↑  | 0.0  | 3.9  | 3558   | 0.0  | 0.0  | 3558  | 0.0  | 1    | 0.0  | 3558  | 0.0  | 1        | 0.0  |
| 2-70-10-55-10 | 2699       | 2699  | 2699  | 0.0    | 2699  | 0.0  | 2699   | 0.0  | 0.0  | 2699   | 0.0  | 0.0  | 2699  | 0.0  | 1    | 0.0  | 2699  | 0.0  | 1        | 0.0  |
| 2-50-10-45-20 | 8684       | 8684  | 8684  | 0.3    | 8684  | 0.0  | 8684   | 0.0  | 0.0  | 8684   | 0.1  | 0.0  | 8684  | 0.1  | 1    | 0.0  | 8684  | 0.1  | 1        | 0.0  |
| 2-50-10-50-20 | 8070       | 8070  | 8070  | 0.5    | 8070  | 0.0  | 8155↑  | 0.0  | 1.0  | 8155↑  | 0.1  | 1.0  | 8070  | 0.2  | 3    | 0.0  | 8070  | 0.2  | 3        | 0.0  |
| 2-50-10-55-20 | 7172       | 7172  | 7172  | 0.0    | 7172  | 0.0  | 7172   | 0.0  | 0.0  | 7172   | 0.0  | 0.0  | 7172  | 0.0  | 1    | 0.0  | 7172  | 0.0  | 1        | 0.0  |
| 2-60-10-45-20 | 8921       | 8921  | 8921  | 2.4    | 8921  | 0.0  | 8958↑  | 0.0  | 0.4  | 8958↑  | 0.1  | 0.4  | 8921  | 0.1  | 2    | 0.0  | 8921  | 0.1  | 2        | 0.0  |
| 2-60-10-50-20 | 8228       | 8228  | 8228  | 0.3    | 8228  | 0.0  | 8228   | 0.0  | 0.0  | 8228   | 0.0  | 0.0  | 8228  | 0.0  | 1    | 0.0  | 8228  | 0.0  | 1        | 0.0  |
| 2-60-10-55-20 | 7668       | 7668  | 7668  | 0.3    | 7668  | 0.0  | 7668   | 0.0  | 0.0  | 7668   | 0.0  | 0.0  | 7668  | 0.0  | 1    | 0.0  | 7668  | 0.0  | 1        | 0.0  |
| 2-70-10-45-20 | 12238      | 12238 | 12238 | 0.3    | 12238 | 0.0  | 12238  | 0.0  | 0.0  | 12238  | 0.1  | 0.0  | 12238 | 0.1  | 1    | 0.0  | 12238 | 0.1  | 1        | 0.0  |
| 2-70-10-50-20 | 11941      | 11941 | 11941 | 18.0   | 11941 | 0.0  | 11984↑ | 0.0  | 0.4  | 11941  | 0.1  | 0.0  | 11941 | 0.1  | 1    | 0.0  | 11941 | 0.1  | 1        | 0.0  |
| 2-70-10-55-20 | 11428      | 11428 | 11428 | 6.6    | 11428 | 0.0  | 11559↑ | 0.0  | 1.1  | 11428  | 0.1  | 0.0  | 11428 | 0.1  | 1    | 0.0  | 11428 | 0.1  | 1        | 0.0  |
| 2-50-10-45-30 | 9924       | 9924  | 9924  | 0.2    | 9924  | 0.0  | 9924   | 0.0  | 0.0  | 9924   | 0.0  | 0.0  | 9924  | 0.0  | 1    | 0.0  | 9924  | 0.0  | 1        | 0.0  |
| 2-50-10-50-30 | 9242       | 9242  | 9242  | 0.4    | 9242  | 0.0  | 9242   | 0.0  | 0.0  | 9242   | 0.0  | 0.0  | 9242  | 0.0  | 1    | 0.0  | 9242  | 0.0  | 1        | 0.0  |
| 2-50-10-55-30 | 8763       | 8763  | 8763  | 0.1    | 8763  | 0.0  | 8763   | 0.0  | 0.0  | 8763   | 0.0  | 0.0  | 8763  | 0.0  | 1    | 0.0  | 8763  | 0.0  | 1        | 0.0  |
| 2-60-10-45-30 | 11486      | 11486 | 11486 | 1.8    | 11486 | 0.0  | 11486  | 0.0  | 0.0  | 11486  | 0.0  | 0.0  | 11486 | 0.0  | 1    | 0.0  | 11486 | 0.0  | 1        | 0.0  |
| 2-60-10-50-30 | 11324      | 11324 | 11324 | 1.5    | 11324 | 0.0  | 11324  | 0.0  | 0.0  | 11324  | 0.0  | 0.0  | 11324 | 0.0  | 1    | 0.0  | 11324 | 0.0  | 1        | 0.0  |
| 2-60-10-55-30 | 10490      | 10490 | 10490 | 0.2    | 10490 | 0.0  | 10496↑ | 0.0  | 0.1  | 10496↑ | 0.0  | 0.1  | 10490 | 0.1  | 2    | 0.0  | 10490 | 0.0  | 2        | 0.0  |
| 2-70-10-45-30 | 17726      | 17726 | 17726 | 63.1   | 17726 | 0.0  | 17726  | 0.0  | 0.0  | 17726  | 0.1  | 0.0  | 17726 | 0.1  | 1    | 0.0  | 17726 | 0.1  | 1        | 0.0  |
| 2-70-10-50-30 | 17300      | 17300 | 17300 | 90.4   | 17300 | 0.0  | 17300  | 0.0  | 0.0  | 17300  | 0.1  | 0.0  | 17300 | 0.1  | 1    | 0.0  | 17300 | 0.1  | 1        | 0.0  |
| 2-70-10-55-30 | 16239      | 16239 | 16239 | 0.3    | 16239 | 0.0  | 16239  | 0.0  | 0.0  | 16239  | 0.0  | 0.0  | 16239 | 0.0  | 1    | 0.0  | 16239 | 0.0  | 1        | 0.0  |

**Table EC.6** MMR-KP results for type-3 instances

| instance      | Best Known |       | B&C    |        |       |      | Fix    |      |      | DS     |      |      | iDS-H |      |      |      | iDS-B |      |      |      |
|---------------|------------|-------|--------|--------|-------|------|--------|------|------|--------|------|------|-------|------|------|------|-------|------|------|------|
|               | LB         | UB    | obj    | time   | LB    | %gap | obj    | time | %gap | obj    | time | %gap | obj   | time | iter | %gap | obj   | time | iter | %gap |
| 3-50-01-45-10 | 726        | 726   | 726    | 10.1   | 726   | 0.0  | 726    | 0.0  | 0.0  | 726    | 0.1  | 0.0  | 726   | 0.1  | 1    | 0.0  | 726   | 0.1  | 1    | 0.0  |
| 3-50-01-50-10 | 719        | 719   | 719    | 0.3    | 719   | 0.0  | 729↑   | 0.0  | 0.0  | 719    | 0.1  | 0.0  | 719   | 0.1  | 1    | 0.0  | 719   | 0.1  | 1    | 0.0  |
| 3-50-01-55-10 | 714        | 714   | 714    | 0.3    | 714   | 0.0  | 730↑   | 0.0  | 2.2  | 714    | 0.0  | 0.0  | 714   | 0.0  | 1    | 0.0  | 714   | 0.0  | 1    | 0.0  |
| 3-60-01-45-10 | 868        | 868   | 868    | 35.7   | 868   | 0.0  | 868    | 0.0  | 0.0  | 868    | 0.1  | 0.0  | 868   | 0.1  | 1    | 0.0  | 868   | 0.1  | 1    | 0.0  |
| 3-60-01-50-10 | 909        | 909   | 909    | 214.0  | 909   | 0.0  | 909    | 0.0  | 0.0  | 909    | 0.2  | 0.0  | 909   | 0.2  | 1    | 0.0  | 909   | 0.2  | 1    | 0.0  |
| 3-60-01-55-10 | 909        | 909   | 909    | 367.7  | 909   | 0.0  | 909    | 0.0  | 0.0  | 909    | 0.2  | 0.0  | 909   | 0.2  | 1    | 0.0  | 909   | 0.2  | 1    | 0.0  |
| 3-70-01-45-10 | 977        | 977   | 977    | 797.9  | 977   | 0.0  | 977    | 0.0  | 0.0  | 977    | 0.4  | 0.0  | 977   | 0.4  | 1    | 0.0  | 977   | 0.4  | 1    | 0.0  |
| 3-70-01-50-10 | 1008       | 1008  | 1008   | 584.7  | 1000  | 0.0  | 1008   | 0.0  | 0.0  | 1008   | 0.3  | 0.0  | 1008  | 0.3  | 1    | 0.0  | 1008  | 0.3  | 1    | 0.0  |
| 3-70-01-55-10 | 1027       | 1027  | 1027   | 2081.1 | 983   | 0.0  | 1027   | 0.0  | 0.0  | 1027   | 0.3  | 0.0  | 1027  | 0.3  | 1    | 0.0  | 1027  | 0.3  | 1    | 0.0  |
| 3-50-01-45-20 | 2112       | 2112  | 2122↑  | 1340.7 | 2000  | 0.5  | 2122↑  | 0.0  | 0.5  | 2124↑  | 0.3  | 0.6  | 2112  | 2.1  | 5    | 0.0  | 2112  | 2.2  | 5    | 0.0  |
| 3-50-01-50-20 | 2135       | 2135  | 2135   | 1642.4 | 2003  | 0.0  | 2146↑  | 0.0  | 0.5  | 2146↑  | 0.3  | 0.5  | 2135  | 0.7  | 2    | 0.0  | 2135  | 0.7  | 2    | 0.0  |
| 3-50-01-55-20 | 2098       | 2098  | 2098   | 2385.7 | 1956  | 0.0  | 2098   | 0.0  | 0.0  | 2098   | 0.2  | 0.0  | 2098  | 0.2  | 1    | 0.0  | 2098  | 0.2  | 1    | 0.0  |
| 3-60-01-45-20 | 1961       | 2517  | 2517   | 896.8  | 2183  | 13.3 | 2525↑  | 0.0  | 13.5 | 2525↑  | 0.5  | 13.5 | 2517  | 1.8  | 3    | 13.3 | 2517  | 1.5  | 3    | 13.3 |
| 3-60-01-50-20 | 1932       | 2530  | 2530   | 1133.5 | 2196  | 13.2 | 2530   | 0.0  | 13.2 | 2530   | 0.4  | 13.2 | 2530  | 0.4  | 1    | 13.2 | 2530  | 0.4  | 1    | 13.2 |
| 3-60-01-55-20 | 1919       | 2441  | 2441   | 2198.4 | 2167  | 11.2 | 2441   | 0.0  | 11.2 | 2441   | 0.1  | 11.2 | 2441  | 0.1  | 1    | 11.2 | 2441  | 0.1  | 1    | 11.2 |
| 3-70-01-45-20 | 2073       | 2760  | 2760   | 674.1  | 2331  | 15.5 | 2780↑  | 0.0  | 16.2 | 2760   | 0.7  | 15.5 | 2756↓ | 1.9  | 2    | 15.4 | 2756↓ | 1.5  | 2    | 15.4 |
| 3-70-01-50-20 | 2081       | 2786  | 2883↑  | 2656.7 | 2312  | 19.8 | 2801↑  | 0.0  | 17.5 | 2786   | 0.5  | 17.0 | 2786  | 0.5  | 1    | 17.0 | 2786  | 0.5  | 1    | 17.0 |
| 3-70-01-55-20 | 2044       | 2715  | 2715   | 0.3    | 2341  | 13.8 | 2715   | 0.0  | 13.8 | 2715   | 0.4  | 13.8 | 2715  | 0.4  | 1    | 13.8 | 2715  | 0.4  | 1    | 13.8 |
| 3-50-01-45-30 | 2640       | 2640  | 2640   | 464.4  | 2640  | 0.0  | 2640   | 0.0  | 0.0  | 2651↑  | 0.2  | 0.4  | 2640  | 0.5  | 2    | 0.0  | 2640  | 0.4  | 2    | 0.0  |
| 3-50-01-50-30 | 2866       | 2866  | 2879↑  | 1534.6 | 2716  | 0.5  | 2866   | 0.0  | 0.0  | 2866   | 0.5  | 0.0  | 2866  | 0.5  | 1    | 0.0  | 2866  | 0.5  | 1    | 0.0  |
| 3-50-01-55-30 | 2974       | 2974  | 2991↑  | 858.3  | 2742  | 0.6  | 2983↑  | 0.0  | 0.3  | 2974   | 0.4  | 0.0  | 2974  | 0.4  | 1    | 0.0  | 2974  | 0.4  | 1    | 0.0  |
| 3-60-01-45-30 | 3361       | 3361  | 3385↑  | 675.3  | 3094  | 0.7  | 3361   | 0.0  | 0.0  | 3361   | 0.3  | 0.0  | 3361  | 0.3  | 1    | 0.0  | 3361  | 0.3  | 1    | 0.0  |
| 3-60-01-50-30 | 2871       | 3668  | 3670↑  | 3479.0 | 3134  | 14.6 | 3668   | 0.0  | 14.6 | 3670↑  | 0.7  | 14.6 | 3668  | 2.4  | 2    | 14.6 | 3668  | 2.0  | 2    | 14.6 |
| 3-60-01-55-30 | 2851       | 3790  | 3819↑  | 1351.7 | 3127  | 18.1 | 3790   | 0.0  | 17.5 | 3790   | 0.9  | 17.5 | 3790  | 0.9  | 1    | 17.5 | 3790  | 0.9  | 1    | 17.5 |
| 3-70-01-45-30 | 3002       | 3628  | 3667↑  | 1451.1 | 3242  | 11.6 | 3632↑  | 0.0  | 10.7 | 3632↑  | 0.3  | 10.7 | 3628  | 1.1  | 3    | 10.6 | 3628  | 1.0  | 3    | 10.6 |
| 3-70-01-50-30 | 3013       | 3958  | 4018↑  | 0.4    | 3298  | 17.9 | 3958   | 0.0  | 16.7 | 3958   | 0.9  | 16.7 | 3958  | 0.9  | 1    | 16.7 | 3958  | 0.9  | 1    | 16.7 |
| 3-70-01-55-30 | 3023       | 4111  | 4152↑  | 0.4    | 3260  | 21.5 | 4111   | 0.0  | 20.7 | 4111   | 1.2  | 20.7 | 4111  | 1.2  | 1    | 20.7 | 4111  | 1.2  | 1    | 20.7 |
| 3-50-10-45-10 | 3656       | 3656  | 3656   | 0.2    | 3656  | 0.0  | 3829↑  | 0.0  | 4.5  | 3656   | 0.0  | 0.0  | 3656  | 0.0  | 1    | 0.0  | 3656  | 0.0  | 1    | 0.0  |
| 3-50-10-50-10 | 4167       | 4167  | 4167   | 0.3    | 4167  | 0.0  | 4167   | 0.0  | 0.0  | 4167   | 0.0  | 0.0  | 4167  | 0.0  | 1    | 0.0  | 4167  | 0.0  | 1    | 0.0  |
| 3-50-10-55-10 | 4132       | 4132  | 4132   | 0.5    | 4132  | 0.0  | 4132   | 0.0  | 0.0  | 4132   | 0.0  | 0.0  | 4132  | 0.0  | 1    | 0.0  | 4132  | 0.0  | 1    | 0.0  |
| 3-60-10-45-10 | 4500       | 4500  | 4500   | 0.5    | 4500  | 0.0  | 4588↑  | 0.0  | 1.9  | 4500   | 0.0  | 0.0  | 4500  | 0.0  | 1    | 0.0  | 4500  | 0.0  | 1    | 0.0  |
| 3-60-10-50-10 | 5172       | 5172  | 5172   | 0.7    | 5172  | 0.0  | 5381↑  | 0.0  | 0.0  | 5172   | 0.1  | 0.0  | 5172  | 0.1  | 1    | 0.0  | 5172  | 0.1  | 1    | 0.0  |
| 3-60-10-55-10 | 5568       | 5568  | 5568   | 1.3    | 5568  | 0.0  | 5854↑  | 0.0  | 4.9  | 5568   | 0.2  | 0.0  | 5568  | 0.2  | 1    | 0.0  | 5568  | 0.2  | 1    | 0.0  |
| 3-70-10-45-10 | 5816       | 5816  | 5816   | 6.5    | 5816  | 0.0  | 5816   | 0.0  | 0.0  | 5816   | 0.1  | 0.0  | 5816  | 0.1  | 1    | 0.0  | 5816  | 0.1  | 1    | 0.0  |
| 3-70-10-50-10 | 6128       | 6128  | 6128   | 0.4    | 6128  | 0.0  | 6128   | 0.0  | 0.0  | 6128   | 0.1  | 0.0  | 6128  | 0.1  | 1    | 0.0  | 6128  | 0.1  | 1    | 0.0  |
| 3-70-10-55-10 | 6623       | 6623  | 6623   | 0.3    | 6623  | 0.0  | 6718↑  | 0.0  | 1.4  | 6623   | 0.1  | 0.0  | 6623  | 0.1  | 1    | 0.0  | 6623  | 0.1  | 1    | 0.0  |
| 3-50-10-45-20 | 11130      | 11130 | 11130  | 22.6   | 11130 | 0.0  | 11618↑ | 0.0  | 4.2  | 11130  | 0.0  | 0.0  | 11130 | 0.0  | 1    | 0.0  | 11130 | 0.0  | 1    | 0.0  |
| 3-50-10-50-20 | 12264      | 12264 | 12264  | 22.5   | 12264 | 0.0  | 12561↑ | 0.0  | 2.4  | 12264  | 0.1  | 0.0  | 12264 | 0.1  | 1    | 0.0  | 12264 | 0.1  | 1    | 0.0  |
| 3-50-10-55-20 | 12427      | 12427 | 12427  | 13.6   | 12427 | 0.0  | 12602↑ | 0.0  | 0.0  | 12427  | 0.1  | 0.0  | 12427 | 0.1  | 1    | 0.0  | 12427 | 0.1  | 1    | 0.0  |
| 3-60-10-45-20 | 13482      | 13482 | 13482  | 351.4  | 13482 | 0.0  | 13694↑ | 0.0  | 1.5  | 13482  | 0.1  | 0.0  | 13482 | 0.1  | 1    | 0.0  | 13482 | 0.1  | 1    | 0.0  |
| 3-60-10-50-20 | 14384      | 14384 | 14384  | 405.9  | 14384 | 0.0  | 14384  | 0.0  | 0.0  | 14384  | 0.2  | 0.0  | 14384 | 0.2  | 1    | 0.0  | 14384 | 0.2  | 1    | 0.0  |
| 3-60-10-55-20 | 14975      | 14975 | 14975  | 9.5    | 14975 | 0.0  | 14975  | 0.0  | 0.0  | 14975  | 0.3  | 0.0  | 14975 | 0.3  | 1    | 0.0  | 14975 | 0.3  | 1    | 0.0  |
| 3-70-10-45-20 | 16027      | 16027 | 16027  | 601.7  | 15701 | 0.0  | 16572↑ | 0.0  | 3.3  | 16027  | 0.1  | 0.0  | 16027 | 0.1  | 1    | 0.0  | 16027 | 0.1  | 1    | 0.0  |
| 3-70-10-50-20 | 17352      | 17352 | 17352  | 1227.7 | 16305 | 0.0  | 17352  | 0.0  | 0.0  | 17352  | 0.2  | 0.0  | 17352 | 0.2  | 1    | 0.0  | 17352 | 0.2  | 1    | 0.0  |
| 3-70-10-55-20 | 18054      | 18054 | 18155↑ | 0.6    | 16552 | 0.6  | 18054  | 0.0  | 0.0  | 18054  | 0.6  | 0.0  | 18054 | 0.6  | 1    | 0.0  | 18054 | 0.6  | 1    | 0.0  |
| 3-50-10-45-30 | 17258      | 17258 | 17258  | 26.4   | 17258 | 0.0  | 17393↑ | 0.0  | 0.8  | 17271↑ | 0.1  | 0.1  | 17258 | 0.1  | 2    | 0.0  | 17258 | 0.1  | 2    | 0.0  |
| 3-50-10-50-30 | 18954      | 18954 | 18954  | 67.5   | 18954 | 0.0  | 18954  | 0.0  | 0.0  | 18954  | 0.1  | 0.0  | 18954 | 0.1  | 1    | 0.0  | 18954 | 0.1  | 1    | 0.0  |
| 3-50-10-55-30 | 19774      | 19774 | 19774  | 66.7   | 19774 | 0.0  | 19774  | 0.0  | 0.0  | 19798↑ | 0.1  | 0.1  | 19774 | 0.3  | 2    | 0.0  | 19774 | 0.3  | 2    | 0.0  |
| 3-60-10-45-30 | 22057      | 22057 | 22212↑ | 3569.4 | 20690 | 0.7  | 22057  | 0.0  | 0.0  | 22057  | 0.1  | 0.0  | 22057 | 0.1  | 1    | 0.0  | 22057 | 0.1  | 1    | 0.0  |
| 3-60-10-50-30 | 23229      | 23229 | 23229  | 1944.3 | 21593 | 0.0  | 23229  | 0.0  | 0.0  | 23229  | 0.3  | 0.0  | 23229 | 0.3  | 1    | 0.0  | 23229 | 0.3  | 1    | 0.0  |
| 3-60-10-55-30 | 24219      | 24219 | 24219  | 1639.0 | 22218 | 0.0  | 24219  | 0.0  | 0.0  | 24219  | 0.3  | 0.0  | 24219 | 0.3  | 1    | 0.0  | 24219 | 0.3  | 1    | 0.0  |
| 3-70-10-45-30 | 25142      | 25142 | 26078↑ | 1183.4 | 22830 | 3.6  | 25142  | 0.0  | 0.0  | 25142  | 0.3  | 0.0  | 25142 | 0.3  | 1    | 0.0  | 25142 | 0.3  | 1    | 0.0  |
| 3-70-10-50-30 | 20672      | 26380 | 27225↑ | 2793.9 | 23400 | 14.0 | 26390↑ | 0.0  | 11.3 | 26380  | 0.3  | 11.3 | 26380 | 0.3  | 1    | 11.3 | 26380 | 0.3  | 1    | 11.3 |
| 3-70-10-55-30 | 26878      | 26878 | 26931↑ | 0.4    | 23576 | 0.2  | 26878  | 0.0  | 0.0  | 26931↑ | 0.3  | 0.2  | 26878 | 0.7  | 2    | 0.0  | 26878 | 0.7  | 2    | 0.0  |



**Table EC.7** MMR-KP results for type-4 instances

| instance      | Best Known |       | B&C    |        |       |      | Fix    |      |      | DS     |      |      | iDS-H |      |      |      | iDS-B |      |      |      |
|---------------|------------|-------|--------|--------|-------|------|--------|------|------|--------|------|------|-------|------|------|------|-------|------|------|------|
|               | LB         | UB    | obj    | time   | LB    | %gap | obj    | time | %gap | obj    | time | %gap | obj   | time | iter | %gap | obj   | time | iter | %gap |
| 4-50-01-45-10 | 582        | 582   | 582    | 11.2   | 582   | 0.0  | 582    | 0.0  | 0.0  | 582    | 0.1  | 0.0  | 582   | 0.1  | 1    | 0.0  | 582   | 0.1  | 1    | 0.0  |
| 4-50-01-50-10 | 547        | 547   | 547    | 11.4   | 547   | 0.0  | 547    | 0.0  | 0.0  | 547    | 0.1  | 0.0  | 547   | 0.1  | 1    | 0.0  | 547   | 0.1  | 1    | 0.0  |
| 4-50-01-55-10 | 490        | 490   | 490    | 0.3    | 490   | 0.0  | 496↑   | 0.0  | 1.2  | 490    | 0.1  | 0.0  | 490   | 0.1  | 1    | 0.0  | 490   | 0.1  | 1    | 0.0  |
| 4-60-01-45-10 | 710        | 710   | 710    | 21.3   | 710   | 0.0  | 710    | 0.0  | 0.0  | 710    | 0.1  | 0.0  | 710   | 0.1  | 1    | 0.0  | 710   | 0.1  | 1    | 0.0  |
| 4-60-01-50-10 | 668        | 668   | 668    | 8.6    | 668   | 0.0  | 668    | 0.0  | 0.0  | 668    | 0.1  | 0.0  | 668   | 0.1  | 1    | 0.0  | 668   | 0.1  | 1    | 0.0  |
| 4-60-01-55-10 | 603        | 603   | 603    | 18.0   | 603   | 0.0  | 603    | 0.0  | 0.0  | 603    | 0.1  | 0.0  | 603   | 0.1  | 1    | 0.0  | 603   | 0.1  | 1    | 0.0  |
| 4-70-01-45-10 | 754        | 754   | 754    | 8.2    | 746   | 0.0  | 766↑   | 0.0  | 1.6  | 754    | 0.2  | 0.0  | 754   | 0.2  | 1    | 0.0  | 754   | 0.2  | 1    | 0.0  |
| 4-70-01-50-10 | 708        | 708   | 708    | 633.5  | 708   | 0.0  | 708    | 0.0  | 0.0  | 709↑   | 0.2  | 0.1  | 708   | 0.6  | 2    | 0.0  | 708   | 0.5  | 2    | 0.0  |
| 4-70-01-55-10 | 637        | 637   | 637    | 26.0   | 637   | 0.0  | 639↑   | 0.0  | 0.3  | 639↑   | 0.1  | 0.3  | 637   | 0.3  | 2    | 0.0  | 637   | 0.3  | 2    | 0.0  |
| 4-50-01-45-20 | 1532       | 1532  | 1532   | 118.9  | 1532  | 0.0  | 1532   | 0.0  | 0.0  | 1532   | 0.3  | 0.0  | 1532  | 0.3  | 1    | 0.0  | 1532  | 0.3  | 1    | 0.0  |
| 4-50-01-50-20 | 1528       | 1528  | 1528   | 5.3    | 1502  | 0.0  | 1554↑  | 0.0  | 1.7  | 1528   | 0.2  | 0.0  | 1528  | 0.2  | 1    | 0.0  | 1528  | 0.2  | 1    | 0.0  |
| 4-50-01-55-20 | 1456       | 1456  | 1456   | 1262.3 | 1456  | 0.0  | 1474↑  | 0.0  | 1.2  | 1474↑  | 0.2  | 1.2  | 1456  | 0.6  | 2    | 0.0  | 1456  | 0.5  | 2    | 0.0  |
| 4-60-01-45-20 | 1913       | 1913  | 1918↑  | 719.5  | 1715  | 0.3  | 1913   | 0.0  | 0.0  | 1913   | 0.5  | 0.0  | 1913  | 0.5  | 1    | 0.0  | 1913  | 0.5  | 1    | 0.0  |
| 4-60-01-50-20 | 1920       | 1920  | 1938↑  | 1737.2 | 1707  | 0.9  | 1920   | 0.0  | 0.0  | 1920   | 0.4  | 0.0  | 1920  | 0.4  | 1    | 0.0  | 1920  | 0.4  | 1    | 0.0  |
| 4-60-01-55-20 | 1859       | 1859  | 1859   | 1275.1 | 1694  | 0.0  | 1863↑  | 0.0  | 0.2  | 1859   | 0.4  | 0.0  | 1859  | 0.4  | 1    | 0.0  | 1859  | 0.4  | 1    | 0.0  |
| 4-70-01-45-20 | 1674       | 2173  | 2183↑  | 600.7  | 1883  | 13.7 | 2199↑  | 0.0  | 14.4 | 2173   | 0.5  | 13.3 | 2173  | 0.5  | 1    | 13.3 | 2173  | 0.5  | 1    | 13.3 |
| 4-70-01-50-20 | 1650       | 2156  | 2156   | 890.0  | 1876  | 13.0 | 2156   | 0.0  | 13.0 | 2156   | 0.4  | 13.0 | 2156  | 0.4  | 1    | 13.0 | 2156  | 0.4  | 1    | 13.0 |
| 4-70-01-55-20 | 1639       | 2065  | 2065   | 803.6  | 1852  | 10.3 | 2065   | 0.0  | 10.3 | 2065   | 0.3  | 10.3 | 2065  | 0.3  | 1    | 10.3 | 2065  | 0.3  | 1    | 10.3 |
| 4-50-01-45-30 | 2235       | 2235  | 2235   | 190.3  | 2235  | 0.0  | 2235   | 0.0  | 0.0  | 2235   | 0.3  | 0.0  | 2235  | 0.3  | 1    | 0.0  | 2235  | 0.3  | 1    | 0.0  |
| 4-50-01-50-30 | 2144       | 2144  | 2144   | 7.4    | 2144  | 0.0  | 2144   | 0.0  | 0.0  | 2144   | 0.1  | 0.0  | 2144  | 0.1  | 1    | 0.0  | 2144  | 0.1  | 1    | 0.0  |
| 4-50-01-55-30 | 1993       | 1993  | 1993   | 9.1    | 1993  | 0.0  | 2048↑  | 0.0  | 2.7  | 1993   | 0.0  | 0.0  | 1993  | 0.0  | 1    | 0.0  | 1993  | 0.0  | 1    | 0.0  |
| 4-60-01-45-30 | 2749       | 2749  | 2749   | 1496.3 | 2560  | 0.0  | 2773↑  | 0.0  | 0.9  | 2749   | 0.4  | 0.0  | 2749  | 0.4  | 1    | 0.0  | 2749  | 0.4  | 1    | 0.0  |
| 4-60-01-50-30 | 2696       | 2696  | 2743↑  | 2323.8 | 2529  | 1.7  | 2720↑  | 0.0  | 0.9  | 2696   | 0.3  | 0.0  | 2696  | 0.3  | 1    | 0.0  | 2696  | 0.3  | 1    | 0.0  |
| 4-60-01-55-30 | 2546       | 2546  | 2546   | 244.4  | 2421  | 0.0  | 2556↑  | 0.0  | 0.4  | 2556↑  | 0.2  | 0.4  | 2546  | 0.5  | 2    | 0.0  | 2546  | 0.5  | 2    | 0.0  |
| 4-70-01-45-30 | 2992       | 2992  | 2992   | 974.8  | 2693  | 0.0  | 2992   | 0.0  | 0.0  | 2992   | 0.4  | 0.0  | 2992  | 0.4  | 1    | 0.0  | 2992  | 0.4  | 1    | 0.0  |
| 4-70-01-50-30 | 2930       | 2930  | 2954↑  | 2846.8 | 2646  | 0.8  | 2930   | 0.0  | 0.0  | 2930   | 0.7  | 0.0  | 2930  | 0.7  | 1    | 0.0  | 2930  | 0.7  | 1    | 0.0  |
| 4-70-01-55-30 | 2734       | 2734  | 2734   | 961.5  | 2569  | 0.0  | 2734   | 0.0  | 0.0  | 2734   | 0.1  | 0.0  | 2734  | 0.1  | 1    | 0.0  | 2734  | 0.1  | 1    | 0.0  |
| 4-50-10-45-10 | 3623       | 3623  | 3623   | 0.3    | 3623  | 0.0  | 3623   | 0.0  | 0.0  | 3655↑  | 0.0  | 0.9  | 3623  | 0.1  | 3    | 0.0  | 3623  | 0.1  | 3    | 0.0  |
| 4-50-10-50-10 | 3503       | 3503  | 3503   | 0.5    | 3503  | 0.0  | 3503   | 0.0  | 0.0  | 3503   | 0.0  | 0.0  | 3503  | 0.0  | 1    | 0.0  | 3503  | 0.0  | 1    | 0.0  |
| 4-50-10-55-10 | 3363       | 3363  | 3363   | 0.7    | 3363  | 0.0  | 3445↑  | 0.0  | 0.0  | 3363   | 0.1  | 0.0  | 3363  | 0.1  | 1    | 0.0  | 3363  | 0.1  | 1    | 0.0  |
| 4-60-10-45-10 | 4587       | 4587  | 4587   | 0.3    | 4587  | 0.0  | 4587   | 0.0  | 0.0  | 4587   | 0.1  | 0.0  | 4587  | 0.1  | 1    | 0.0  | 4587  | 0.1  | 1    | 0.0  |
| 4-60-10-50-10 | 4016       | 4016  | 4016   | 0.9    | 4016  | 0.0  | 4092↑  | 0.0  | 0.0  | 4016   | 0.0  | 0.0  | 4016  | 0.0  | 1    | 0.0  | 4016  | 0.0  | 1    | 0.0  |
| 4-60-10-55-10 | 3536       | 3536  | 3536   | 0.4    | 3536  | 0.0  | 3681↑  | 0.0  | 3.9  | 3536   | 0.0  | 0.0  | 3536  | 0.0  | 1    | 0.0  | 3536  | 0.0  | 1    | 0.0  |
| 4-70-10-45-10 | 5627       | 5627  | 5627   | 4.1    | 5627  | 0.0  | 5635↑  | 0.0  | 0.1  | 5627   | 0.1  | 0.0  | 5627  | 0.1  | 1    | 0.0  | 5627  | 0.1  | 1    | 0.0  |
| 4-70-10-50-10 | 4672       | 4672  | 4672   | 2.4    | 4672  | 0.0  | 4800↑  | 0.0  | 2.7  | 4672   | 0.0  | 0.0  | 4672  | 0.0  | 1    | 0.0  | 4672  | 0.0  | 1    | 0.0  |
| 4-70-10-55-10 | 4261       | 4261  | 4261   | 3.3    | 4261  | 0.0  | 4261   | 0.0  | 0.0  | 4268↑  | 0.1  | 0.2  | 4261  | 0.2  | 2    | 0.0  | 4261  | 0.2  | 2    | 0.0  |
| 4-50-10-45-20 | 9450       | 9450  | 9450   | 5.7    | 9450  | 0.0  | 9450   | 0.0  | 0.0  | 9450   | 0.1  | 0.0  | 9450  | 0.1  | 1    | 0.0  | 9450  | 0.1  | 1    | 0.0  |
| 4-50-10-50-20 | 9274       | 9274  | 9274   | 3.9    | 9274  | 0.0  | 9286↑  | 0.0  | 0.1  | 9286↑  | 0.1  | 0.1  | 9274  | 0.3  | 3    | 0.0  | 9274  | 0.3  | 3    | 0.0  |
| 4-50-10-55-20 | 8098       | 8098  | 8098   | 0.2    | 8098  | 0.0  | 8208↑  | 0.0  | 0.0  | 8098   | 0.0  | 0.0  | 8098  | 0.0  | 1    | 0.0  | 8098  | 0.0  | 1    | 0.0  |
| 4-60-10-45-20 | 13415      | 13415 | 13415  | 218.1  | 13415 | 0.0  | 13415  | 0.0  | 0.0  | 13415  | 0.2  | 0.0  | 13415 | 0.2  | 1    | 0.0  | 13415 | 0.2  | 1    | 0.0  |
| 4-60-10-50-20 | 12942      | 12942 | 12942  | 292.5  | 12942 | 0.0  | 13009↑ | 0.0  | 0.5  | 13009↑ | 0.3  | 0.5  | 12942 | 0.6  | 2    | 0.0  | 12942 | 0.6  | 2    | 0.0  |
| 4-60-10-55-20 | 11131      | 11131 | 11131  | 0.4    | 11131 | 0.0  | 11131  | 0.0  | 0.0  | 11131  | 0.1  | 0.0  | 11131 | 0.1  | 1    | 0.0  | 11131 | 0.1  | 1    | 0.0  |
| 4-70-10-45-20 | 14202      | 14202 | 14202  | 645.9  | 13525 | 0.0  | 14202  | 0.0  | 0.0  | 14202  | 0.1  | 0.0  | 14202 | 0.1  | 1    | 0.0  | 14202 | 0.1  | 1    | 0.0  |
| 4-70-10-50-20 | 13696      | 13696 | 13696  | 1716.6 | 13455 | 0.0  | 13734↑ | 0.0  | 0.3  | 13696  | 0.3  | 0.0  | 13696 | 0.3  | 1    | 0.0  | 13696 | 0.3  | 1    | 0.0  |
| 4-70-10-55-20 | 12570      | 12570 | 12570  | 198.3  | 12570 | 0.0  | 12581↑ | 0.0  | 0.1  | 12581↑ | 0.1  | 0.1  | 12570 | 0.3  | 2    | 0.0  | 12570 | 0.3  | 2    | 0.0  |
| 4-50-10-45-30 | 22100      | 22100 | 22100  | 6.1    | 22100 | 0.0  | 22100  | 0.0  | 0.0  | 22100  | 0.3  | 0.0  | 22100 | 0.3  | 1    | 0.0  | 22100 | 0.3  | 1    | 0.0  |
| 4-50-10-50-30 | 21724      | 21724 | 21724  | 545.8  | 21407 | 0.0  | 21724  | 0.0  | 0.0  | 21724  | 0.1  | 0.0  | 21724 | 0.1  | 1    | 0.0  | 21724 | 0.1  | 1    | 0.0  |
| 4-50-10-55-30 | 20216      | 20216 | 20216  | 6.4    | 20216 | 0.0  | 20216  | 0.0  | 0.0  | 20216  | 0.1  | 0.0  | 20216 | 0.1  | 1    | 0.0  | 20216 | 0.1  | 1    | 0.0  |
| 4-60-10-45-30 | 25186      | 25186 | 25186  | 756.4  | 23337 | 0.0  | 25201↑ | 0.0  | 0.1  | 25186  | 0.3  | 0.0  | 25186 | 0.3  | 1    | 0.0  | 25186 | 0.3  | 1    | 0.0  |
| 4-60-10-50-30 | 25408      | 25408 | 25408  | 838.8  | 23097 | 0.0  | 25408  | 0.0  | 0.0  | 25441↑ | 0.5  | 0.1  | 25408 | 1.6  | 3    | 0.0  | 25408 | 1.6  | 3    | 0.0  |
| 4-60-10-55-30 | 23982      | 23982 | 24012↑ | 823.2  | 22383 | 0.1  | 23982  | 0.0  | 0.0  | 23982  | 0.3  | 0.0  | 23982 | 0.3  | 1    | 0.0  | 23982 | 0.3  | 1    | 0.0  |
| 4-70-10-45-30 | 28220      | 28220 | 28220  | 660.4  | 24773 | 0.0  | 28220  | 0.0  | 0.0  | 28220  | 0.3  | 0.0  | 28220 | 0.3  | 1    | 0.0  | 28220 | 0.3  | 1    | 0.0  |
| 4-70-10-50-30 | 28298      | 28298 | 28298  | 449.9  | 24436 | 0.0  | 28298  | 0.0  | 0.0  | 28298  | 0.5  | 0.0  | 28298 | 0.5  | 1    | 0.0  | 28298 | 0.5  | 1    | 0.0  |
| 4-70-10-55-30 | 26642      | 26642 | 26642  | 576.1  | 23792 | 0.0  | 26642  | 0.0  | 0.0  | 26642  | 0.4  | 0.0  | 26642 | 0.4  | 1    | 0.0  | 26642 | 0.4  | 1    | 0.0  |

**Table EC.8** MMR-KP results for type-5 instances

| instance      | Best Known |       | B&C    |        |       |      | Fix    |      |      | DS     |      |      | iDS-H        |      |      |      | iDS-B |      |      |      |
|---------------|------------|-------|--------|--------|-------|------|--------|------|------|--------|------|------|--------------|------|------|------|-------|------|------|------|
|               | LB         | UB    | obj    | time   | LB    | %gap | obj    | time | %gap | obj    | time | %gap | obj          | time | iter | %gap | obj   | time | iter | %gap |
| 5-50-01-45-10 | 731        | 731   | 731    | 17.5   | 731   | 0.0  | 736↑   | 0.0  | 0.7  | 736↑   | 0.1  | 0.7  | 731          | 0.5  | 3    | 0.0  | 731   | 0.4  | 3    | 0.0  |
| 5-50-01-50-10 | 770        | 770   | 770    | 13.8   | 770   | 0.0  | 770    | 0.0  | 0.0  | 770    | 0.3  | 0.0  | 770          | 0.3  | 1    | 0.0  | 770   | 0.3  | 1    | 0.0  |
| 5-50-01-55-10 | 777        | 777   | 777    | 15.0   | 777   | 0.0  | 777    | 0.0  | 0.0  | 777    | 0.1  | 0.0  | 777          | 0.1  | 1    | 0.0  | 777   | 0.1  | 1    | 0.0  |
| 5-60-01-45-10 | 874        | 874   | 874    | 10.4   | 874   | 0.0  | 874    | 0.0  | 0.0  | 874    | 0.2  | 0.0  | 874          | 0.2  | 1    | 0.0  | 874   | 0.2  | 1    | 0.0  |
| 5-60-01-50-10 | 924        | 924   | 924    | 1507.5 | 915   | 0.0  | 924    | 0.0  | 0.0  | 932↑   | 0.6  | 0.9  | 924          | 1.6  | 3    | 0.0  | 924   | 1.6  | 3    | 0.0  |
| 5-60-01-55-10 | 931        | 931   | 931    | 0.2    | 918   | 0.0  | 931    | 0.0  | 0.0  | 931    | 0.3  | 0.0  | 931          | 0.3  | 1    | 0.0  | 931   | 0.3  | 1    | 0.0  |
| 5-70-01-45-10 | 986        | 986   | 986    | 3090.7 | 932   | 0.0  | 991↑   | 0.0  | 0.5  | 993↑   | 0.7  | 0.7  | 986          | 1.2  | 2    | 0.0  | 986   | 1.3  | 2    | 0.0  |
| 5-70-01-50-10 | 1012       | 1012  | 1012   | 0.4    | 955   | 0.0  | 1012   | 0.0  | 0.0  | 1012   | 0.1  | 0.0  | 1012         | 0.1  | 1    | 0.0  | 1012  | 0.1  | 1    | 0.0  |
| 5-70-01-55-10 | 1034       | 1034  | 1045↑  | 1689.8 | 979   | 1.1  | 1034   | 0.0  | 0.0  | 1034   | 0.3  | 0.0  | 1034         | 0.3  | 1    | 0.0  | 1034  | 0.3  | 1    | 0.0  |
| 5-50-01-45-20 | 1566       | 1566  | 1566   | 308.1  | 1566  | 0.0  | 1566   | 0.0  | 0.0  | 1566   | 0.1  | 0.0  | 1566         | 0.1  | 1    | 0.0  | 1566  | 0.1  | 1    | 0.0  |
| 5-50-01-50-20 | 1688       | 1688  | 1688   | 2452.4 | 1688  | 0.0  | 1705↑  | 0.0  | 1.0  | 1705↑  | 0.3  | 1.0  | 1688         | 1.5  | 5    | 0.0  | 1688  | 1.5  | 5    | 0.0  |
| 5-50-01-55-20 | 1726       | 1726  | 1726   | 1534.3 | 1687  | 0.0  | 1726   | 0.0  | 0.0  | 1726   | 0.2  | 0.0  | 1726         | 0.2  | 1    | 0.0  | 1726  | 0.2  | 1    | 0.0  |
| 5-60-01-45-20 | 1951       | 1951  | 1955↑  | 2475.6 | 1833  | 0.2  | 1960↑  | 0.0  | 0.5  | 1951   | 0.4  | 0.0  | 1951         | 0.4  | 1    | 0.0  | 1951  | 0.4  | 1    | 0.0  |
| 5-60-01-50-20 | 2073       | 2073  | 2073   | 410.3  | 1908  | 0.0  | 2086↑  | 0.0  | 0.6  | 2086↑  | 0.4  | 0.6  | 2073         | 0.7  | 2    | 0.0  | 2073  | 0.7  | 2    | 0.0  |
| 5-60-01-55-20 | 2142       | 2142  | 2179↑  | 1050.6 | 1959  | 1.7  | 2179↑  | 0.0  | 1.7  | 2142   | 0.4  | 0.0  | 2142         | 0.4  | 1    | 0.0  | 2142  | 0.4  | 1    | 0.0  |
| 5-70-01-45-20 | 2225       | 2225  | 2253↑  | 2212.9 | 2069  | 1.2  | 2236↑  | 0.0  | 0.5  | 2225   | 0.2  | 0.0  | 2225         | 0.2  | 1    | 0.0  | 2225  | 0.2  | 1    | 0.0  |
| 5-70-01-50-20 | 1951       | 2385  | 2428↑  | 2862.4 | 2134  | 12.1 | 2401↑  | 0.0  | 11.1 | 2399↑  | 0.3  | 11.0 | <b>2384↓</b> | 0.7  | 2    | 10.5 | 2385  | 0.7  | 2    | 10.5 |
| 5-70-01-55-20 | 1917       | 2524  | 2543↑  | 0.4    | 2150  | 15.5 | 2524   | 0.0  | 14.8 | 2524   | 0.8  | 14.8 | 2524         | 0.8  | 1    | 14.8 | 2524  | 0.8  | 1    | 14.8 |
| 5-50-01-45-30 | 2251       | 2251  | 2251   | 912.2  | 2167  | 0.0  | 2251   | 0.0  | 0.0  | 2251   | 0.2  | 0.0  | 2251         | 0.2  | 1    | 0.0  | 2251  | 0.2  | 1    | 0.0  |
| 5-50-01-50-30 | 2200       | 2200  | 2200   | 8.3    | 2147  | 0.0  | 2200   | 0.0  | 0.0  | 2200   | 0.1  | 0.0  | 2200         | 0.1  | 1    | 0.0  | 2200  | 0.1  | 1    | 0.0  |
| 5-50-01-55-30 | 2087       | 2087  | 2087   | 11.7   | 2087  | 0.0  | 2087   | 0.0  | 0.0  | 2087   | 0.1  | 0.0  | 2087         | 0.1  | 1    | 0.0  | 2087  | 0.1  | 1    | 0.0  |
| 5-60-01-45-30 | 2768       | 2768  | 2768   | 987.6  | 2510  | 0.0  | 2768   | 0.0  | 0.0  | 2768   | 0.3  | 0.0  | 2768         | 0.3  | 1    | 0.0  | 2768  | 0.3  | 1    | 0.0  |
| 5-60-01-50-30 | 2752       | 2752  | 2782↑  | 800.4  | 2468  | 1.1  | 2752   | 0.0  | 0.0  | 2752   | 0.3  | 0.0  | 2752         | 0.3  | 1    | 0.0  | 2752  | 0.3  | 1    | 0.0  |
| 5-60-01-55-30 | 2657       | 2657  | 2657   | 843.2  | 2421  | 0.0  | 2657   | 0.0  | 0.0  | 2657   | 0.2  | 0.0  | 2657         | 0.2  | 1    | 0.0  | 2657  | 0.2  | 1    | 0.0  |
| 5-70-01-45-30 | 2621       | 3450  | 3520↑  | 2064.9 | 2931  | 16.7 | 3450   | 0.0  | 15.0 | 3450   | 0.5  | 15.0 | 3450         | 0.5  | 1    | 15.0 | 3450  | 0.5  | 1    | 15.0 |
| 5-70-01-50-30 | 2587       | 3287  | 3414↑  | 910.9  | 2926  | 14.3 | 3415↑  | 0.0  | 14.3 | 3415↑  | 0.4  | 14.3 | 3406↑        | 0.8  | 2    | 14.1 | 3406↑ | 0.8  | 2    | 14.1 |
| 5-70-01-55-30 | 2590       | 3303  | 3387↑  | 0.3    | 2860  | 15.6 | 3303   | 0.0  | 13.4 | 3303   | 0.2  | 13.4 | 3303         | 0.2  | 1    | 13.4 | 3303  | 0.2  | 1    | 13.4 |
| 5-50-10-45-10 | 3322       | 3322  | 3322   | 0.7    | 3322  | 0.0  | 3461↑  | 0.0  | 4.0  | 3322   | 0.1  | 0.0  | 3322         | 0.1  | 1    | 0.0  | 3322  | 0.1  | 1    | 0.0  |
| 5-50-10-50-10 | 3358       | 3358  | 3358   | 0.5    | 3358  | 0.0  | 3358   | 0.0  | 0.0  | 3374↑  | 0.0  | 0.5  | 3358         | 0.1  | 2    | 0.0  | 3358  | 0.1  | 2    | 0.0  |
| 5-50-10-55-10 | 3494       | 3494  | 3494   | 0.7    | 3494  | 0.0  | 3494   | 0.0  | 0.0  | 3494   | 0.0  | 0.0  | 3494         | 0.0  | 1    | 0.0  | 3494  | 0.0  | 1    | 0.0  |
| 5-60-10-45-10 | 3458       | 3458  | 3458   | 0.3    | 3458  | 0.0  | 3461↑  | 0.0  | 0.1  | 3461↑  | 0.0  | 0.1  | 3458         | 0.1  | 2    | 0.0  | 3458  | 0.1  | 2    | 0.0  |
| 5-60-10-50-10 | 3685       | 3685  | 3685   | 1.6    | 3685  | 0.0  | 3816↑  | 0.0  | 0.0  | 3815↑  | 0.1  | 3.4  | 3685         | 0.3  | 3    | 0.0  | 3685  | 0.3  | 3    | 0.0  |
| 5-60-10-55-10 | 3797       | 3797  | 3797   | 1.2    | 3797  | 0.0  | 3797   | 0.0  | 0.0  | 3851↑  | 0.1  | 1.4  | 3797         | 0.1  | 2    | 0.0  | 3797  | 0.1  | 2    | 0.0  |
| 5-70-10-45-10 | 4431       | 4431  | 4431   | 6.5    | 4431  | 0.0  | 4431   | 0.0  | 0.0  | 4431   | 0.1  | 0.0  | 4431         | 0.1  | 1    | 0.0  | 4431  | 0.1  | 1    | 0.0  |
| 5-70-10-50-10 | 4575       | 4575  | 4575   | 8.2    | 4575  | 0.0  | 4575   | 0.0  | 0.0  | 4575   | 0.1  | 0.0  | 4575         | 0.1  | 1    | 0.0  | 4575  | 0.1  | 1    | 0.0  |
| 5-70-10-55-10 | 5061       | 5061  | 5061   | 3.4    | 5061  | 0.0  | 5061   | 0.0  | 0.0  | 5071↑  | 0.1  | 0.2  | 5061         | 0.3  | 3    | 0.0  | 5061  | 0.3  | 3    | 0.0  |
| 5-50-10-45-20 | 7664       | 7664  | 7664   | 0.5    | 7664  | 0.0  | 7664   | 0.0  | 0.0  | 7664   | 0.0  | 0.0  | 7664         | 0.0  | 1    | 0.0  | 7664  | 0.0  | 1    | 0.0  |
| 5-50-10-50-20 | 8764       | 8764  | 8764   | 1.4    | 8764  | 0.0  | 8764   | 0.0  | 0.0  | 8764   | 0.1  | 0.0  | 8764         | 0.1  | 1    | 0.0  | 8764  | 0.1  | 1    | 0.0  |
| 5-50-10-55-20 | 9369       | 9369  | 9369   | 3.5    | 9369  | 0.0  | 9391↑  | 0.0  | 0.0  | 9369   | 0.1  | 0.0  | 9369         | 0.1  | 1    | 0.0  | 9369  | 0.1  | 1    | 0.0  |
| 5-60-10-45-20 | 8020       | 8020  | 8020   | 0.3    | 8020  | 0.0  | 8020   | 0.0  | 0.0  | 8020   | 0.0  | 0.0  | 8020         | 0.0  | 1    | 0.0  | 8020  | 0.0  | 1    | 0.0  |
| 5-60-10-50-20 | 8730       | 8730  | 8730   | 0.3    | 8730  | 0.0  | 8730   | 0.0  | 0.0  | 8730   | 0.0  | 0.0  | 8730         | 0.0  | 1    | 0.0  | 8730  | 0.0  | 1    | 0.0  |
| 5-60-10-55-20 | 9873       | 9873  | 9873   | 0.5    | 9873  | 0.0  | 9932↑  | 0.0  | 0.6  | 9932↑  | 0.1  | 0.6  | 9873         | 0.2  | 2    | 0.0  | 9873  | 0.1  | 2    | 0.0  |
| 5-70-10-45-20 | 11891      | 11891 | 11891  | 0.5    | 11891 | 0.0  | 11891  | 0.0  | 0.0  | 11891  | 0.1  | 0.0  | 11891        | 0.1  | 1    | 0.0  | 11891 | 0.1  | 1    | 0.0  |
| 5-70-10-50-20 | 13582      | 13582 | 13582  | 54.5   | 13582 | 0.0  | 13582  | 0.0  | 0.0  | 13582  | 0.1  | 0.0  | 13582        | 0.1  | 1    | 0.0  | 13582 | 0.1  | 1    | 0.0  |
| 5-70-10-55-20 | 14862      | 14862 | 14862  | 240.5  | 14862 | 0.0  | 14897↑ | 0.0  | 0.2  | 14897↑ | 0.3  | 0.2  | 14862        | 1.0  | 3    | 0.0  | 14862 | 1.1  | 3    | 0.0  |
| 5-50-10-45-30 | 16984      | 16984 | 16984  | 28.2   | 16984 | 0.0  | 17216↑ | 0.0  | 1.3  | 16984  | 0.1  | 0.0  | 16984        | 0.1  | 1    | 0.0  | 16984 | 0.1  | 1    | 0.0  |
| 5-50-10-50-30 | 17680      | 17680 | 17680  | 21.2   | 17680 | 0.0  | 17680  | 0.0  | 0.0  | 17680  | 0.1  | 0.0  | 17680        | 0.1  | 1    | 0.0  | 17680 | 0.1  | 1    | 0.0  |
| 5-50-10-55-30 | 17894      | 17894 | 17894  | 40.5   | 17894 | 0.0  | 17985↑ | 0.0  | 0.5  | 17985↑ | 0.0  | 0.5  | 17894        | 0.1  | 2    | 0.0  | 17894 | 0.1  | 2    | 0.0  |
| 5-60-10-45-30 | 18381      | 18381 | 18381  | 127.9  | 18381 | 0.0  | 18396↑ | 0.0  | 0.1  | 18396↑ | 0.1  | 0.1  | 18381        | 0.2  | 2    | 0.0  | 18381 | 0.2  | 2    | 0.0  |
| 5-60-10-50-30 | 19414      | 19414 | 19414  | 10.9   | 19414 | 0.0  | 19414  | 0.0  | 0.0  | 19414  | 0.1  | 0.0  | 19414        | 0.1  | 1    | 0.0  | 19414 | 0.1  | 1    | 0.0  |
| 5-60-10-55-30 | 19884      | 19884 | 19884  | 697.2  | 19884 | 0.0  | 20066↑ | 0.0  | 0.9  | 19884  | 0.1  | 0.0  | 19884        | 0.1  | 1    | 0.0  | 19884 | 0.1  | 1    | 0.0  |
| 5-70-10-45-30 | 24536      | 24536 | 24536  | 3178.1 | 23694 | 0.0  | 24716↑ | 0.0  | 0.7  | 24536  | 0.1  | 0.0  | 24536        | 0.1  | 1    | 0.0  | 24536 | 0.1  | 1    | 0.0  |
| 5-70-10-50-30 | 26382      | 26382 | 26390↑ | 0.3    | 24549 | 0.0  | 26390↑ | 0.0  | 0.0  | 26382  | 0.3  | 0.0  | 26382        | 0.3  | 1    | 0.0  | 26382 | 0.3  | 1    | 0.0  |
| 5-70-10-55-30 | 27692      | 27692 | 28295↑ | 0.4    | 24866 | 2.1  | 27692  | 0.0  | 0.0  | 27692  | 0.3  | 0.0  | 27692        | 0.3  | 1    | 0.0  | 27692 | 0.3  | 1    | 0.0  |

**Table EC.9** MMR-KP results for type-6 instances

| instance      | Best Known |       | B&C    |        |       |      | Fix    |      |      | DS     |      |      | iDS-H  |       |      |      | iDS-B  |      |           |      |
|---------------|------------|-------|--------|--------|-------|------|--------|------|------|--------|------|------|--------|-------|------|------|--------|------|-----------|------|
|               | LB         | UB    | obj    | time   | LB    | %gap | obj    | time | %gap | obj    | time | %gap | obj    | time  | iter | %gap | obj    | time | iter      | %gap |
| 6-50-01-45-10 | 760        | 760   | 768↑   | 18.0   | 724   | 1.0  | 760    | 0.0  | 0.0  | 765↑   | 0.1  | 0.7  | 760    | 0.2   | 2    | 0.0  | 760    | 0.2  | 2         | 0.0  |
| 6-50-01-50-10 | 740        | 740   | 740    | 1655.6 | 724   | 0.0  | 740    | 0.0  | 0.0  | 740    | 0.1  | 0.0  | 740    | 0.1   | 1    | 0.0  | 740    | 0.1  | 1         | 0.0  |
| 6-50-01-55-10 | 743        | 743   | 746↑   | 2584.8 | 718   | 0.4  | 743    | 0.0  | 0.0  | 743    | 0.1  | 0.0  | 743    | 0.1   | 1    | 0.0  | 743    | 0.1  | 1         | 0.0  |
| 6-60-01-45-10 | 775        | 991   | 995↑   | 491.9  | 877   | 11.9 | 991    | 0.0  | 11.5 | 991    | 0.1  | 11.5 | 991    | 0.1   | 1    | 11.5 | 991    | 0.1  | 1         | 11.5 |
| 6-60-01-50-10 | 775        | 998   | 1001↑  | 642.1  | 879   | 12.2 | 999↑   | 0.0  | 12.0 | 999↑   | 0.1  | 12.0 | 998    | 0.5   | 3    | 11.9 | 998    | 0.5  | 3         | 11.9 |
| 6-60-01-55-10 | 780        | 1005  | 1014↑  | 2276.1 | 876   | 13.6 | 1005   | 0.0  | 12.8 | 1005   | 0.2  | 12.8 | 1005   | 0.2   | 1    | 12.8 | 1005   | 0.2  | 1         | 12.8 |
| 6-70-01-45-10 | 828        | 1090  | 1093↑  | 788.7  | 918   | 16.0 | 1093↑  | 0.0  | 16.0 | 1090   | 0.4  | 15.8 | 1090   | 0.4   | 1    | 15.8 | 1090   | 0.4  | 1         | 15.8 |
| 6-70-01-50-10 | 829        | 1109  | 1112↑  | 842.0  | 929   | 16.5 | 1109   | 0.0  | 16.2 | 1109   | 0.4  | 16.2 | 1109   | 0.4   | 1    | 16.2 | 1109   | 0.4  | 1         | 16.2 |
| 6-70-01-55-10 | 828        | 1117  | 1119↑  | 822.8  | 928   | 17.1 | 1117   | 0.0  | 16.9 | 1117   | 0.4  | 16.9 | 1117   | 0.4   | 1    | 16.9 | 1117   | 0.4  | 1         | 16.9 |
| 6-50-01-45-20 | 1691       | 1691  | 1702↑  | 597.4  | 1523  | 0.6  | 1698↑  | 0.0  | 0.4  | 1698↑  | 0.4  | 0.4  | 1691   | 2.5   | 9    | 0.0  | 1691   | 1.3  | <b>5</b>  | 0.0  |
| 6-50-01-50-20 | 1705       | 1705  | 1705   | 747.4  | 1536  | 0.0  | 1707↑  | 0.0  | 0.1  | 1705   | 0.2  | 0.0  | 1705   | 0.2   | 1    | 0.0  | 1705   | 0.2  | 1         | 0.0  |
| 6-50-01-55-20 | 1706       | 1706  | 1707↑  | 616.9  | 1547  | 0.1  | 1706   | 0.0  | 0.0  | 1706   | 0.3  | 0.0  | 1706   | 0.3   | 1    | 0.0  | 1706   | 0.3  | 1         | 0.0  |
| 6-60-01-45-20 | 1626       | 2213  | 2238↑  | 1055.5 | 1779  | 20.5 | 2213   | 0.0  | 19.6 | 2213   | 0.4  | 19.6 | 2213   | 0.4   | 1    | 19.6 | 2213   | 0.4  | 1         | 19.6 |
| 6-60-01-50-20 | 1638       | 2240  | 2240   | 1940.4 | 1817  | 18.9 | 2240   | 0.0  | 18.9 | 2240   | 0.5  | 18.9 | 2240   | 0.5   | 1    | 18.9 | 2240   | 0.5  | 1         | 18.9 |
| 6-60-01-55-20 | 1634       | 2245  | 2245   | 803.4  | 1824  | 18.8 | 2251↑  | 0.0  | 19.0 | 2245   | 0.5  | 18.8 | 2245   | 0.5   | 1    | 18.8 | 2245   | 0.5  | 1         | 18.8 |
| 6-70-01-45-20 | 1795       | 2556  | 2570↑  | 879.8  | 1983  | 22.8 | 2554↓  | 0.0  | 22.4 | 2556   | 0.8  | 22.4 | 2554↓  | 1.7   | 2    | 22.4 | 2554↓  | 1.8  | 2         | 22.4 |
| 6-70-01-50-20 | 1818       | 2597  | 2599↑  | 1279.2 | 1977  | 23.9 | 2597   | 0.0  | 23.9 | 2597   | 0.8  | 23.9 | 2597   | 0.8   | 1    | 23.9 | 2597   | 0.8  | 1         | 23.9 |
| 6-70-01-55-20 | 1818       | 2601  | 2601   | 914.7  | 1967  | 24.4 | 2601   | 0.0  | 24.4 | 2601   | 0.9  | 24.4 | 2601   | 0.9   | 1    | 24.4 | 2601   | 0.9  | 1         | 24.4 |
| 6-50-01-45-30 | 2559       | 2559  | 2559   | 944.5  | 2428  | 0.0  | 2559   | 0.0  | 0.0  | 2559   | 0.2  | 0.0  | 2559   | 0.2   | 1    | 0.0  | 2559   | 0.2  | 1         | 0.0  |
| 6-50-01-50-30 | 2560       | 2560  | 2590↑  | 650.2  | 2402  | 1.2  | 2560   | 0.0  | 0.0  | 2560   | 0.1  | 0.0  | 2560   | 0.1   | 1    | 0.0  | 2560   | 0.1  | 1         | 0.0  |
| 6-50-01-55-30 | 2535       | 2535  | 2535   | 729.2  | 2405  | 0.0  | 2544↑  | 0.0  | 0.4  | 2535   | 0.3  | 0.0  | 2535   | 0.3   | 1    | 0.0  | 2535   | 0.3  | 1         | 0.0  |
| 6-60-01-45-30 | 2434       | 3157  | 3159↑  | 849.8  | 2707  | 14.3 | 3159↑  | 0.0  | 14.3 | 3159↑  | 0.5  | 14.3 | 3157   | 1.1   | 2    | 14.3 | 3157   | 1.1  | 2         | 14.3 |
| 6-60-01-50-30 | 2437       | 3175  | 3175   | 753.8  | 2727  | 14.1 | 3175   | 0.0  | 14.1 | 3175   | 0.3  | 14.1 | 3175   | 0.3   | 1    | 14.1 | 3175   | 0.3  | 1         | 14.1 |
| 6-60-01-55-30 | 2426       | 3163  | 3194↑  | 704.5  | 2665  | 16.6 | 3163   | 0.0  | 15.7 | 3163   | 0.4  | 15.7 | 3163   | 0.4   | 1    | 15.7 | 3163   | 0.4  | 1         | 15.7 |
| 6-70-01-45-30 | 2587       | 3481  | 3492↑  | 989.0  | 2881  | 17.5 | 3481   | 0.0  | 17.2 | 3481   | 0.7  | 17.2 | 3481   | 0.7   | 1    | 17.2 | 3481   | 0.7  | 1         | 17.2 |
| 6-70-01-50-30 | 2598       | 3501  | 3505↑  | 873.8  | 2847  | 18.8 | 3501   | 0.0  | 18.7 | 3501   | 0.4  | 18.7 | 3501   | 0.4   | 1    | 18.7 | 3501   | 0.4  | 1         | 18.7 |
| 6-70-01-55-30 | 2577       | 3477  | 3487↑  | 901.5  | 2782  | 20.2 | 3478↑  | 0.0  | 20.0 | 3478↑  | 0.6  | 20.0 | 3475↓  | 1.6   | 3    | 19.9 | 3475↓  | 1.1  | <b>2</b>  | 19.9 |
| 6-50-10-45-10 | 7851       | 7851  | 7851   | 1406.5 | 7409  | 0.0  | 7851   | 0.0  | 0.0  | 7851   | 0.3  | 0.0  | 7851   | 0.3   | 1    | 0.0  | 7851   | 0.3  | 1         | 0.0  |
| 6-50-10-50-10 | 7904       | 7904  | 7962↑  | 572.3  | 7200  | 0.0  | 7919↑  | 0.0  | 0.0  | 7904   | 0.7  | 0.0  | 7904   | 0.7   | 1    | 0.0  | 7904   | 0.7  | 1         | 0.0  |
| 6-50-10-55-10 | 7589       | 7589  | 7652↑  | 1989.8 | 7222  | 0.0  | 7603↑  | 0.0  | 0.0  | 7597↑  | 0.2  | 0.1  | 7589   | 2.6   | 9    | 0.0  | 7589   | 1.6  | <b>5</b>  | 0.0  |
| 6-60-10-45-10 | 7604       | 9667  | 9667   | 3340.4 | 8379  | 13.3 | 9667   | 0.0  | 13.3 | 9667   | 0.4  | 13.3 | 9667   | 0.4   | 1    | 13.3 | 9667   | 0.4  | 1         | 13.3 |
| 6-60-10-50-10 | 7574       | 9774  | 9797↑  | 1179.7 | 8293  | 0.0  | 9774   | 0.0  | 0.0  | 9774   | 0.6  | 15.2 | 9774   | 0.6   | 1    | 15.2 | 9774   | 0.6  | 1         | 15.2 |
| 6-60-10-55-10 | 9441       | 9441  | 9539↑  | 589.5  | 8280  | 1.0  | 9462↑  | 0.0  | 0.2  | 9462↑  | 0.6  | 0.2  | 9441   | 1.1   | 2    | 0.0  | 9441   | 1.1  | 2         | 0.0  |
| 6-70-10-45-10 | 8217       | 11060 | 11139↑ | 742.8  | 8998  | 19.2 | 11078↑ | 0.0  | 18.8 | 11060  | 1.9  | 18.6 | 11060  | 1.9   | 1    | 18.6 | 11060  | 1.9  | 1         | 18.6 |
| 6-70-10-50-10 | 8197       | 11054 | 11054  | 717.7  | 8852  | 19.9 | 11054  | 0.0  | 19.9 | 11054  | 1.0  | 19.9 | 11054  | 1.0   | 1    | 19.9 | 11054  | 1.0  | 1         | 19.9 |
| 6-70-10-55-10 | 8081       | 10722 | 10851↑ | 864.9  | 8720  | 19.6 | 10722  | 0.0  | 18.7 | 10722  | 0.9  | 18.7 | 10722  | 0.9   | 1    | 18.7 | 10722  | 0.9  | 1         | 18.7 |
| 6-50-10-45-20 | 12921      | 12921 | 12921  | 2351.7 | 12545 | 0.0  | 12993↑ | 0.0  | 0.6  | 12921  | 0.1  | 0.0  | 12921  | 0.1   | 1    | 0.0  | 12921  | 0.1  | 1         | 0.0  |
| 6-50-10-50-20 | 13240      | 13240 | 13262↑ | 2212.7 | 12664 | 0.2  | 13250↑ | 0.0  | 0.1  | 13250↑ | 0.2  | 0.1  | 13240  | 1.0   | 4    | 0.0  | 13240  | 0.8  | <b>3</b>  | 0.0  |
| 6-50-10-55-20 | 13070      | 13070 | 13136↑ | 2617.6 | 12603 | 0.0  | 13120↑ | 0.0  | 0.0  | 13112↑ | 0.2  | 0.3  | 13070  | 197.3 | 190  | 0.0  | 13070  | 89.6 | <b>98</b> | 0.0  |
| 6-60-10-45-20 | 16849      | 16849 | 16878↑ | 596.7  | 15032 | 0.2  | 16878↑ | 0.0  | 0.2  | 16878↑ | 0.4  | 0.2  | 16849  | 3.2   | 9    | 0.0  | 16849  | 1.8  | <b>5</b>  | 0.0  |
| 6-60-10-50-20 | 13556      | 17333 | 17376↑ | 971.1  | 15177 | 12.7 | 17348↑ | 0.0  | 12.5 | 17348↑ | 0.5  | 12.5 | 17333  | 8.5   | 15   | 12.4 | 17333  | 4.3  | <b>8</b>  | 12.4 |
| 6-60-10-55-20 | 17123      | 17123 | 17191↑ | 754.9  | 14929 | 0.4  | 17123  | 0.0  | 0.0  | 17148↑ | 0.4  | 0.1  | 17123  | 1.1   | 3    | 0.0  | 17123  | 0.7  | <b>2</b>  | 0.0  |
| 6-70-10-45-20 | 14104      | 18673 | 18711↑ | 816.7  | 15576 | 16.8 | 18697↑ | 0.0  | 16.7 | 18686↑ | 0.6  | 16.6 | 18673  | 6.7   | 10   | 16.6 | 18673  | 3.9  | <b>6</b>  | 16.6 |
| 6-70-10-50-20 | 14151      | 18890 | 18917↑ | 919.5  | 15433 | 18.4 | 18959↑ | 0.0  | 18.6 | 18890  | 0.6  | 18.3 | 18890  | 0.6   | 1    | 18.3 | 18890  | 0.6  | 1         | 18.3 |
| 6-70-10-55-20 | 14070      | 18668 | 18712↑ | 792.5  | 15460 | 17.4 | 18759↑ | 0.0  | 17.6 | 18671↑ | 0.3  | 17.2 | 18652↓ | 32.3  | 44   | 17.1 | 18652↓ | 18.7 | <b>25</b> | 17.1 |
| 6-50-10-45-30 | 23190      | 23190 | 23277↑ | 1475.4 | 21460 | 0.4  | 23277↑ | 0.0  | 0.4  | 23190  | 0.2  | 0.0  | 23190  | 0.2   | 1    | 0.0  | 23190  | 0.2  | 1         | 0.0  |
| 6-50-10-50-30 | 24190      | 24190 | 24190  | 720.7  | 21943 | 0.0  | 24190  | 0.0  | 0.0  | 24190  | 0.3  | 0.0  | 24190  | 0.3   | 1    | 0.0  | 24190  | 0.3  | 1         | 0.0  |
| 6-50-10-55-30 | 24324      | 24324 | 24324  | 815.3  | 22058 | 0.0  | 24324  | 0.0  | 0.0  | 24324  | 0.3  | 0.0  | 24324  | 0.3   | 1    | 0.0  | 24324  | 0.3  | 1         | 0.0  |
| 6-60-10-45-30 | 21122      | 27417 | 27785↑ | 1284.2 | 23081 | 16.9 | 27518↑ | 0.0  | 16.1 | 27417  | 0.4  | 15.8 | 27417  | 0.4   | 1    | 15.8 | 27417  | 0.4  | 1         | 15.8 |
| 6-60-10-50-30 | 21364      | 28524 | 28649↑ | 584.5  | 23463 | 18.1 | 28524  | 0.0  | 17.7 | 28524  | 0.5  | 17.7 | 28524  | 0.5   | 1    | 17.7 | 28524  | 0.5  | 1         | 17.7 |
| 6-60-10-55-30 | 21371      | 28476 | 28553↑ | 850.8  | 23479 | 17.8 | 28476  | 0.0  | 17.5 | 28476  | 0.5  | 17.5 | 28476  | 0.5   | 1    | 17.5 | 28476  | 0.5  | 1         | 17.5 |
| 6-70-10-45-30 | 22925      | 31130 | 31460↑ | 683.6  | 25231 | 19.8 | 31301↑ | 0.0  | 19.4 | 31130  | 0.5  | 18.9 | 31130  | 0.5   | 1    | 18.9 | 31130  | 0.5  | 1         | 18.9 |
| 6-70-10-50-30 | 23305      | 32207 | 32207  | 892.7  | 25627 | 20.4 | 32230↑ | 0.0  | 20.5 | 32230↑ | 0.6  | 20.5 | 32207  | 1.6   | 2    | 20.4 | 32207  | 1.8  | 2         | 20.4 |
| 6-70-10-55-30 | 23164      | 32067 | 32111↑ | 875.2  | 25455 | 20.7 | 32067  | 0.0  | 20.6 | 32067  | 0.5  | 20.6 | 32067  | 0.5   | 1    | 20.6 | 32067  | 0.5  | 1         | 20.6 |

**Table EC.10** MMR-KP results for type-7 instances

| instance      | Best Known |       | B&C    |        |       |      | Fix    |      |      | DS     |      |      | iDS-H  |       |          |      | iDS-B  |       |           |      |
|---------------|------------|-------|--------|--------|-------|------|--------|------|------|--------|------|------|--------|-------|----------|------|--------|-------|-----------|------|
|               | LB         | UB    | obj    | time   | LB    | %gap | obj    | time | %gap | obj    | time | %gap | obj    | time  | iter     | %gap | obj    | time  | iter      | %gap |
| 7-50-01-45-10 | 833        | 833   | 833    | 870.8  | 786   | 0.0  | 833    | 0.0  | 0.0  | 833    | 0.2  | 0.0  | 833    | 0.2   | 1        | 0.0  | 833    | 0.2   | 1         | 0.0  |
| 7-50-01-50-10 | 810        | 810   | 810    | 2864.5 | 773   | 0.0  | 810    | 0.0  | 0.0  | 810    | 0.1  | 0.0  | 810    | 0.1   | 1        | 0.0  | 810    | 0.1   | 1         | 0.0  |
| 7-50-01-55-10 | 803        | 803   | 809↑   | 1961.9 | 774   | 0.7  | 803    | 0.0  | 0.0  | 803    | 0.1  | 0.0  | 803    | 0.1   | 1        | 0.0  | 803    | 0.1   | 1         | 0.0  |
| 7-60-01-45-10 | 820        | 1061  | 1066↑  | 994.2  | 923   | 13.4 | 1061   | 0.0  | 13.0 | 1061   | 0.4  | 13.0 | 1061   | 0.4   | 1        | 13.0 | 1061   | 0.4   | 1         | 13.0 |
| 7-60-01-50-10 | 820        | 1073  | 1073   | 617.7  | 927   | 13.6 | 1073   | 0.0  | 13.6 | 1073   | 0.3  | 13.6 | 1073   | 0.3   | 1        | 13.6 | 1073   | 0.3   | 1         | 13.6 |
| 7-60-01-55-10 | 816        | 1072  | 1080↑  | 576.7  | 912   | 15.6 | 1072   | 0.0  | 14.9 | 1072   | 0.3  | 14.9 | 1072   | 0.3   | 1        | 14.9 | 1072   | 0.3   | 1         | 14.9 |
| 7-70-01-45-10 | 868        | 1157  | 1157   | 609.8  | 968   | 16.3 | 1157   | 0.0  | 16.3 | 1157   | 0.4  | 16.3 | 1157   | 0.4   | 1        | 16.3 | 1157   | 0.4   | 1         | 16.3 |
| 7-70-01-50-10 | 869        | 1179  | 1184↑  | 945.7  | 977   | 17.5 | 1179   | 0.0  | 17.1 | 1179   | 0.4  | 17.1 | 1179   | 0.4   | 1        | 17.1 | 1179   | 0.4   | 1         | 17.1 |
| 7-70-01-55-10 | 868        | 1183  | 1183   | 854.0  | 959   | 18.9 | 1185↑  | 0.0  | 19.1 | 1185↑  | 0.4  | 19.1 | 1183   | 1.3   | 3        | 18.9 | 1183   | 1.2   | 3         | 18.9 |
| 7-50-01-45-20 | 1661       | 1661  | 1670↑  | 954.3  | 1549  | 0.5  | 1669↑  | 0.0  | 0.5  | 1669↑  | 0.3  | 0.5  | 1661   | 0.8   | 3        | 0.0  | 1661   | 0.8   | 3         | 0.0  |
| 7-50-01-50-20 | 1679       | 1679  | 1682↑  | 626.0  | 1557  | 0.2  | 1683↑  | 0.0  | 0.2  | 1679   | 0.2  | 0.0  | 1679   | 0.2   | 1        | 0.0  | 1679   | 0.2   | 1         | 0.0  |
| 7-50-01-55-20 | 1674       | 1674  | 1674   | 703.7  | 1566  | 0.0  | 1674   | 0.0  | 0.0  | 1674   | 0.2  | 0.0  | 1674   | 0.2   | 1        | 0.0  | 1674   | 0.2   | 1         | 0.0  |
| 7-60-01-45-20 | 1635       | 2193  | 2197↑  | 789.9  | 1819  | 17.2 | 2197↑  | 0.0  | 17.2 | 2193   | 0.5  | 17.1 | 2193   | 0.5   | 1        | 17.1 | 2193   | 0.5   | 1         | 17.1 |
| 7-60-01-50-20 | 1642       | 2222  | 2228↑  | 830.7  | 1835  | 17.6 | 2223↑  | 0.0  | 17.5 | 2223↑  | 0.5  | 17.5 | 2222   | 1.4   | 3        | 17.4 | 2222   | 1.5   | 3         | 17.4 |
| 7-60-01-55-20 | 1647       | 2220  | 2220   | 786.6  | 1821  | 18.0 | 2220   | 0.0  | 18.0 | 2224↑  | 0.5  | 18.1 | 2220   | 1.0   | 2        | 18.0 | 2220   | 0.9   | 2         | 18.0 |
| 7-70-01-45-20 | 1809       | 2532  | 2536↑  | 839.8  | 2002  | 21.1 | 2537↑  | 0.0  | 21.1 | 2532   | 0.6  | 20.9 | 2532   | 0.6   | 1        | 20.9 | 2532   | 0.6   | 1         | 20.9 |
| 7-70-01-50-20 | 1827       | 2562  | 2562   | 593.5  | 2004  | 21.8 | 2562   | 0.0  | 21.8 | 2562   | 0.8  | 21.8 | 2562   | 0.8   | 1        | 21.8 | 2562   | 0.8   | 1         | 21.8 |
| 7-70-01-55-20 | 1823       | 2578  | 2578   | 1034.7 | 2004  | 22.3 | 2581↑  | 0.0  | 22.4 | 2582↑  | 0.7  | 22.4 | 2578   | 2.0   | 3        | 22.3 | 2578   | 2.1   | 3         | 22.3 |
| 7-50-01-45-30 | 2346       | 2346  | 2346   | 693.5  | 2254  | 0.0  | 2346   | 0.0  | 0.0  | 2346   | 0.1  | 0.0  | 2346   | 0.1   | 1        | 0.0  | 2346   | 0.1   | 1         | 0.0  |
| 7-50-01-50-30 | 2382       | 2382  | 2382   | 930.1  | 2256  | 0.0  | 2382   | 0.0  | 0.0  | 2382   | 0.2  | 0.0  | 2382   | 0.2   | 1        | 0.0  | 2382   | 0.2   | 1         | 0.0  |
| 7-50-01-55-30 | 2385       | 2385  | 2389↑  | 869.1  | 2240  | 0.2  | 2385   | 0.0  | 0.0  | 2389↑  | 0.1  | 0.2  | 2385   | 0.6   | 3        | 0.0  | 2385   | 0.3   | <b>2</b>  | 0.0  |
| 7-60-01-45-30 | 2360       | 3059  | 3069↑  | 692.4  | 2643  | 13.9 | 3073↑  | 0.0  | 14.0 | 3059   | 0.4  | 13.6 | 3059   | 0.4   | 1        | 13.6 | 3059   | 0.4   | 1         | 13.6 |
| 7-60-01-50-30 | 2371       | 3117  | 3118↑  | 954.5  | 2651  | 15.0 | 3118↑  | 0.0  | 15.0 | 3118↑  | 0.4  | 15.0 | 3117   | 2.3   | 6        | 15.0 | 3117   | 1.6   | <b>4</b>  | 15.0 |
| 7-60-01-55-30 | 2368       | 3120  | 3127↑  | 814.5  | 2620  | 16.2 | 3120   | 0.0  | 16.0 | 3120   | 0.3  | 16.0 | 3120   | 0.3   | 1        | 16.0 | 3120   | 0.3   | 1         | 16.0 |
| 7-70-01-45-30 | 2486       | 3326  | 3344↑  | 656.6  | 2766  | 17.3 | 3338↑  | 0.0  | 17.1 | 3326   | 0.5  | 16.8 | 3326   | 0.5   | 1        | 16.8 | 3326   | 0.5   | 1         | 16.8 |
| 7-70-01-50-30 | 2503       | 3399  | 3407↑  | 1070.6 | 2765  | 18.8 | 3399   | 0.0  | 18.7 | 3399   | 0.4  | 18.7 | 3399   | 0.4   | 1        | 18.7 | 3399   | 0.4   | 1         | 18.7 |
| 7-70-01-55-30 | 2496       | 3413  | 3414↑  | 1094.2 | 2704  | 20.8 | 3413   | 0.0  | 20.8 | 3413   | 0.5  | 20.8 | 3412↓  | 0.9   | <b>2</b> | 20.8 | 3412↓  | 2.0   | 4         | 20.8 |
| 7-50-10-45-10 | 7519       | 7519  | 7526↑  | 1574.1 | 7211  | 0.1  | 7530↑  | 0.0  | 0.1  | 7529↑  | 0.3  | 0.1  | 7519   | 2.6   | 9        | 0.0  | 7519   | 2.0   | <b>6</b>  | 0.0  |
| 7-50-10-50-10 | 7600       | 7600  | 7648↑  | 919.6  | 7183  | 0.0  | 7600   | 0.0  | 0.0  | 7600   | 0.3  | 0.0  | 7600   | 0.3   | 1        | 0.0  | 7600   | 0.3   | 1         | 0.0  |
| 7-50-10-55-10 | 7372       | 7372  | 7391↑  | 3360.4 | 7189  | 0.0  | 7377↑  | 0.0  | 0.0  | 7377↑  | 0.3  | 0.1  | 7372   | 0.9   | 3        | 0.0  | 7372   | 0.6   | <b>2</b>  | 0.0  |
| 7-60-10-45-10 | 9335       | 9335  | 9360↑  | 1164.7 | 8322  | 0.3  | 9355↑  | 0.0  | 0.2  | 9335   | 0.4  | 0.0  | 9335   | 0.4   | 1        | 0.0  | 9335   | 0.4   | 1         | 0.0  |
| 7-60-10-50-10 | 9499       | 9499  | 9520↑  | 908.9  | 8299  | 0.0  | 9502↑  | 0.0  | 0.0  | 9499   | 0.7  | 0.0  | 9499   | 0.7   | 1        | 0.0  | 9499   | 0.7   | 1         | 0.0  |
| 7-60-10-55-10 | 9252       | 9252  | 9252   | 920.6  | 8183  | 0.0  | 9322↑  | 0.0  | 0.8  | 9259↑  | 0.4  | 0.1  | 9252   | 1.9   | 5        | 0.0  | 9252   | 1.1   | <b>3</b>  | 0.0  |
| 7-70-10-45-10 | 8082       | 10700 | 10700  | 1153.7 | 8930  | 16.5 | 10719↑ | 0.0  | 16.7 | 10700  | 0.6  | 16.5 | 10698↓ | 2.4   | 3        | 16.5 | 10698↓ | 1.7   | <b>2</b>  | 16.5 |
| 7-70-10-50-10 | 8115       | 10765 | 10765  | 711.0  | 8894  | 17.4 | 10765  | 0.0  | 17.4 | 10765  | 0.6  | 17.4 | 10747↓ | 1.4   | 2        | 17.2 | 10747↓ | 1.4   | 2         | 17.2 |
| 7-70-10-55-10 | 8031       | 10475 | 10518↑ | 700.9  | 8755  | 16.8 | 10475  | 0.0  | 16.4 | 10475  | 0.7  | 16.4 | 10466↓ | 2.2   | 3        | 16.3 | 10466↓ | 1.3   | <b>2</b>  | 16.3 |
| 7-50-10-45-20 | 13464      | 13464 | 13476↑ | 626.5  | 12716 | 0.1  | 13476↑ | 0.0  | 0.1  | 13485↑ | 0.2  | 0.2  | 13464  | 1.3   | 5        | 0.0  | 13464  | 0.8   | <b>3</b>  | 0.0  |
| 7-50-10-50-20 | 13920      | 13920 | 13935↑ | 769.1  | 12823 | 0.1  | 13947↑ | 0.0  | 0.2  | 13920  | 0.5  | 0.0  | 13920  | 0.5   | 1        | 0.0  | 13920  | 0.5   | 1         | 0.0  |
| 7-50-10-55-20 | 13728      | 13728 | 13740↑ | 2092.2 | 12841 | 0.0  | 13728  | 0.0  | 0.0  | 13768↑ | 0.3  | 0.3  | 13728  | 2.9   | 8        | 0.0  | 13728  | 1.9   | <b>5</b>  | 0.0  |
| 7-60-10-45-20 | 13573      | 17262 | 17264↑ | 635.7  | 15037 | 12.9 | 17327↑ | 0.0  | 13.2 | 17287↑ | 0.4  | 13.0 | 17262  | 5.9   | 11       | 12.9 | 17262  | 3.0   | <b>6</b>  | 12.9 |
| 7-60-10-50-20 | 13789      | 17964 | 18028↑ | 2967.7 | 15218 | 15.6 | 17964  | 0.0  | 15.3 | 17964  | 0.7  | 15.3 | 17964  | 0.7   | 1        | 15.3 | 17964  | 0.7   | 1         | 15.3 |
| 7-60-10-55-20 | 13726      | 17776 | 17791↑ | 777.5  | 15217 | 14.5 | 17780↑ | 0.0  | 14.4 | 17798↑ | 0.4  | 14.5 | 17776  | 3.9   | 9        | 14.4 | 17776  | 2.6   | <b>6</b>  | 14.4 |
| 7-70-10-45-20 | 14306      | 19238 | 19334↑ | 787.2  | 15692 | 18.8 | 19301↑ | 0.0  | 18.7 | 19238  | 0.8  | 18.4 | 19238  | 0.8   | 1        | 18.4 | 19238  | 0.8   | 1         | 18.4 |
| 7-70-10-50-20 | 14419      | 19557 | 19644↑ | 957.7  | 15725 | 20.0 | 19557  | 0.0  | 19.6 | 19557  | 0.7  | 19.6 | 19557  | 0.7   | 1        | 19.6 | 19557  | 0.7   | 1         | 19.6 |
| 7-70-10-55-20 | 14359      | 19284 | 19391↑ | 761.6  | 15697 | 19.1 | 19373↑ | 0.0  | 19.0 | 19284  | 0.7  | 18.6 | 19273↓ | 238.0 | 135      | 18.6 | 19273↓ | 146.9 | <b>73</b> | 18.6 |
| 7-50-10-45-30 | 25515      | 25515 | 25676↑ | 635.4  | 23147 | 0.6  | 25682↑ | 0.0  | 0.7  | 25515  | 0.5  | 0.0  | 25515  | 0.5   | 1        | 0.0  | 25515  | 0.5   | 1         | 0.0  |
| 7-50-10-50-30 | 26163      | 26163 | 26163  | 2556.4 | 22904 | 0.0  | 26163  | 0.0  | 0.0  | 26163  | 0.6  | 0.0  | 26163  | 0.6   | 1        | 0.0  | 26163  | 0.6   | 1         | 0.0  |
| 7-50-10-55-30 | 25509      | 25509 | 25803↑ | 851.6  | 22820 | 1.1  | 25509  | 0.0  | 0.0  | 25509  | 0.6  | 0.0  | 25509  | 0.6   | 1        | 0.0  | 25509  | 0.6   | 1         | 0.0  |
| 7-60-10-45-30 | 22821      | 30203 | 30509↑ | 560.1  | 25065 | 17.8 | 30233↑ | 0.0  | 17.1 | 30203  | 0.7  | 17.0 | 30203  | 0.7   | 1        | 17.0 | 30203  | 0.7   | 1         | 17.0 |
| 7-60-10-50-30 | 23026      | 30978 | 30978  | 874.8  | 25343 | 18.2 | 30978  | 0.0  | 18.2 | 30978  | 0.8  | 18.2 | 30978  | 0.8   | 1        | 18.2 | 30978  | 0.8   | 1         | 18.2 |
| 7-60-10-55-30 | 22939      | 30456 | 30456  | 669.5  | 24753 | 18.7 | 30456  | 0.0  | 18.7 | 30456  | 1.1  | 18.7 | 30456  | 1.1   | 1        | 18.7 | 30456  | 1.1   | 1         | 18.7 |
| 7-70-10-45-30 | 24479      | 33427 | 33764↑ | 967.9  | 26783 | 20.7 | 33606↑ | 0.0  | 20.3 | 33427  | 0.9  | 19.9 | 33427  | 0.9   | 1        | 19.9 | 33427  | 0.9   | 1         | 19.9 |
| 7-70-10-50-30 | 24621      | 34350 | 34357↑ | 771.6  | 26956 | 21.5 | 34357↑ | 0.0  | 21.5 | 34357↑ | 0.9  | 21.5 | 34350  | 1.9   | 2        | 21.5 | 34350  | 3.5   | 2         | 21.5 |
| 7-70-10-55-30 | 24364      | 34054 | 34074↑ | 1183.4 | 26171 | 23.2 | 34054  | 0.0  | 23.1 | 34054  | 2.5  | 23.1 | 34054  | 2.5   | 1        | 23.1 | 34054  | 2.5   | 1         | 23.1 |

**Table EC.11** MMR-KP results for type-8 instances

| instance      | Best Known |       | B&C    |        |       |      | Fix    |      |      | DS     |      |      | iDS-H |      |      |      | iDS-B |      |      |      |
|---------------|------------|-------|--------|--------|-------|------|--------|------|------|--------|------|------|-------|------|------|------|-------|------|------|------|
|               | LB         | UB    | obj    | time   | LB    | %gap | obj    | time | %gap | obj    | time | %gap | obj   | time | iter | %gap | obj   | time | iter | %gap |
| 8-50-01-45-10 | 620        | 620   | 620    | 0.2    | 620   | 0.0  | 620    | 0.0  | 0.0  | 620    | 0.1  | 0.0  | 620   | 0.1  | 1    | 0.0  | 620   | 0.1  | 1    | 0.0  |
| 8-50-01-50-10 | 644        | 644   | 644    | 4.4    | 644   | 0.0  | 646↑   | 0.0  | 0.0  | 646↑   | 0.1  | 0.3  | 644   | 0.2  | 3    | 0.0  | 644   | 0.2  | 3    | 0.0  |
| 8-50-01-55-10 | 632        | 632   | 632    | 0.2    | 632   | 0.0  | 634↑   | 0.0  | 0.3  | 634↑   | 0.0  | 0.3  | 632   | 0.1  | 2    | 0.0  | 632   | 0.1  | 2    | 0.0  |
| 8-60-01-45-10 | 782        | 782   | 782    | 26.7   | 782   | 0.0  | 782    | 0.0  | 0.0  | 782    | 0.1  | 0.0  | 782   | 0.1  | 1    | 0.0  | 782   | 0.1  | 1    | 0.0  |
| 8-60-01-50-10 | 815        | 815   | 815    | 30.1   | 815   | 0.0  | 815    | 0.0  | 0.0  | 815    | 0.1  | 0.0  | 815   | 0.1  | 1    | 0.0  | 815   | 0.1  | 1    | 0.0  |
| 8-60-01-55-10 | 847        | 847   | 847    | 193.1  | 847   | 0.0  | 847    | 0.0  | 0.0  | 847    | 0.2  | 0.0  | 847   | 0.2  | 1    | 0.0  | 847   | 0.2  | 1    | 0.0  |
| 8-70-01-45-10 | 884        | 884   | 884    | 100.7  | 884   | 0.0  | 906↑   | 0.0  | 2.4  | 884    | 0.2  | 0.0  | 884   | 0.2  | 1    | 0.0  | 884   | 0.2  | 1    | 0.0  |
| 8-70-01-50-10 | 927        | 927   | 927    | 556.0  | 927   | 0.0  | 929↑   | 0.0  | 0.2  | 927    | 0.3  | 0.0  | 927   | 0.3  | 1    | 0.0  | 927   | 0.3  | 1    | 0.0  |
| 8-70-01-55-10 | 927        | 927   | 927    | 0.3    | 927   | 0.0  | 927    | 0.0  | 0.0  | 927    | 0.1  | 0.0  | 927   | 0.1  | 1    | 0.0  | 927   | 0.1  | 1    | 0.0  |
| 8-50-01-45-20 | 2098       | 2098  | 2098   | 1956.7 | 2021  | 0.0  | 2098   | 0.0  | 0.0  | 2098   | 0.4  | 0.0  | 2098  | 0.4  | 1    | 0.0  | 2098  | 0.4  | 1    | 0.0  |
| 8-50-01-50-20 | 2112       | 2112  | 2112   | 2108.3 | 2011  | 0.0  | 2112   | 0.0  | 0.0  | 2112   | 0.3  | 0.0  | 2112  | 0.3  | 1    | 0.0  | 2112  | 0.3  | 1    | 0.0  |
| 8-50-01-55-20 | 2054       | 2054  | 2054   | 8.9    | 2002  | 0.0  | 2054   | 0.0  | 0.0  | 2054   | 0.1  | 0.0  | 2054  | 0.1  | 1    | 0.0  | 2054  | 0.1  | 1    | 0.0  |
| 8-60-01-45-20 | 1962       | 2492  | 2492   | 1562.4 | 2194  | 12.0 | 2492   | 0.0  | 12.0 | 2492   | 0.4  | 12.0 | 2492  | 0.4  | 1    | 12.0 | 2492  | 0.4  | 1    | 12.0 |
| 8-60-01-50-20 | 1937       | 2538  | 2544↑  | 1018.0 | 2183  | 14.2 | 2541↑  | 0.0  | 14.1 | 2541↑  | 2.4  | 14.1 | 2538  | 7.2  | 3    | 14.0 | 2538  | 3.9  | 3    | 14.0 |
| 8-60-01-55-20 | 1935       | 2417  | 2485↑  | 853.3  | 2181  | 12.2 | 2484↑  | 0.0  | 12.2 | 2485↑  | 0.4  | 12.2 | 2484↑ | 0.8  | 2    | 12.2 | 2484↑ | 0.8  | 2    | 12.2 |
| 8-70-01-45-20 | 2071       | 2732  | 2732   | 645.6  | 2304  | 15.7 | 2739↑  | 0.0  | 15.9 | 2732   | 0.7  | 15.7 | 2732  | 0.7  | 1    | 15.7 | 2732  | 0.7  | 1    | 15.7 |
| 8-70-01-50-20 | 2070       | 2785  | 2785   | 706.0  | 2357  | 15.4 | 2785   | 0.0  | 15.4 | 2785   | 0.6  | 15.4 | 2785  | 0.5  | 1    | 15.4 | 2785  | 0.5  | 1    | 15.4 |
| 8-70-01-55-20 | 2059       | 2729  | 2758↑  | 0.3    | 2351  | 14.8 | 2729   | 0.0  | 13.9 | 2729   | 0.5  | 13.9 | 2729  | 0.5  | 1    | 13.9 | 2729  | 0.5  | 1    | 13.9 |
| 8-50-01-45-30 | 2542       | 2542  | 2542   | 120.8  | 2542  | 0.0  | 2568↑  | 0.0  | 1.0  | 2542   | 0.1  | 0.0  | 2542  | 0.1  | 1    | 0.0  | 2542  | 0.1  | 1    | 0.0  |
| 8-50-01-50-30 | 2720       | 2720  | 2720   | 2041.5 | 2636  | 0.0  | 2721↑  | 0.0  | 0.0  | 2720   | 0.3  | 0.0  | 2720  | 0.3  | 1    | 0.0  | 2720  | 0.3  | 1    | 0.0  |
| 8-50-01-55-30 | 2759       | 2759  | 2759   | 2947.0 | 2662  | 0.0  | 2759   | 0.0  | 0.0  | 2759   | 0.2  | 0.0  | 2759  | 0.2  | 1    | 0.0  | 2759  | 0.2  | 1    | 0.0  |
| 8-60-01-45-30 | 3074       | 3074  | 3087↑  | 7.4    | 2913  | 0.4  | 3087↑  | 0.0  | 0.4  | 3074   | 0.1  | 0.0  | 3074  | 0.1  | 1    | 0.0  | 3074  | 0.1  | 1    | 0.0  |
| 8-60-01-50-30 | 3255       | 3255  | 3341↑  | 1524.2 | 3017  | 2.6  | 3335↑  | 0.0  | 2.4  | 3284↑  | 0.5  | 0.9  | 3284↑ | 0.5  | 1    | 0.9  | 3284↑ | 0.5  | 1    | 0.9  |
| 8-60-01-55-30 | 3363       | 3363  | 3395↑  | 2169.5 | 3000  | 0.9  | 3363   | 0.0  | 0.0  | 3372↑  | 0.3  | 0.3  | 3363  | 0.8  | 2    | 0.0  | 3363  | 1.0  | 2    | 0.0  |
| 8-70-01-45-30 | 2804       | 3417  | 3435↑  | 1883.0 | 3141  | 8.6  | 3417   | 0.0  | 8.1  | 3417   | 0.2  | 8.1  | 3417  | 0.2  | 1    | 8.1  | 3417  | 0.2  | 1    | 8.1  |
| 8-70-01-50-30 | 2866       | 3619  | 3671↑  | 2851.2 | 3226  | 12.1 | 3619   | 0.0  | 10.9 | 3636↑  | 0.4  | 11.3 | 3619  | 1.6  | 3    | 10.9 | 3619  | 1.5  | 3    | 10.9 |
| 8-70-01-55-30 | 2842       | 3724  | 3813↑  | 878.5  | 3167  | 16.9 | 3724   | 0.0  | 15.0 | 3724   | 0.6  | 15.0 | 3724  | 0.6  | 1    | 15.0 | 3724  | 0.6  | 1    | 15.0 |
| 8-50-10-45-10 | 4205       | 4205  | 4205   | 0.5    | 4205  | 0.0  | 4343↑  | 0.0  | 3.2  | 4205   | 0.0  | 0.0  | 4205  | 0.0  | 1    | 0.0  | 4205  | 0.0  | 1    | 0.0  |
| 8-50-10-50-10 | 4592       | 4592  | 4592   | 0.4    | 4592  | 0.0  | 4592   | 0.0  | 0.0  | 4592   | 0.0  | 0.0  | 4592  | 0.0  | 1    | 0.0  | 4592  | 0.0  | 1    | 0.0  |
| 8-50-10-55-10 | 4911       | 4911  | 4911   | 0.3    | 4911  | 0.0  | 5170↑  | 0.0  | 0.0  | 4911   | 0.1  | 0.0  | 4911  | 0.1  | 1    | 0.0  | 4911  | 0.1  | 1    | 0.0  |
| 8-60-10-45-10 | 4990       | 4990  | 4990   | 0.3    | 4990  | 0.0  | 4990   | 0.0  | 0.0  | 5026↑  | 0.1  | 0.7  | 4990  | 0.1  | 2    | 0.0  | 4990  | 0.1  | 2    | 0.0  |
| 8-60-10-50-10 | 5651       | 5651  | 5651   | 0.4    | 5651  | 0.0  | 5924↑  | 0.0  | 0.0  | 5675↑  | 0.1  | 0.4  | 5651  | 0.2  | 2    | 0.0  | 5651  | 0.1  | 2    | 0.0  |
| 8-60-10-55-10 | 6271       | 6271  | 6271   | 2.0    | 6271  | 0.0  | 6624↑  | 0.0  | 5.3  | 6271   | 0.1  | 0.0  | 6271  | 0.1  | 1    | 0.0  | 6271  | 0.1  | 1    | 0.0  |
| 8-70-10-45-10 | 6203       | 6203  | 6203   | 0.3    | 6203  | 0.0  | 6203   | 0.0  | 0.0  | 6203   | 0.0  | 0.0  | 6203  | 0.0  | 1    | 0.0  | 6203  | 0.0  | 1    | 0.0  |
| 8-70-10-50-10 | 6915       | 6915  | 6915   | 38.2   | 6915  | 0.0  | 6915   | 0.0  | 0.0  | 6915   | 0.1  | 0.0  | 6915  | 0.1  | 1    | 0.0  | 6915  | 0.1  | 1    | 0.0  |
| 8-70-10-55-10 | 7513       | 7513  | 7513   | 0.3    | 7513  | 0.0  | 7644↑  | 0.0  | 1.7  | 7513   | 0.1  | 0.0  | 7513  | 0.1  | 1    | 0.0  | 7513  | 0.1  | 1    | 0.0  |
| 8-50-10-45-20 | 11220      | 11220 | 11220  | 1.0    | 11220 | 0.0  | 11220  | 0.0  | 0.0  | 11220  | 0.1  | 0.0  | 11220 | 0.1  | 1    | 0.0  | 11220 | 0.1  | 1    | 0.0  |
| 8-50-10-50-20 | 11900      | 11900 | 11900  | 7.5    | 11900 | 0.0  | 11900  | 0.0  | 0.0  | 11900  | 0.0  | 0.0  | 11900 | 0.0  | 1    | 0.0  | 11900 | 0.0  | 1    | 0.0  |
| 8-50-10-55-20 | 12756      | 12756 | 12756  | 66.6   | 12756 | 0.0  | 12756  | 0.0  | 0.0  | 12756  | 0.1  | 0.0  | 12756 | 0.1  | 1    | 0.0  | 12756 | 0.1  | 1    | 0.0  |
| 8-60-10-45-20 | 13681      | 13681 | 13681  | 603.4  | 13681 | 0.0  | 13750↑ | 0.0  | 0.5  | 13719↑ | 0.2  | 0.3  | 13681 | 0.5  | 3    | 0.0  | 13681 | 0.4  | 3    | 0.0  |
| 8-60-10-50-20 | 14419      | 14419 | 14419  | 8.2    | 14419 | 0.0  | 14419  | 0.0  | 0.0  | 14419  | 0.1  | 0.0  | 14419 | 0.1  | 1    | 0.0  | 14419 | 0.1  | 1    | 0.0  |
| 8-60-10-55-20 | 15147      | 15147 | 15147  | 8.6    | 15147 | 0.0  | 15147  | 0.0  | 0.0  | 15147  | 0.2  | 0.0  | 15147 | 0.2  | 1    | 0.0  | 15147 | 0.2  | 1    | 0.0  |
| 8-70-10-45-20 | 16111      | 16111 | 16111  | 1293.7 | 16111 | 0.0  | 16330↑ | 0.0  | 1.3  | 16111  | 0.1  | 0.0  | 16111 | 0.1  | 1    | 0.0  | 16111 | 0.1  | 1    | 0.0  |
| 8-70-10-50-20 | 17460      | 17460 | 17595↑ | 0.3    | 16332 | 0.8  | 17460  | 0.0  | 0.0  | 17460  | 0.3  | 0.0  | 17460 | 0.3  | 1    | 0.0  | 17460 | 0.3  | 1    | 0.0  |
| 8-70-10-55-20 | 18295      | 18295 | 18579↑ | 2403.9 | 16789 | 1.5  | 18295  | 0.0  | 0.0  | 18295  | 0.4  | 0.0  | 18295 | 0.4  | 1    | 0.0  | 18295 | 0.4  | 1    | 0.0  |
| 8-50-10-45-30 | 17390      | 17390 | 17390  | 8.2    | 17390 | 0.0  | 17390  | 0.0  | 0.0  | 17390  | 0.1  | 0.0  | 17390 | 0.1  | 1    | 0.0  | 17390 | 0.1  | 1    | 0.0  |
| 8-50-10-50-30 | 18060      | 18060 | 18060  | 9.5    | 18060 | 0.0  | 18154↑ | 0.0  | 0.5  | 18136↑ | 0.1  | 0.4  | 18060 | 0.3  | 4    | 0.0  | 18060 | 0.3  | 4    | 0.0  |
| 8-50-10-55-30 | 18830      | 18830 | 18830  | 37.9   | 18830 | 0.0  | 18966↑ | 0.0  | 0.7  | 18830  | 0.1  | 0.0  | 18830 | 0.1  | 1    | 0.0  | 18830 | 0.1  | 1    | 0.0  |
| 8-60-10-45-30 | 21541      | 21541 | 21541  | 7.7    | 20861 | 0.0  | 21541  | 0.0  | 0.0  | 21580↑ | 0.1  | 0.2  | 21541 | 0.3  | 2    | 0.0  | 21541 | 0.2  | 2    | 0.0  |
| 8-60-10-50-30 | 22592      | 22592 | 22592  | 1902.2 | 21713 | 0.0  | 22592  | 0.0  | 0.0  | 22592  | 0.1  | 0.0  | 22592 | 0.1  | 1    | 0.0  | 22592 | 0.1  | 1    | 0.0  |
| 8-60-10-55-30 | 23212      | 23212 | 23212  | 2982.6 | 21815 | 0.0  | 23337↑ | 0.0  | 0.5  | 23337↑ | 0.3  | 0.5  | 23212 | 0.6  | 2    | 0.0  | 23212 | 0.7  | 2    | 0.0  |
| 8-70-10-45-30 | 25429      | 25429 | 25429  | 868.5  | 23528 | 0.0  | 25515↑ | 0.0  | 0.3  | 25447↑ | 0.3  | 0.1  | 25429 | 0.5  | 2    | 0.0  | 25429 | 0.4  | 2    | 0.0  |
| 8-70-10-50-30 | 26486      | 26486 | 26738↑ | 1280.5 | 24167 | 0.9  | 26539↑ | 0.0  | 0.2  | 26539↑ | 0.3  | 0.2  | 26486 | 0.6  | 2    | 0.0  | 26486 | 0.5  | 2    | 0.0  |
| 8-70-10-55-30 | 26652      | 26652 | 26652  | 3519.0 | 24095 | 0.0  | 26652  | 0.0  | 0.0  | 26652  | 0.1  | 0.0  | 26652 | 0.1  | 1    | 0.0  | 26652 | 0.1  | 1    | 0.0  |

**Table EC.12** MMR-KP results for type-9 instances

| instance      | Best Known |      | B&C  |      |      |      | Fix  |      |      | DS   |      |      | iDS-H |      |      |      | iDS-B |      |      |      |
|---------------|------------|------|------|------|------|------|------|------|------|------|------|------|-------|------|------|------|-------|------|------|------|
|               | LB         | UB   | obj  | time | LB   | %gap | obj  | time | %gap | obj  | time | %gap | obj   | time | iter | %gap | obj   | time | iter | %gap |
| 9-50-01-45-10 | 46         | 46   | 46   | 0.0  | 46   | 0.0  | 46   | 0.0  | 0.0  | 46   | 0.0  | 0.0  | 46    | 0.0  | 1    | 0.0  | 46    | 0.0  | 1    | 0.0  |
| 9-50-01-50-10 | 31         | 31   | 31   | 0.0  | 31   | 0.0  | 31   | 0.0  | 0.0  | 31   | 0.0  | 0.0  | 31    | 0.0  | 1    | 0.0  | 31    | 0.0  | 1    | 0.0  |
| 9-50-01-55-10 | 51         | 51   | 51   | 0.0  | 51   | 0.0  | 51   | 0.0  | 0.0  | 51   | 0.0  | 0.0  | 51    | 0.0  | 1    | 0.0  | 51    | 0.0  | 1    | 0.0  |
| 9-60-01-45-10 | 46         | 46   | 46   | 0.0  | 46   | 0.0  | 46   | 0.0  | 0.0  | 46   | 0.0  | 0.0  | 46    | 0.0  | 1    | 0.0  | 46    | 0.0  | 1    | 0.0  |
| 9-60-01-50-10 | 40         | 40   | 40   | 0.0  | 40   | 0.0  | 40   | 0.0  | 0.0  | 40   | 0.0  | 0.0  | 40    | 0.0  | 1    | 0.0  | 40    | 0.0  | 1    | 0.0  |
| 9-60-01-55-10 | 71         | 71   | 71   | 0.0  | 71   | 0.0  | 71   | 0.0  | 0.0  | 71   | 0.0  | 0.0  | 71    | 0.0  | 1    | 0.0  | 71    | 0.0  | 1    | 0.0  |
| 9-70-01-45-10 | 92         | 92   | 92   | 0.0  | 92   | 0.0  | 92   | 0.0  | 0.0  | 92   | 0.0  | 0.0  | 92    | 0.0  | 1    | 0.0  | 92    | 0.0  | 1    | 0.0  |
| 9-70-01-50-10 | 34         | 34   | 34   | 0.0  | 34   | 0.0  | 34   | 0.0  | 0.0  | 34   | 0.0  | 0.0  | 34    | 0.0  | 1    | 0.0  | 34    | 0.0  | 1    | 0.0  |
| 9-70-01-55-10 | 71         | 71   | 71   | 0.0  | 71   | 0.0  | 71   | 0.0  | 0.0  | 71   | 0.0  | 0.0  | 71    | 0.0  | 1    | 0.0  | 71    | 0.0  | 1    | 0.0  |
| 9-50-01-45-20 | 335        | 335  | 335  | 0.1  | 335  | 0.0  | 335  | 0.0  | 0.0  | 335  | 0.0  | 0.0  | 335   | 0.0  | 1    | 0.0  | 335   | 0.0  | 1    | 0.0  |
| 9-50-01-50-20 | 242        | 242  | 242  | 0.0  | 242  | 0.0  | 242  | 0.0  | 0.0  | 242  | 0.0  | 0.0  | 242   | 0.0  | 1    | 0.0  | 242   | 0.0  | 1    | 0.0  |
| 9-50-01-55-20 | 168        | 168  | 168  | 0.0  | 168  | 0.0  | 168  | 0.0  | 0.0  | 168  | 0.0  | 0.0  | 168   | 0.0  | 1    | 0.0  | 168   | 0.0  | 1    | 0.0  |
| 9-60-01-45-20 | 335        | 335  | 335  | 0.1  | 335  | 0.0  | 335  | 0.0  | 0.0  | 335  | 0.0  | 0.0  | 335   | 0.0  | 1    | 0.0  | 335   | 0.0  | 1    | 0.0  |
| 9-60-01-50-20 | 249        | 249  | 249  | 0.0  | 249  | 0.0  | 249  | 0.0  | 0.0  | 249  | 0.0  | 0.0  | 249   | 0.0  | 1    | 0.0  | 249   | 0.0  | 1    | 0.0  |
| 9-60-01-55-20 | 247        | 247  | 247  | 0.1  | 247  | 0.0  | 247  | 0.0  | 0.0  | 247  | 0.0  | 0.0  | 247   | 0.0  | 1    | 0.0  | 247   | 0.0  | 1    | 0.0  |
| 9-70-01-45-20 | 421        | 421  | 421  | 0.1  | 421  | 0.0  | 421  | 0.0  | 0.0  | 421  | 0.0  | 0.0  | 421   | 0.0  | 1    | 0.0  | 421   | 0.0  | 1    | 0.0  |
| 9-70-01-50-20 | 286        | 286  | 286  | 0.0  | 286  | 0.0  | 286  | 0.0  | 0.0  | 286  | 0.0  | 0.0  | 286   | 0.0  | 1    | 0.0  | 286   | 0.0  | 1    | 0.0  |
| 9-70-01-55-20 | 247        | 247  | 247  | 0.0  | 247  | 0.0  | 247  | 0.0  | 0.0  | 247  | 0.0  | 0.0  | 247   | 0.0  | 1    | 0.0  | 247   | 0.0  | 1    | 0.0  |
| 9-50-01-45-30 | 637        | 637  | 637  | 0.1  | 637  | 0.0  | 637  | 0.0  | 0.0  | 637  | 0.0  | 0.0  | 637   | 0.0  | 1    | 0.0  | 637   | 0.0  | 1    | 0.0  |
| 9-50-01-50-30 | 581        | 581  | 581  | 0.1  | 581  | 0.0  | 581  | 0.0  | 0.0  | 581  | 0.0  | 0.0  | 581   | 0.0  | 1    | 0.0  | 581   | 0.0  | 1    | 0.0  |
| 9-50-01-55-30 | 551        | 551  | 551  | 0.0  | 551  | 0.0  | 551  | 0.0  | 0.0  | 551  | 0.0  | 0.0  | 551   | 0.0  | 1    | 0.0  | 551   | 0.0  | 1    | 0.0  |
| 9-60-01-45-30 | 749        | 749  | 749  | 0.1  | 749  | 0.0  | 749  | 0.0  | 0.0  | 749  | 0.0  | 0.0  | 749   | 0.0  | 1    | 0.0  | 749   | 0.0  | 1    | 0.0  |
| 9-60-01-50-30 | 748        | 748  | 748  | 0.2  | 748  | 0.0  | 748  | 0.0  | 0.0  | 748  | 0.0  | 0.0  | 748   | 0.0  | 1    | 0.0  | 748   | 0.0  | 1    | 0.0  |
| 9-60-01-55-30 | 685        | 685  | 685  | 0.1  | 685  | 0.0  | 685  | 0.0  | 0.0  | 687↑ | 0.0  | 0.3  | 685   | 0.0  | 2    | 0.0  | 685   | 0.0  | 2    | 0.0  |
| 9-70-01-45-30 | 864        | 864  | 864  | 0.1  | 864  | 0.0  | 864  | 0.0  | 0.0  | 864  | 0.0  | 0.0  | 864   | 0.0  | 1    | 0.0  | 864   | 0.0  | 1    | 0.0  |
| 9-70-01-50-30 | 819        | 819  | 819  | 0.2  | 819  | 0.0  | 819  | 0.0  | 0.0  | 819  | 0.0  | 0.0  | 819   | 0.0  | 1    | 0.0  | 819   | 0.0  | 1    | 0.0  |
| 9-70-01-55-30 | 701        | 701  | 701  | 0.1  | 701  | 0.0  | 712↑ | 0.0  | 1.5  | 701  | 0.0  | 0.0  | 701   | 0.0  | 1    | 0.0  | 701   | 0.0  | 1    | 0.0  |
| 9-50-10-45-10 | 124        | 124  | 124  | 0.0  | 124  | 0.0  | 124  | 0.0  | 0.0  | 124  | 0.0  | 0.0  | 124   | 0.0  | 1    | 0.0  | 124   | 0.0  | 1    | 0.0  |
| 9-50-10-50-10 | 298        | 298  | 298  | 0.0  | 298  | 0.0  | 298  | 0.0  | 0.0  | 298  | 0.0  | 0.0  | 298   | 0.0  | 1    | 0.0  | 298   | 0.0  | 1    | 0.0  |
| 9-50-10-55-10 | 259        | 259  | 259  | 0.0  | 259  | 0.0  | 259  | 0.0  | 0.0  | 259  | 0.0  | 0.0  | 259   | 0.0  | 1    | 0.0  | 259   | 0.0  | 1    | 0.0  |
| 9-60-10-45-10 | 245        | 245  | 245  | 0.0  | 245  | 0.0  | 245  | 0.0  | 0.0  | 245  | 0.0  | 0.0  | 245   | 0.0  | 1    | 0.0  | 245   | 0.0  | 1    | 0.0  |
| 9-60-10-50-10 | 0          | 0    | 0    | 0.0  | 0    | 0.0  | 0    | 0.0  | 0.0  | 0    | 0.0  | 0.0  | 0     | 0.0  | 1    | 0.0  | 0     | 0.0  | 1    | 0.0  |
| 9-60-10-55-10 | 181        | 181  | 181  | 0.0  | 181  | 0.0  | 181  | 0.0  | 0.0  | 181  | 0.0  | 0.0  | 181   | 0.0  | 1    | 0.0  | 181   | 0.0  | 1    | 0.0  |
| 9-70-10-45-10 | 274        | 274  | 274  | 0.0  | 274  | 0.0  | 274  | 0.0  | 0.0  | 274  | 0.0  | 0.0  | 274   | 0.0  | 1    | 0.0  | 274   | 0.0  | 1    | 0.0  |
| 9-70-10-50-10 | 245        | 245  | 245  | 0.0  | 245  | 0.0  | 245  | 0.0  | 0.0  | 245  | 0.0  | 0.0  | 245   | 0.0  | 1    | 0.0  | 245   | 0.0  | 1    | 0.0  |
| 9-70-10-55-10 | 121        | 121  | 121  | 0.0  | 121  | 0.0  | 121  | 0.0  | 0.0  | 121  | 0.0  | 0.0  | 121   | 0.0  | 1    | 0.0  | 121   | 0.0  | 1    | 0.0  |
| 9-50-10-45-20 | 1349       | 1349 | 1349 | 0.0  | 1349 | 0.0  | 1349 | 0.0  | 0.0  | 1349 | 0.0  | 0.0  | 1349  | 0.0  | 1    | 0.0  | 1349  | 0.0  | 1    | 0.0  |
| 9-50-10-50-20 | 907        | 907  | 907  | 0.0  | 907  | 0.0  | 907  | 0.0  | 0.0  | 907  | 0.0  | 0.0  | 907   | 0.0  | 1    | 0.0  | 907   | 0.0  | 1    | 0.0  |
| 9-50-10-55-20 | 927        | 927  | 927  | 0.0  | 927  | 0.0  | 927  | 0.0  | 0.0  | 927  | 0.0  | 0.0  | 927   | 0.0  | 1    | 0.0  | 927   | 0.0  | 1    | 0.0  |
| 9-60-10-45-20 | 905        | 905  | 905  | 0.0  | 905  | 0.0  | 905  | 0.0  | 0.0  | 905  | 0.0  | 0.0  | 905   | 0.0  | 1    | 0.0  | 905   | 0.0  | 1    | 0.0  |
| 9-60-10-50-20 | 562        | 562  | 562  | 0.0  | 562  | 0.0  | 562  | 0.0  | 0.0  | 562  | 0.0  | 0.0  | 562   | 0.0  | 1    | 0.0  | 562   | 0.0  | 1    | 0.0  |
| 9-60-10-55-20 | 959        | 959  | 959  | 0.0  | 959  | 0.0  | 959  | 0.0  | 0.0  | 959  | 0.0  | 0.0  | 959   | 0.0  | 1    | 0.0  | 959   | 0.0  | 1    | 0.0  |
| 9-70-10-45-20 | 1720       | 1720 | 1720 | 0.0  | 1720 | 0.0  | 1720 | 0.0  | 0.0  | 1720 | 0.0  | 0.0  | 1720  | 0.0  | 1    | 0.0  | 1720  | 0.0  | 1    | 0.0  |
| 9-70-10-50-20 | 905        | 905  | 905  | 0.0  | 905  | 0.0  | 905  | 0.0  | 0.0  | 905  | 0.0  | 0.0  | 905   | 0.0  | 1    | 0.0  | 905   | 0.0  | 1    | 0.0  |
| 9-70-10-55-20 | 784        | 784  | 784  | 0.0  | 784  | 0.0  | 784  | 0.0  | 0.0  | 784  | 0.0  | 0.0  | 784   | 0.0  | 1    | 0.0  | 784   | 0.0  | 1    | 0.0  |
| 9-50-10-45-30 | 2376       | 2376 | 2376 | 0.0  | 2376 | 0.0  | 2376 | 0.0  | 0.0  | 2376 | 0.0  | 0.0  | 2376  | 0.0  | 1    | 0.0  | 2376  | 0.0  | 1    | 0.0  |
| 9-50-10-50-30 | 1600       | 1600 | 1600 | 0.0  | 1600 | 0.0  | 1600 | 0.0  | 0.0  | 1600 | 0.0  | 0.0  | 1600  | 0.0  | 1    | 0.0  | 1600  | 0.0  | 1    | 0.0  |
| 9-50-10-55-30 | 590        | 590  | 590  | 0.0  | 590  | 0.0  | 590  | 0.0  | 0.0  | 590  | 0.0  | 0.0  | 590   | 0.0  | 1    | 0.0  | 590   | 0.0  | 1    | 0.0  |
| 9-60-10-45-30 | 2673       | 2673 | 2673 | 0.0  | 2673 | 0.0  | 2673 | 0.0  | 0.0  | 2673 | 0.0  | 0.0  | 2673  | 0.0  | 1    | 0.0  | 2673  | 0.0  | 1    | 0.0  |
| 9-60-10-50-30 | 1492       | 1492 | 1492 | 0.0  | 1492 | 0.0  | 1492 | 0.0  | 0.0  | 1492 | 0.0  | 0.0  | 1492  | 0.0  | 1    | 0.0  | 1492  | 0.0  | 1    | 0.0  |
| 9-60-10-55-30 | 1218       | 1218 | 1218 | 0.0  | 1218 | 0.0  | 1218 | 0.0  | 0.0  | 1218 | 0.0  | 0.0  | 1218  | 0.0  | 1    | 0.0  | 1218  | 0.0  | 1    | 0.0  |
| 9-70-10-45-30 | 3248       | 3248 | 3248 | 0.0  | 3248 | 0.0  | 3248 | 0.0  | 0.0  | 3248 | 0.0  | 0.0  | 3248  | 0.0  | 1    | 0.0  | 3248  | 0.0  | 1    | 0.0  |
| 9-70-10-50-30 | 2673       | 2673 | 2673 | 0.0  | 2673 | 0.0  | 2673 | 0.0  | 0.0  | 2673 | 0.0  | 0.0  | 2673  | 0.0  | 1    | 0.0  | 2673  | 0.0  | 1    | 0.0  |
| 9-70-10-55-30 | 995        | 995  | 995  | 0.0  | 995  | 0.0  | 995  | 0.0  | 0.0  | 995  | 0.0  | 0.0  | 995   | 0.0  | 1    | 0.0  | 995   | 0.0  | 1    | 0.0  |

**Table EC.13** MMR-SCP results for type-B instances

| instance | Best Known |     | B&C  |       |     |      | Fix  |      |      | DS   |       |      | iDS-H |        |      |      | iDS-B |        |      |      |
|----------|------------|-----|------|-------|-----|------|------|------|------|------|-------|------|-------|--------|------|------|-------|--------|------|------|
|          | LB         | UB  | obj  | time  | LB  | %gap | obj  | time | %gap | obj  | time  | %gap | obj   | time   | iter | %gap | obj   | time   | iter | %gap |
| B40110   | 21         | 21  | 21   | 4.1   | 21  | 0.0  | 21   | 0.0  | 0.0  | 21   | 0.493 | 0.0  | 21    | 0.05   | 1    | 0.0  | 21    | 0.05   | 1    | 0.0  |
| B40130   | 67         | 67  | 67   | 4.5   | 67  | 0.0  | 71↑  | 0.0  | 5.6  | 67   | 0.516 | 0.0  | 67    | 0.26   | 1    | 0.0  | 67    | 0.26   | 1    | 0.0  |
| B40150   | 124        | 124 | 124  | 12.0  | 124 | 0.0  | 136↑ | 0.0  | 8.8  | 126↑ | 0.124 | 1.6  | 124   | 3.78   | 8    | 0.0  | 124   | 1.60   | 4    | 0.0  |
| B40210   | 23         | 23  | 23   | 5.0   | 23  | 0.0  | 23   | 0.0  | 0.0  | 23   | 0.273 | 0.0  | 23    | 0.12   | 1    | 0.0  | 23    | 0.12   | 1    | 0.0  |
| B40230   | 93         | 93  | 93   | 15.8  | 93  | 0.0  | 95↑  | 0.0  | 2.1  | 94↑  | 0.422 | 1.1  | 93    | 3.88   | 9    | 0.0  | 93    | 2.58   | 5    | 0.0  |
| B40250   | 163        | 163 | 163  | 11.1  | 163 | 0.0  | 175↑ | 0.0  | 6.9  | 164↑ | 0.085 | 0.6  | 163   | 1.71   | 3    | 0.0  | 163   | 2.11   | 3    | 0.0  |
| B40310   | 12         | 12  | 12   | 2.5   | 12  | 0.0  | 14↑  | 0.0  | 14.3 | 12   | 0.268 | 0.0  | 12    | 0.03   | 1    | 0.0  | 12    | 0.03   | 1    | 0.0  |
| B40330   | 86         | 86  | 86   | 17.0  | 86  | 0.0  | 92↑  | 0.0  | 6.5  | 86   | 0.538 | 0.0  | 86    | 0.31   | 1    | 0.0  | 86    | 0.31   | 1    | 0.0  |
| B40350   | 190        | 190 | 190  | 22.7  | 190 | 0.0  | 192↑ | 0.0  | 1.0  | 191↑ | 0.212 | 0.5  | 190   | 5.22   | 7    | 0.0  | 190   | 5.69   | 7    | 0.0  |
| B40410   | 20         | 20  | 20   | 4.4   | 20  | 0.0  | 21↑  | 0.0  | 4.8  | 20   | 0.456 | 0.0  | 20    | 0.07   | 1    | 0.0  | 20    | 0.07   | 1    | 0.0  |
| B40430   | 85         | 85  | 85   | 10.1  | 85  | 0.0  | 87↑  | 0.0  | 2.3  | 85   | 0.557 | 0.0  | 85    | 0.55   | 1    | 0.0  | 85    | 0.55   | 1    | 0.0  |
| B40450   | 160        | 160 | 160  | 20.7  | 160 | 0.0  | 170↑ | 0.0  | 5.9  | 160  | 0.334 | 0.0  | 160   | 0.94   | 1    | 0.0  | 160   | 0.94   | 1    | 0.0  |
| B40510   | 13         | 13  | 13   | 3.7   | 13  | 0.0  | 13   | 0.0  | 0.0  | 13   | 0.349 | 0.0  | 13    | 0.04   | 1    | 0.0  | 13    | 0.04   | 1    | 0.0  |
| B40530   | 73         | 73  | 73   | 8.9   | 73  | 0.0  | 77↑  | 0.0  | 5.2  | 74↑  | 0.868 | 1.4  | 73    | 5.66   | 15   | 0.0  | 73    | 2.65   | 7    | 0.0  |
| B40550   | 165        | 165 | 165  | 29.1  | 165 | 0.0  | 169↑ | 0.0  | 2.4  | 165  | 0.110 | 0.0  | 165   | 0.56   | 1    | 0.0  | 165   | 0.56   | 1    | 0.0  |
| B40610   | 16         | 16  | 16   | 5.6   | 16  | 0.0  | 19↑  | 0.0  | 15.8 | 17↑  | 0.444 | 5.9  | 16    | 0.27   | 3    | 0.0  | 16    | 0.36   | 3    | 0.0  |
| B40630   | 84         | 84  | 84   | 21.8  | 84  | 0.0  | 86↑  | 0.0  | 2.3  | 85↑  | 0.615 | 1.2  | 84    | 3.32   | 8    | 0.0  | 84    | 3.97   | 7    | 0.0  |
| B40650   | 175        | 175 | 175  | 34.0  | 175 | 0.0  | 188↑ | 0.0  | 6.9  | 181↑ | 0.045 | 3.3  | 175   | 199.30 | 165  | 0.0  | 175   | 113.01 | 73   | 0.0  |
| B40710   | 17         | 17  | 17   | 3.2   | 17  | 0.0  | 18↑  | 0.0  | 5.6  | 17   | 0.181 | 0.0  | 17    | 0.09   | 1    | 0.0  | 17    | 0.09   | 1    | 0.0  |
| B40730   | 59         | 59  | 59   | 6.1   | 59  | 0.0  | 68↑  | 0.0  | 13.2 | 60↑  | 0.519 | 1.7  | 59    | 0.82   | 3    | 0.0  | 59    | 0.59   | 2    | 0.0  |
| B40750   | 104        | 104 | 104  | 7.0   | 104 | 0.0  | 115↑ | 0.0  | 9.6  | 106↑ | 0.415 | 1.9  | 104   | 1.13   | 5    | 0.0  | 104   | 0.40   | 2    | 0.0  |
| B40810   | 24         | 24  | 24   | 5.4   | 24  | 0.0  | 27↑  | 0.0  | 11.1 | 24   | 0.835 | 0.0  | 24    | 0.21   | 1    | 0.0  | 24    | 0.21   | 1    | 0.0  |
| B40830   | 54         | 54  | 54   | 8.2   | 54  | 0.0  | 56↑  | 0.0  | 3.6  | 56↑  | 0.864 | 3.6  | 54    | 0.97   | 4    | 0.0  | 54    | 1.03   | 3    | 0.0  |
| B40850   | 155        | 155 | 155  | 19.4  | 155 | 0.0  | 160↑ | 0.0  | 3.1  | 155  | 0.493 | 0.0  | 155   | 0.79   | 1    | 0.0  | 155   | 0.79   | 1    | 0.0  |
| B40910   | 33         | 33  | 33   | 5.2   | 33  | 0.0  | 34↑  | 0.0  | 2.9  | 33   | 0.546 | 0.0  | 33    | 0.36   | 1    | 0.0  | 33    | 0.36   | 1    | 0.0  |
| B40930   | 99         | 99  | 99   | 11.1  | 99  | 0.0  | 103↑ | 0.0  | 3.9  | 100↑ | 0.894 | 1.0  | 99    | 12.93  | 16   | 0.0  | 99    | 2.09   | 4    | 0.0  |
| B40950   | 263        | 263 | 263  | 49.6  | 263 | 0.0  | 267↑ | 0.0  | 1.5  | 263  | 0.081 | 0.0  | 263   | 1.14   | 1    | 0.0  | 263   | 1.14   | 1    | 0.0  |
| B41010   | 17         | 17  | 17   | 3.7   | 17  | 0.0  | 18↑  | 0.0  | 5.6  | 17   | 0.568 | 0.0  | 17    | 0.03   | 1    | 0.0  | 17    | 0.03   | 1    | 0.0  |
| B41030   | 63         | 63  | 63   | 6.6   | 63  | 0.0  | 63   | 0.0  | 0.0  | 63   | 0.592 | 0.0  | 63    | 0.21   | 1    | 0.0  | 63    | 0.21   | 1    | 0.0  |
| B41050   | 141        | 141 | 141  | 16.6  | 141 | 0.0  | 151↑ | 0.0  | 6.6  | 143↑ | 0.157 | 1.4  | 141   | 2.01   | 8    | 0.0  | 141   | 2.09   | 8    | 0.0  |
| B50110   | 24         | 24  | 24   | 15.8  | 24  | 0.0  | 24   | 0.1  | 0.0  | 24   | 0.262 | 0.0  | 24    | 0.55   | 1    | 0.0  | 24    | 0.55   | 1    | 0.0  |
| B50130   | 53         | 53  | 53   | 33.6  | 53  | 0.0  | 57↑  | 0.0  | 7.0  | 54↑  | 0.567 | 1.9  | 53    | 16.80  | 20   | 0.0  | 53    | 17.42  | 16   | 0.0  |
| B50150   | 93         | 93  | 93   | 128.4 | 93  | 0.0  | 95↑  | 0.0  | 2.1  | 95↑  | 0.496 | 2.1  | 93    | 4.77   | 5    | 0.0  | 93    | 4.66   | 5    | 0.0  |
| B50210   | 19         | 19  | 19   | 13.2  | 19  | 0.0  | 22↑  | 0.0  | 13.6 | 19   | 0.902 | 0.0  | 19    | 0.48   | 1    | 0.0  | 19    | 0.48   | 1    | 0.0  |
| B50230   | 69         | 69  | 69   | 27.2  | 69  | 0.0  | 74↑  | 0.2  | 6.8  | 72↑  | 1.219 | 4.2  | 69    | 2.24   | 2    | 0.0  | 69    | 2.33   | 2    | 0.0  |
| B50250   | 121        | 121 | 121  | 109.8 | 121 | 0.0  | 123↑ | 0.1  | 1.6  | 122↑ | 0.12  | 0.8  | 121   | 2.54   | 2    | 0.0  | 121   | 2.48   | 2    | 0.0  |
| B50310   | 12         | 12  | 12   | 11.4  | 12  | 0.0  | 13↑  | 0.0  | 7.7  | 13↑  | 0.38  | 7.7  | 12    | 0.75   | 7    | 0.0  | 12    | 0.41   | 3    | 0.0  |
| B50330   | 24         | 24  | 24   | 9.8   | 24  | 0.0  | 27↑  | 0.0  | 11.1 | 24   | 0.42  | 0.0  | 24    | 0.10   | 1    | 0.0  | 24    | 0.10   | 1    | 0.0  |
| B50350   | 66         | 66  | 66   | 16.9  | 66  | 0.0  | 66   | 0.0  | 0.0  | 67↑  | 0.07  | 1.5  | 66    | 1.43   | 5    | 0.0  | 66    | 0.54   | 2    | 0.0  |
| B50410   | 18         | 18  | 18   | 12.1  | 18  | 0.0  | 18   | 0.0  | 0.0  | 19↑  | 0.67  | 5.3  | 18    | 1.12   | 4    | 0.0  | 18    | 1.47   | 4    | 0.0  |
| B50430   | 50         | 50  | 50   | 50.9  | 50  | 0.0  | 51↑  | 0.0  | 2.0  | 51↑  | 0.10  | 2.0  | 50    | 1.49   | 3    | 0.0  | 50    | 1.23   | 2    | 0.0  |
| B50450   | 84         | 84  | 84   | 61.9  | 84  | 0.0  | 86↑  | 0.0  | 2.3  | 86↑  | 0.17  | 2.3  | 84    | 1.15   | 2    | 0.0  | 84    | 1.21   | 2    | 0.0  |
| B50510   | 10         | 10  | 10   | 7.9   | 10  | 0.0  | 10   | 0.0  | 0.0  | 11↑  | 0.57  | 9.1  | 10    | 0.25   | 2    | 0.0  | 10    | 0.29   | 2    | 0.0  |
| B50530   | 34         | 34  | 34   | 11.1  | 34  | 0.0  | 37↑  | 0.0  | 8.1  | 37↑  | 0.48  | 8.1  | 34    | 1.22   | 4    | 0.0  | 34    | 1.51   | 4    | 0.0  |
| B50550   | 57         | 57  | 57   | 10.0  | 57  | 0.0  | 64↑  | 0.0  | 10.9 | 57   | 0.86  | 0.0  | 57    | 0.42   | 1    | 0.0  | 57    | 0.42   | 1    | 0.0  |
| B50610   | 13         | 13  | 13   | 6.4   | 13  | 0.0  | 13   | 0.0  | 0.0  | 13   | 0.11  | 0.0  | 13    | 0.09   | 1    | 0.0  | 13    | 0.09   | 1    | 0.0  |
| B50630   | 29         | 29  | 29   | 8.9   | 29  | 0.0  | 30↑  | 0.0  | 3.3  | 29   | 0.33  | 0.0  | 29    | 0.27   | 1    | 0.0  | 29    | 0.27   | 1    | 0.0  |
| B50650   | 51         | 51  | 51   | 13.1  | 51  | 0.0  | 51   | 0.0  | 0.0  | 52↑  | 0.44  | 1.9  | 51    | 8.77   | 17   | 0.0  | 51    | 2.08   | 4    | 0.0  |
| B50710   | 17         | 17  | 17   | 7.4   | 17  | 0.0  | 20↑  | 0.0  | 15.0 | 17   | 0.16  | 0.0  | 17    | 0.21   | 1    | 0.0  | 17    | 0.21   | 1    | 0.0  |
| B50730   | 54         | 54  | 54   | 20.7  | 54  | 0.0  | 55↑  | 0.0  | 1.8  | 54   | 0.19  | 0.0  | 54    | 0.46   | 1    | 0.0  | 54    | 0.46   | 1    | 0.0  |
| B50750   | 88         | 88  | 88   | 21.4  | 88  | 0.0  | 97↑  | 0.0  | 9.3  | 88   | 1.04  | 0.0  | 88    | 0.56   | 1    | 0.0  | 88    | 0.56   | 1    | 0.0  |
| B50810   | 24         | 24  | 24   | 14.1  | 24  | 0.0  | 27↑  | 0.0  | 11.1 | 25↑  | 0.32  | 4.0  | 24    | 2.24   | 5    | 0.0  | 24    | 1.13   | 3    | 0.0  |
| B50830   | 57         | 57  | 57   | 28.7  | 57  | 0.0  | 59↑  | 0.0  | 3.4  | 57   | 0.47  | 0.0  | 57    | 0.35   | 1    | 0.0  | 57    | 0.35   | 1    | 0.0  |
| B50850   | 105        | 105 | 105  | 106.5 | 105 | 0.0  | 115↑ | 0.0  | 8.7  | 105  | 0.31  | 0.0  | 105   | 0.87   | 1    | 0.0  | 105   | 0.87   | 1    | 0.0  |
| B50910   | 21         | 21  | 21   | 9.2   | 21  | 0.0  | 21   | 0.0  | 0.0  | 21   | 0.29  | 0.0  | 21    | 0.11   | 1    | 0.0  | 21    | 0.11   | 1    | 0.0  |
| B50930   | 56         | 56  | 56   | 25.0  | 56  | 0.0  | 58↑  | 0.0  | 3.4  | 57↑  | 0.53  | 1.8  | 56    | 1.38   | 3    | 0.0  | 56    | 1.66   | 3    | 0.0  |
| B50950   | 91         | 91  | 91   | 18.0  | 91  | 0.0  | 99↑  | 0.0  | 8.1  | 91   | 0.19  | 0.0  | 91    | 0.62   | 1    | 0.0  | 91    | 0.62   | 1    | 0.0  |
| B51010   | 10         | 10  | 10   | 7.7   | 10  | 0.0  | 10   | 0.0  | 0.0  | 10   | 0.13  | 0.0  | 10    | 0.05   | 1    | 0.0  | 10    | 0.05   | 1    | 0.0  |
| B51030   | 37         | 37  | 37   | 22.2  | 37  | 0.0  | 39↑  | 0.0  | 5.1  | 37   | 0.49  | 0.0  | 37    | 0.18   | 1    | 0.0  | 37    | 0.18   | 1    | 0.0  |
| B51050   | 76         | 76  | 76   | 50.5  | 76  | 0.0  | 82↑  | 0.0  | 7.3  | 76   | 0.25  | 0.0  | 76    | 0.52   | 1    | 0.0  | 76    | 0.52   | 1    | 0.0  |
| B60110   | 17         | 17  | 17</ |       |     |      |      |      |      |      |       |      |       |        |      |      |       |        |      |      |

**Table EC.14** MMR-SCP results for type-M instances

| instance | Best Known |      | B&C  |       |      |      | Fix   |      |      | DS    |      |      | iDS-H |       |      |      | iDS-B |       |      |      |
|----------|------------|------|------|-------|------|------|-------|------|------|-------|------|------|-------|-------|------|------|-------|-------|------|------|
|          | LB         | UB   | obj  | time  | LB   | %gap | obj   | time | %gap | obj   | time | %gap | obj   | time  | iter | %gap | obj   | time  | iter | %gap |
| M401-1   | 3160       | 3160 | 3160 | 58.0  | 3160 | 0.0  | 3304↑ | 0.1  | 4.4  | 3160  | 0.68 | 0.0  | 3160  | 0.68  | 1    | 0.0  | 3160  | 0.68  | 1    | 0.0  |
| M401-2   | 3495       | 3495 | 3495 | 24.4  | 3495 | 0.0  | 3636↑ | 0.0  | 3.9  | 3495  | 0.32 | 0.0  | 3495  | 0.32  | 1    | 0.0  | 3495  | 0.32  | 1    | 0.0  |
| M401-3   | 3382       | 3382 | 3382 | 82.8  | 3382 | 0.0  | 3491↑ | 0.1  | 3.1  | 3382  | 0.93 | 0.0  | 3382  | 0.93  | 1    | 0.0  | 3382  | 0.93  | 1    | 0.0  |
| M402-1   | 3610       | 3610 | 3610 | 57.2  | 3610 | 0.0  | 3787↑ | 0.0  | 4.7  | 3610  | 1.00 | 0.0  | 3610  | 1.00  | 1    | 0.0  | 3610  | 1.00  | 1    | 0.0  |
| M402-2   | 2986       | 2986 | 2986 | 24.0  | 2986 | 0.0  | 3188↑ | 0.0  | 6.3  | 2986  | 0.36 | 0.0  | 2986  | 0.36  | 1    | 0.0  | 2986  | 0.36  | 1    | 0.0  |
| M402-3   | 4294       | 4294 | 4294 | 130.6 | 4294 | 0.0  | 4467↑ | 0.1  | 3.9  | 4294  | 1.12 | 0.0  | 4294  | 1.12  | 1    | 0.0  | 4294  | 1.12  | 1    | 0.0  |
| M403-1   | 3233       | 3233 | 3233 | 22.5  | 3233 | 0.0  | 3375↑ | 0.0  | 4.2  | 3233  | 0.24 | 0.0  | 3233  | 0.24  | 1    | 0.0  | 3233  | 0.24  | 1    | 0.0  |
| M403-2   | 4205       | 4205 | 4205 | 70.4  | 4205 | 0.0  | 4326↑ | 0.0  | 2.8  | 4205  | 0.60 | 0.0  | 4205  | 0.60  | 1    | 0.0  | 4205  | 0.60  | 1    | 0.0  |
| M403-3   | 3589       | 3589 | 3589 | 35.5  | 3589 | 0.0  | 3884↑ | 0.0  | 7.6  | 3594↑ | 0.79 | 0.1  | 3589  | 9.20  | 11   | 0.0  | 3589  | 1.94  | 2    | 0.0  |
| M404-1   | 3628       | 3628 | 3628 | 45.0  | 3628 | 0.0  | 3884↑ | 0.0  | 6.6  | 3628  | 0.28 | 0.0  | 3628  | 0.28  | 1    | 0.0  | 3628  | 0.28  | 1    | 0.0  |
| M404-2   | 3954       | 3954 | 3954 | 58.9  | 3954 | 0.0  | 4148↑ | 0.0  | 4.7  | 3954  | 0.80 | 0.0  | 3954  | 0.80  | 1    | 0.0  | 3954  | 0.80  | 1    | 0.0  |
| M404-3   | 2957       | 2957 | 2957 | 40.1  | 2957 | 0.0  | 3115↑ | 0.0  | 5.1  | 2957  | 0.19 | 0.0  | 2957  | 0.19  | 1    | 0.0  | 2957  | 0.19  | 1    | 0.0  |
| M405-1   | 3546       | 3546 | 3546 | 16.8  | 3546 | 0.0  | 3980↑ | 0.1  | 10.9 | 3546  | 0.70 | 0.0  | 3546  | 0.70  | 1    | 0.0  | 3546  | 0.70  | 1    | 0.0  |
| M405-2   | 3589       | 3589 | 3589 | 54.2  | 3589 | 0.0  | 3931↑ | 0.0  | 8.7  | 3589  | 0.25 | 0.0  | 3589  | 0.25  | 1    | 0.0  | 3589  | 0.25  | 1    | 0.0  |
| M405-3   | 3698       | 3698 | 3698 | 46.5  | 3698 | 0.0  | 3855↑ | 0.1  | 4.1  | 3698  | 0.66 | 0.0  | 3698  | 0.66  | 1    | 0.0  | 3698  | 0.66  | 1    | 0.0  |
| M406-1   | 3549       | 3549 | 3549 | 67.3  | 3549 | 0.0  | 3692↑ | 0.0  | 3.9  | 3549  | 0.98 | 0.0  | 3549  | 0.98  | 1    | 0.0  | 3549  | 0.98  | 1    | 0.0  |
| M406-2   | 2975       | 2975 | 2975 | 7.9   | 2975 | 0.0  | 3000↑ | 0.0  | 0.8  | 2979↑ | 0.18 | 0.1  | 2975  | 1.89  | 9    | 0.0  | 2975  | 1.23  | 4    | 0.0  |
| M406-3   | 3199       | 3199 | 3199 | 30.9  | 3199 | 0.0  | 3296↑ | 0.0  | 2.9  | 3199  | 0.26 | 0.0  | 3199  | 0.26  | 1    | 0.0  | 3199  | 0.26  | 1    | 0.0  |
| M407-1   | 3115       | 3115 | 3115 | 54.2  | 3115 | 0.0  | 3320↑ | 0.0  | 6.2  | 3115  | 0.61 | 0.0  | 3115  | 0.61  | 1    | 0.0  | 3115  | 0.61  | 1    | 0.0  |
| M407-2   | 4674       | 4674 | 4674 | 223.3 | 4674 | 0.0  | 4840↑ | 0.0  | 3.4  | 4680↑ | 0.98 | 0.1  | 4674  | 20.78 | 18   | 0.0  | 4674  | 19.19 | 12   | 0.0  |
| M407-3   | 4136       | 4136 | 4136 | 44.0  | 4136 | 0.0  | 4367↑ | 0.0  | 5.3  | 4136  | 0.41 | 0.0  | 4136  | 0.41  | 1    | 0.0  | 4136  | 0.41  | 1    | 0.0  |
| M408-1   | 3802       | 3802 | 3802 | 68.2  | 3802 | 0.0  | 3882↑ | 0.0  | 2.1  | 3802  | 0.63 | 0.0  | 3802  | 0.63  | 1    | 0.0  | 3802  | 0.63  | 1    | 0.0  |
| M408-2   | 3302       | 3302 | 3302 | 36.4  | 3302 | 0.0  | 3512↑ | 0.0  | 6.0  | 3310↑ | 0.36 | 0.2  | 3302  | 0.61  | 2    | 0.0  | 3302  | 0.89  | 2    | 0.0  |
| M408-3   | 3147       | 3147 | 3147 | 19.1  | 3147 | 0.0  | 3339↑ | 0.0  | 5.8  | 3147  | 0.21 | 0.0  | 3147  | 0.21  | 1    | 0.0  | 3147  | 0.21  | 1    | 0.0  |
| M409-1   | 3602       | 3602 | 3602 | 47.9  | 3602 | 0.0  | 3923↑ | 0.0  | 8.2  | 3602  | 0.21 | 0.0  | 3602  | 0.21  | 1    | 0.0  | 3602  | 0.21  | 1    | 0.0  |
| M409-2   | 4222       | 4222 | 4222 | 180.0 | 4222 | 0.0  | 4436↑ | 0.0  | 4.8  | 4222  | 0.58 | 0.0  | 4222  | 0.58  | 1    | 0.0  | 4222  | 0.58  | 1    | 0.0  |
| M409-3   | 3365       | 3365 | 3365 | 29.7  | 3365 | 0.0  | 3494↑ | 0.0  | 3.7  | 3365  | 0.25 | 0.0  | 3365  | 0.25  | 1    | 0.0  | 3365  | 0.25  | 1    | 0.0  |
| M410-1   | 3000       | 3000 | 3000 | 30.9  | 3000 | 0.0  | 3200↑ | 0.0  | 6.3  | 3000  | 0.11 | 0.0  | 3000  | 0.11  | 1    | 0.0  | 3000  | 0.11  | 1    | 0.0  |
| M410-2   | 4340       | 4340 | 4340 | 124.1 | 4340 | 0.0  | 4439↑ | 0.0  | 2.2  | 4340  | 0.71 | 0.0  | 4340  | 0.71  | 1    | 0.0  | 4340  | 0.71  | 1    | 0.0  |
| M410-3   | 3235       | 3235 | 3235 | 25.3  | 3235 | 0.0  | 3338↑ | 0.0  | 3.1  | 3235  | 0.10 | 0.0  | 3235  | 0.10  | 1    | 0.0  | 3235  | 0.10  | 1    | 0.0  |
| M501-1   | 1864       | 1864 | 1864 | 44.3  | 1864 | 0.0  | 1930↑ | 0.0  | 3.4  | 1864  | 0.28 | 0.0  | 1864  | 0.28  | 1    | 0.0  | 1864  | 0.28  | 1    | 0.0  |
| M501-2   | 1683       | 1683 | 1683 | 43.0  | 1683 | 0.0  | 1757↑ | 0.0  | 4.2  | 1683  | 0.09 | 0.0  | 1683  | 0.09  | 1    | 0.0  | 1683  | 0.09  | 1    | 0.0  |
| M501-3   | 1708       | 1708 | 1708 | 83.7  | 1708 | 0.0  | 1719↑ | 0.0  | 0.6  | 1708  | 0.53 | 0.0  | 1708  | 0.53  | 1    | 0.0  | 1708  | 0.53  | 1    | 0.0  |
| M502-1   | 1972       | 1972 | 1972 | 179.5 | 1972 | 0.0  | 1994↑ | 0.0  | 1.1  | 1972  | 0.88 | 0.0  | 1972  | 0.88  | 1    | 0.0  | 1972  | 0.88  | 1    | 0.0  |
| M502-2   | 1805       | 1805 | 1805 | 11.2  | 1805 | 0.0  | 1936↑ | 0.0  | 6.8  | 1805  | 0.07 | 0.0  | 1805  | 0.07  | 1    | 0.0  | 1805  | 0.07  | 1    | 0.0  |
| M502-3   | 1930       | 1930 | 1930 | 32.5  | 1930 | 0.0  | 1968↑ | 0.0  | 1.9  | 1930  | 0.12 | 0.0  | 1930  | 0.12  | 1    | 0.0  | 1930  | 0.12  | 1    | 0.0  |
| M503-1   | 1889       | 1889 | 1889 | 26.4  | 1889 | 0.0  | 1916↑ | 0.0  | 1.4  | 1889  | 0.38 | 0.0  | 1889  | 0.38  | 1    | 0.0  | 1889  | 0.38  | 1    | 0.0  |
| M503-2   | 2220       | 2220 | 2220 | 43.8  | 2220 | 0.0  | 2389↑ | 0.1  | 7.1  | 2220  | 0.42 | 0.0  | 2220  | 0.42  | 1    | 0.0  | 2220  | 0.42  | 1    | 0.0  |
| M503-3   | 1571       | 1571 | 1571 | 23.4  | 1571 | 0.0  | 1610↑ | 0.0  | 2.4  | 1571  | 0.07 | 0.0  | 1571  | 0.07  | 1    | 0.0  | 1571  | 0.07  | 1    | 0.0  |
| M504-1   | 2179       | 2179 | 2179 | 208.1 | 2179 | 0.0  | 2260↑ | 0.0  | 3.6  | 2184↑ | 0.67 | 0.2  | 2179  | 3.32  | 5    | 0.0  | 2179  | 2.16  | 3    | 0.0  |
| M504-2   | 1902       | 1902 | 1902 | 30.6  | 1902 | 0.0  | 1943↑ | 0.0  | 2.1  | 1902  | 0.10 | 0.0  | 1902  | 0.10  | 1    | 0.0  | 1902  | 0.10  | 1    | 0.0  |
| M504-3   | 1870       | 1870 | 1870 | 104.0 | 1870 | 0.0  | 1977↑ | 0.0  | 5.4  | 1870  | 0.17 | 0.0  | 1870  | 0.17  | 1    | 0.0  | 1870  | 0.17  | 1    | 0.0  |
| M505-1   | 1998       | 1998 | 1998 | 111.6 | 1998 | 0.0  | 2080↑ | 0.0  | 3.9  | 1998  | 0.57 | 0.0  | 1998  | 0.57  | 1    | 0.0  | 1998  | 0.57  | 1    | 0.0  |
| M505-2   | 1781       | 1781 | 1781 | 53.1  | 1781 | 0.0  | 1853↑ | 0.0  | 3.9  | 1781  | 0.48 | 0.0  | 1781  | 0.48  | 1    | 0.0  | 1781  | 0.48  | 1    | 0.0  |
| M505-3   | 1869       | 1869 | 1869 | 225.1 | 1869 | 0.0  | 2046↑ | 0.1  | 8.7  | 1869  | 0.86 | 0.0  | 1869  | 0.86  | 1    | 0.0  | 1869  | 0.86  | 1    | 0.0  |
| M506-1   | 1803       | 1803 | 1803 | 22.0  | 1803 | 0.0  | 1973↑ | 0.0  | 8.6  | 1803  | 0.11 | 0.0  | 1803  | 0.11  | 1    | 0.0  | 1803  | 0.11  | 1    | 0.0  |
| M506-2   | 1943       | 1943 | 1943 | 97.9  | 1943 | 0.0  | 1983↑ | 0.0  | 2.0  | 1943  | 0.33 | 0.0  | 1943  | 0.33  | 1    | 0.0  | 1943  | 0.33  | 1    | 0.0  |
| M506-3   | 2001       | 2001 | 2001 | 73.1  | 2001 | 0.0  | 2238↑ | 0.1  | 10.6 | 2001  | 0.44 | 0.0  | 2001  | 0.44  | 1    | 0.0  | 2001  | 0.44  | 1    | 0.0  |
| M507-1   | 2075       | 2075 | 2075 | 54.5  | 2075 | 0.0  | 2285↑ | 0.0  | 9.2  | 2075  | 0.16 | 0.0  | 2075  | 0.16  | 1    | 0.0  | 2075  | 0.16  | 1    | 0.0  |
| M507-2   | 1878       | 1878 | 1878 | 33.4  | 1878 | 0.0  | 1943↑ | 0.0  | 3.3  | 1878  | 0.19 | 0.0  | 1878  | 0.19  | 1    | 0.0  | 1878  | 0.19  | 1    | 0.0  |
| M507-3   | 1791       | 1791 | 1791 | 208.3 | 1791 | 0.0  | 1864↑ | 0.1  | 3.9  | 1791  | 1.04 | 0.0  | 1791  | 1.04  | 1    | 0.0  | 1791  | 1.04  | 1    | 0.0  |
| M508-1   | 1656       | 1656 | 1656 | 49.7  | 1656 | 0.0  | 1702↑ | 0.0  | 2.7  | 1656  | 0.32 | 0.0  | 1656  | 0.32  | 1    | 0.0  | 1656  | 0.32  | 1    | 0.0  |
| M508-2   | 1570       | 1570 | 1570 | 88.2  | 1570 | 0.0  | 1630↑ | 0.0  | 3.7  | 1570  | 0.47 | 0.0  | 1570  | 0.47  | 1    | 0.0  | 1570  | 0.47  | 1    | 0.0  |
| M508-3   | 1765       | 1765 | 1765 | 57.7  | 1765 | 0.0  | 1785↑ | 0.0  | 1.1  | 1765  | 0.31 | 0.0  | 1765  | 0.31  | 1    | 0.0  | 1765  | 0.31  | 1    | 0.0  |
| M509-1   | 1710       | 1710 | 1710 | 33.1  | 1710 | 0.0  | 1778↑ | 0.0  | 3.8  | 1710  | 0.29 | 0.0  | 1710  | 0.29  | 1    | 0.0  | 1710  | 0.29  | 1    | 0.0  |
| M509-2   | 1769       | 1769 | 1769 | 97.8  | 1769 | 0.0  | 1786↑ | 0.0  | 1.0  | 1769  | 0.53 | 0.0  |       |       |      |      |       |       |      |      |



Table EC.15 MMR-SCP results for type-K instances

| instance | Best Known |       | B&C    |        |       |      | Fix    |      |      | DS     |         |      | iDS-H  |        |      |      | iDS-B  |        |      |       |
|----------|------------|-------|--------|--------|-------|------|--------|------|------|--------|---------|------|--------|--------|------|------|--------|--------|------|-------|
|          | LB         | UB    | obj    | time   | LB    | %gap | obj    | time | %gap | obj    | time    | %gap | obj    | time   | iter | %gap | obj    | time   | iter | %gap  |
| K401-1   | 13365      | 14440 | 14467↑ | 3333.3 | 13860 | 4.2  | 15596↑ | 1.8  | 11.1 | 14440  | 20.403  | 4.0  | 14440  | 20.4   | 1    | 4.0  | 14440  | 20.4   | 1    | 4.0   |
| K401-2   | 14026      | 16372 | 16779↑ | 3512.3 | 13688 | 16.4 | 16863↑ | 2.2  | 16.8 | 16247↓ | 419.292 | 13.7 | 16243↓ | 897.8  | 2    | 13.6 | 16243↓ | 912.1  | 2    | 13.6  |
| K401-3   | 11803      | 12974 | 13079↑ | 3427.3 | 11778 | 9.8  | 13294↑ | 0.4  | 11.2 | 12974  | 45.133  | 9.0  | 12974  | 45.2   | 1    | 9.0  | 12974  | 45.1   | 1    | 9.0   |
| K402-1   | 12628      | 14235 | 14591↑ | 3440.1 | 12589 | 13.5 | 15578↑ | 0.8  | 18.9 | 14235  | 77.207  | 11.3 | 14235  | 77.2   | 1    | 11.3 | 14235  | 77.2   | 1    | 11.3  |
| K402-2   | 14325      | 16335 | 16879↑ | 3041.9 | 14216 | 15.1 | 18522↑ | 2.3  | 22.7 | 16351↑ | 155.660 | 12.4 | 16335  | 496.7  | 3    | 12.3 | 16335  | 488.5  | 3    | 12.3  |
| K402-3   | 12445      | 14306 | 14506↑ | 3581.1 | 12428 | 14.2 | 15158↑ | 1.5  | 17.9 | 14306  | 351.183 | 13.0 | 14306  | 351.2  | 1    | 13.0 | 14306  | 351.4  | 1    | 13.0  |
| K403-1   | 14031      | 15139 | 15180↑ | 2872.2 | 14273 | 6.0  | 15968↑ | 0.3  | 10.6 | 15139  | 28.780  | 5.7  | 15139  | 28.8   | 1    | 5.7  | 15139  | 28.8   | 1    | 5.7   |
| K403-2   | 14349      | 16523 | 17066↑ | 3264.5 | 14147 | 15.9 | 17286↑ | 1.6  | 17.0 | 16523  | 176.895 | 13.2 | 16523  | 177.3  | 1    | 13.2 | 16523  | 177.6  | 1    | 13.2  |
| K403-3   | 12436      | 13613 | 13613  | 2468.9 | 12756 | 6.3  | 14831↑ | 0.5  | 14.0 | 13613  | 30.240  | 6.3  | 13613  | 30.2   | 1    | 6.3  | 13613  | 30.2   | 1    | 6.3   |
| K404-1   | 13046      | 13472 | 13472  | 1895.2 | 13472 | 0.0  | 15069↑ | 0.3  | 10.6 | 13472  | 9.412   | 0.0  | 13472  | 9.4    | 1    | 0.0  | 13472  | 9.4    | 1    | 0.0   |
| K404-2   | 13291      | 15871 | 16347↑ | 3510.2 | 13249 | 18.7 | 17252↑ | 1.8  | 23.0 | 15820↓ | 580.562 | 16.0 | 15820↓ | 580.6  | 1    | 16.0 | 15813↓ | 3600.0 | 7    | 15.9  |
| K404-3   | 13255      | 14898 | 15216↑ | 2512.3 | 13039 | 12.9 | 15494↑ | 0.4  | 14.5 | 14954↑ | 38.057  | 11.4 | 14881↓ | 152.8  | 4    | 10.9 | 14881↓ | 146.6  | 4    | 10.9  |
| K405-1   | 13518      | 16242 | 16784↑ | 2391.4 | 13612 | 18.9 | 17670↑ | 1.8  | 23.0 | 16242  | 296.749 | 16.2 | 16242  | 297.8  | 1    | 16.2 | 16242  | 296.7  | 1    | 16.2  |
| K405-2   | 14204      | 16311 | 16596↑ | 1653.6 | 14290 | 13.9 | 17223↑ | 1.6  | 17.0 | 16355↑ | 77.639  | 12.6 | 16311  | 372.7  | 4    | 12.4 | 16311  | 348.7  | 4    | 12.4  |
| K405-3   | 12933      | 14549 | 14655↑ | 3247.5 | 12916 | 11.8 | 15568↑ | 1.2  | 16.9 | 14549  | 71.876  | 11.1 | 14539↓ | 147.4  | 2    | 11.0 | 14539↓ | 167.1  | 2    | 11.0  |
| K406-1   | 12885      | 14067 | 14607  | 2826.2 | 13051 | 7.2  | 15259↑ | 1.1  | 14.5 | 14067  | 90.892  | 7.2  | 14067  | 91.1   | 1    | 7.2  | 14067  | 90.9   | 1    | 7.2   |
| K406-2   | 12522      | 14551 | 15202↑ | 2599.6 | 12411 | 17.6 | 16319↑ | 4.2  | 23.3 | 14555↑ | 199.734 | 14.0 | 14551  | 427.5  | 2    | 13.9 | 14551  | 390.6  | 2    | 13.9  |
| K406-3   | 12312      | 13941 | 14110↑ | 3225.6 | 12113 | 12.7 | 14915↑ | 1.2  | 17.5 | 13941  | 177.886 | 11.7 | 13941  | 178.4  | 1    | 11.7 | 13941  | 177.9  | 1    | 11.7  |
| K407-1   | 13055      | 14928 | 15533↑ | 2224.7 | 13021 | 16.0 | 15627↑ | 0.9  | 16.5 | 14908↓ | 123.242 | 12.4 | 14908↓ | 123.9  | 1    | 12.4 | 14908↓ | 123.2  | 1    | 12.4  |
| K407-2   | 13509      | 15875 | 16118↑ | 2995.0 | 13865 | 14.0 | 16735↑ | 2.0  | 17.1 | 15901↑ | 380.145 | 12.8 | 15875  | 1166.1 | 3    | 12.7 | 15875  | 1151.9 | 3    | 12.7  |
| K407-3   | 13465      | 15262 | 15958↑ | 2586.2 | 13476 | 15.6 | 16411↑ | 1.1  | 17.9 | 15268↑ | 41.457  | 11.7 | 15262  | 246.8  | 5    | 11.7 | 15262  | 108.8  | 2    | 11.7  |
| K408-1   | 12193      | 13752 | 13654↓ | 2178.6 | 12177 | 10.7 | 14547↑ | 0.9  | 16.2 | 13654↓ | 91.841  | 10.7 | 13654↓ | 91.8   | 1    | 10.7 | 13654↓ | 92.0   | 1    | 10.7  |
| K408-2   | 13907      | 15843 | 16464↑ | 3273.1 | 13901 | 15.5 | 17413↑ | 1.2  | 20.1 | 15843  | 47.826  | 12.2 | 15843  | 47.9   | 1    | 12.2 | 15843  | 47.8   | 1    | 12.2  |
| K408-3   | 12430      | 13566 | 13731↑ | 3344.7 | 12591 | 8.3  | 14096↑ | 0.3  | 10.7 | 13566  | 34.834  | 7.2  | 13566  | 34.8   | 1    | 7.2  | 13566  | 34.8   | 1    | 7.2   |
| K409-1   | 13283      | 14872 | 15282↑ | 1428.6 | 12991 | 13.1 | 15680↑ | 1.5  | 15.3 | 14872  | 160.887 | 10.7 | 14872  | 161.2  | 1    | 10.7 | 14872  | 160.9  | 1    | 10.7  |
| K409-2   | 12285      | 14020 | 14037↑ | 3471.0 | 12450 | 11.3 | 14963↑ | 1.6  | 16.8 | 13971↓ | 117.825 | 10.9 | 13971↓ | 117.8  | 1    | 10.9 | 13971↓ | 117.8  | 1    | 10.9  |
| K409-3   | 12949      | 14414 | 14414  | 3550.9 | 12948 | 10.2 | 15399↑ | 0.6  | 15.9 | 14414  | 50.856  | 10.2 | 14414  | 50.9   | 1    | 10.2 | 14414  | 50.9   | 1    | 10.2  |
| K410-1   | 13049      | 15367 | 15996↑ | 2464.7 | 13213 | 17.4 | 16495↑ | 0.7  | 19.9 | 15287↓ | 93.437  | 13.6 | 15254↓ | 316.7  | 3    | 13.4 | 15254↓ | 291.5  | 3    | 13.4  |
| K410-2   | 14265      | 15903 | 15903  | 2990.0 | 14345 | 9.8  | 17072↑ | 1.6  | 16.0 | 15903  | 168.399 | 9.8  | 15903  | 168.4  | 1    | 9.8  | 15903  | 168.7  | 1    | 9.8   |
| K410-3   | 13983      | 16635 | 17334↑ | 3352.4 | 13976 | 19.3 | 16922↑ | 0.7  | 17.4 | 16635  | 344.680 | 15.9 | 16635  | 346.0  | 1    | 15.9 | 16635  | 346.3  | 1    | 15.9  |
| K501-1   | 10925      | 11743 | 11824↑ | 2822.8 | 11277 | 4.6  | 12012↑ | 1.0  | 6.1  | 11743  | 36.964  | 4.0  | 11743  | 37.0   | 1    | 4.0  | 11743  | 37.0   | 1    | 4.0   |
| K501-2   | 10997      | 11899 | 11899  | 2034.0 | 11226 | 5.7  | 12528↑ | 0.5  | 10.4 | 11899  | 16.887  | 5.7  | 11899  | 16.9   | 1    | 5.7  | 11899  | 16.9   | 1    | 5.7   |
| K501-3   | 11328      | 11631 | 11631  | 1974.4 | 11631 | 0.0  | 12195↑ | 1.3  | 4.6  | 11631  | 12.344  | 0.0  | 11631  | 12.3   | 1    | 0.0  | 11631  | 12.3   | 1    | 0.0   |
| K502-1   | 9891       | 10144 | 10144  | 2570.6 | 10144 | 0.0  | 10641↑ | 0.3  | 4.7  | 10152↑ | 15.681  | 0.1  | 10144  | 67.2   | 3    | 0.0  | 10144  | 58.5   | 3    | 0.0   |
| K502-2   | 11450      | 12422 | 12422  | 3084.1 | 11689 | 5.9  | 13232↑ | 2.6  | 11.7 | 12422  | 125.340 | 5.9  | 12422  | 125.3  | 1    | 5.9  | 12422  | 125.3  | 1    | 5.9   |
| K502-3   | 10465      | 11016 | 11016  | 2824.6 | 10668 | 3.2  | 11858↑ | 1.9  | 10.0 | 11016  | 18.901  | 3.2  | 11016  | 18.9   | 1    | 3.2  | 11016  | 18.9   | 1    | 3.2   |
| K503-1   | 10263      | 10265 | 10265  | 74.2   | 10265 | 0.0  | 10486↑ | 0.9  | 2.1  | 10291↑ | 4.596   | 0.3  | 10265  | 9.2    | 2    | 0.0  | 10265  | 9.5    | 2    | 0.0   |
| K503-2   | 11305      | 12321 | 12321  | 2744.5 | 11657 | 5.4  | 13362↑ | 1.0  | 12.8 | 12321  | 22.899  | 5.4  | 12321  | 22.9   | 1    | 5.4  | 12321  | 22.9   | 1    | 5.4   |
| K503-3   | 10650      | 11957 | 11912↓ | 3549.9 | 10876 | 8.7  | 12205↑ | 0.6  | 10.9 | 11919↓ | 69.742  | 8.8  | 11912↓ | 134.9  | 2    | 8.7  | 11912↓ | 128.8  | 2    | 8.7   |
| K504-1   | 10931      | 11429 | 11496↑ | 3346.2 | 11229 | 2.3  | 12612↑ | 0.6  | 11.0 | 11429  | 7.445   | 1.7  | 11429  | 7.4    | 1    | 1.7  | 11429  | 7.4    | 1    | 1.7   |
| K504-2   | 12234      | 13388 | 13599↑ | 3106.7 | 12311 | 9.5  | 14208↑ | 1.0  | 13.4 | 13388  | 30.963  | 8.0  | 13388  | 31.0   | 1    | 8.0  | 13388  | 31.0   | 1    | 8.0   |
| K504-3   | 11281      | 11943 | 11943  | 2447.6 | 11453 | 4.1  | 12923↑ | 1.2  | 11.4 | 11943  | 22.659  | 4.1  | 11943  | 22.7   | 1    | 4.1  | 11943  | 22.7   | 1    | 4.1   |
| K505-1   | 11342      | 12102 | 12102  | 2531.4 | 11454 | 5.4  | 12485↑ | 1.9  | 8.3  | 12116↑ | 10.666  | 5.5  | 12102  | 20.6   | 2    | 5.4  | 12102  | 21.4   | 2    | 5.4   |
| K505-2   | 11847      | 13663 | 13848↑ | 2253.3 | 11849 | 14.4 | 14360↑ | 0.8  | 17.5 | 13663  | 342.522 | 13.3 | 13663  | 342.5  | 1    | 13.3 | 13663  | 342.7  | 1    | 13.3  |
| K505-3   | 10815      | 12159 | 12614↑ | 3029.9 | 10964 | 13.1 | 13213↑ | 2.9  | 17.0 | 12159  | 253.301 | 9.8  | 12159  | 253.3  | 1    | 9.8  | 12159  | 253.3  | 1    | 9.8   |
| K506-1   | 10047      | 10232 | 10232  | 400.9  | 10232 | 0.0  | 11180↑ | 1.0  | 8.5  | 10232  | 10.340  | 0.0  | 10232  | 10.3   | 1    | 0.0  | 10232  | 10.3   | 1    | 0.0   |
| K506-2   | 11645      | 12236 | 12236  | 3443.6 | 11795 | 3.6  | 12399↑ | 3.7  | 4.9  | 12237↑ | 31.781  | 3.6  | 12236  | 64.9   | 2    | 3.6  | 12236  | 63.6   | 2    | 3.6   |
| K506-3   | 9858       | 10291 | 10291  | 2281.8 | 10291 | 0.0  | 10804↑ | 0.5  | 4.7  | 10291  | 10.506  | 0.0  | 10291  | 10.5   | 1    | 0.0  | 10291  | 10.5   | 1    | 0.0   |
| K507-1   | 10605      | 10661 | 10661  | 450.8  | 10661 | 0.0  | 11034↑ | 0.3  | 3.4  | 10661  | 3.128   | 0.0  | 10661  | 3.1    | 1    | 0.0  | 10661  | 3.1    | 1    | 0.0   |
| K507-2   | 11591      | 12200 | 12200  | 2732.5 | 11738 | 3.8  | 12570↑ | 0.6  | 6.6  | 12200  | 27.002  | 3.8  | 12200  | 27.0   | 1    | 3.8  | 12200  | 27.0   | 1    | 3.8   |
| K507-3   | 10506      | 11105 | 11105  | 3512.5 | 10948 | 1.4  | 11945↑ | 0.8  | 8.3  | 11105  | 16.122  | 1.4  | 11105  | 16.1   | 1    | 1.4  | 11105  | 16.1   | 1    | 1.4</ |

**Table EC.16** MMR-GAP results for type-A instances

| instance   | Best Known |     | B&C  |        |     |      | Fix  |      |      | DS  |      |      | iDS-H |       |      |      | iDS-B |       |          |      |
|------------|------------|-----|------|--------|-----|------|------|------|------|-----|------|------|-------|-------|------|------|-------|-------|----------|------|
|            | LB         | UB  | obj  | time   | LB  | %gap | obj  | time | %gap | obj | time | %gap | obj   | time  | iter | %gap | obj   | time  | iter     | %gap |
| a0504010-1 | 16         | 16  | 16   | 0.2    | 16  | 0.0  | 16   | 0.0  | 0.0  | 16  | 0.0  | 0.0  | 16    | 0.0   | 1    | 0.0  | 16    | 0.0   | 1        | 0.0  |
| a0504010-2 | 18         | 18  | 18   | 0.1    | 18  | 0.0  | 18   | 0.0  | 0.0  | 18  | 0.0  | 0.0  | 18    | 0.0   | 1    | 0.0  | 18    | 0.0   | 1        | 0.0  |
| a0504010-3 | 5          | 5   | 5    | 0.1    | 5   | 0.0  | 5    | 0.0  | 0.0  | 5   | 0.0  | 0.0  | 5     | 0.0   | 1    | 0.0  | 5     | 0.0   | 1        | 0.0  |
| a0504010-4 | 18         | 18  | 18   | 0.1    | 18  | 0.0  | 18   | 0.0  | 0.0  | 18  | 0.0  | 0.0  | 18    | 0.0   | 1    | 0.0  | 18    | 0.0   | 1        | 0.0  |
| a0504010-5 | 12         | 12  | 12   | 0.1    | 12  | 0.0  | 13↑  | 0.0  | 7.7  | 12  | 0.0  | 0.0  | 12    | 0.0   | 1    | 0.0  | 12    | 0.0   | 1        | 0.0  |
| a0504025-1 | 80         | 80  | 80   | 5.5    | 80  | 0.0  | 81↑  | 0.0  | 1.2  | 81↑ | 0.1  | 1.2  | 80    | 0.1   | 2    | 0.0  | 80    | 0.1   | 2        | 0.0  |
| a0504025-2 | 67         | 67  | 67   | 0.7    | 67  | 0.0  | 67   | 0.0  | 0.0  | 67  | 0.0  | 0.0  | 67    | 0.0   | 1    | 0.0  | 67    | 0.0   | 1        | 0.0  |
| a0504025-3 | 59         | 59  | 59   | 0.4    | 59  | 0.0  | 59   | 0.0  | 0.0  | 59  | 0.0  | 0.0  | 59    | 0.0   | 1    | 0.0  | 59    | 0.0   | 1        | 0.0  |
| a0504025-4 | 71         | 71  | 71   | 1.0    | 71  | 0.0  | 71   | 0.0  | 0.0  | 71  | 0.1  | 0.0  | 71    | 0.1   | 1    | 0.0  | 71    | 0.1   | 1        | 0.0  |
| a0504025-5 | 84         | 84  | 84   | 4.0    | 84  | 0.0  | 89↑  | 0.0  | 5.6  | 86↑ | 0.2  | 2.3  | 84    | 0.5   | 2    | 0.0  | 84    | 0.4   | 2        | 0.0  |
| a0504050-1 | 235        | 261 | 261  | 1164.8 | 261 | 0.0  | 261  | 0.0  | 0.0  | 261 | 0.2  | 0.0  | 261   | 0.2   | 1    | 0.0  | 261   | 0.2   | 1        | 0.0  |
| a0504050-2 | 182        | 204 | 204  | 447.1  | 204 | 0.0  | 205↑ | 0.0  | 0.5  | 204 | 0.1  | 0.0  | 204   | 0.1   | 1    | 0.0  | 204   | 0.1   | 1        | 0.0  |
| a0504050-3 | 153        | 164 | 164  | 44.5   | 164 | 0.0  | 164  | 0.0  | 0.0  | 164 | 0.0  | 0.0  | 164   | 0.0   | 1    | 0.0  | 164   | 0.0   | 1        | 0.0  |
| a0504050-4 | 215        | 227 | 227  | 39.3   | 227 | 0.0  | 227  | 0.0  | 0.0  | 227 | 0.1  | 0.0  | 227   | 0.1   | 1    | 0.0  | 227   | 0.1   | 1        | 0.0  |
| a0504050-5 | 198        | 219 | 219  | 59.5   | 219 | 0.0  | 219  | 0.0  | 0.0  | 219 | 0.2  | 0.0  | 219   | 0.2   | 1    | 0.0  | 219   | 0.2   | 1        | 0.0  |
| a0508010-1 | 23         | 23  | 23   | 0.4    | 23  | 0.0  | 23   | 0.0  | 0.0  | 23  | 0.0  | 0.0  | 23    | 0.0   | 1    | 0.0  | 23    | 0.0   | 1        | 0.0  |
| a0508010-2 | 29         | 29  | 29   | 1.3    | 29  | 0.0  | 29   | 0.0  | 0.0  | 29  | 0.0  | 0.0  | 29    | 0.0   | 1    | 0.0  | 29    | 0.0   | 1        | 0.0  |
| a0508010-3 | 19         | 19  | 19   | 0.2    | 19  | 0.0  | 20↑  | 0.0  | 5.0  | 20↑ | 0.1  | 5.0  | 19    | 0.2   | 3    | 0.0  | 19    | 0.1   | <b>2</b> | 0.0  |
| a0508010-4 | 27         | 27  | 27   | 0.3    | 27  | 0.0  | 28↑  | 0.0  | 3.6  | 27  | 0.0  | 0.0  | 27    | 0.0   | 1    | 0.0  | 27    | 0.0   | 1        | 0.0  |
| a0508010-5 | 27         | 27  | 27   | 0.4    | 27  | 0.0  | 27   | 0.0  | 0.0  | 27  | 0.1  | 0.0  | 27    | 0.1   | 1    | 0.0  | 27    | 0.1   | 1        | 0.0  |
| a0508025-1 | 118        | 141 | 143↑ | 38.3   | 131 | 8.4  | 141  | 0.0  | 7.1  | 141 | 0.1  | 7.1  | 141   | 0.2   | 1    | 7.1  | 141   | 0.2   | 1        | 7.1  |
| a0508025-2 | 100        | 108 | 108  | 256.1  | 108 | 0.0  | 108  | 0.0  | 0.0  | 108 | 0.1  | 0.0  | 108   | 0.1   | 1    | 0.0  | 108   | 0.1   | 1        | 0.0  |
| a0508025-3 | 83         | 91  | 91   | 108.6  | 91  | 0.0  | 93↑  | 0.0  | 2.2  | 91  | 0.2  | 0.0  | 91    | 0.2   | 1    | 0.0  | 91    | 0.2   | 1        | 0.0  |
| a0508025-4 | 104        | 116 | 116  | 516.9  | 116 | 0.0  | 116  | 0.0  | 0.0  | 116 | 0.1  | 0.0  | 116   | 0.1   | 1    | 0.0  | 116   | 0.1   | 1        | 0.0  |
| a0508025-5 | 96         | 105 | 105  | 132.3  | 105 | 0.0  | 105  | 0.0  | 0.0  | 105 | 0.1  | 0.0  | 105   | 0.1   | 1    | 0.0  | 105   | 0.1   | 1        | 0.0  |
| a0508050-1 | 300        | 427 | 436↑ | 3563.4 | 336 | 22.9 | 427  | 0.0  | 21.3 | 427 | 1.0  | 21.3 | 427   | 1.0   | 1    | 21.3 | 427   | 1.0   | 1        | 21.3 |
| a0508050-2 | 291        | 388 | 396↑ | 91.9   | 324 | 18.2 | 388  | 0.0  | 16.5 | 388 | 0.3  | 16.5 | 388   | 0.3   | 1    | 16.5 | 388   | 0.3   | 1        | 16.5 |
| a0508050-3 | 348        | 487 | 493↑ | 136.0  | 391 | 20.7 | 487  | 0.0  | 19.7 | 487 | 1.2  | 19.7 | 487   | 1.2   | 1    | 19.7 | 487   | 1.2   | 1        | 19.7 |
| a0508050-4 | 307        | 390 | 394↑ | 630.4  | 344 | 12.7 | 395↑ | 0.0  | 12.9 | 390 | 0.2  | 11.8 | 390   | 0.2   | 1    | 11.8 | 390   | 0.2   | 1        | 11.8 |
| a0508050-5 | 307        | 418 | 438↑ | 2952.9 | 337 | 23.1 | 421↑ | 0.0  | 20.0 | 418 | 0.5  | 19.4 | 418   | 0.5   | 1    | 19.4 | 418   | 0.5   | 1        | 19.4 |
| a1004010-1 | 14         | 14  | 14   | 0.3    | 14  | 0.0  | 15↑  | 0.0  | 6.7  | 14  | 0.0  | 0.0  | 14    | 0.0   | 1    | 0.0  | 14    | 0.0   | 1        | 0.0  |
| a1004010-2 | 16         | 16  | 16   | 0.4    | 16  | 0.0  | 16   | 0.0  | 0.0  | 16  | 0.0  | 0.0  | 16    | 0.0   | 1    | 0.0  | 16    | 0.0   | 1        | 0.0  |
| a1004010-3 | 14         | 14  | 14   | 0.3    | 14  | 0.0  | 14   | 0.0  | 0.0  | 14  | 0.0  | 0.0  | 14    | 0.0   | 1    | 0.0  | 14    | 0.0   | 1        | 0.0  |
| a1004010-4 | 13         | 13  | 13   | 0.3    | 13  | 0.0  | 13   | 0.0  | 0.0  | 13  | 0.0  | 0.0  | 13    | 0.0   | 1    | 0.0  | 13    | 0.0   | 1        | 0.0  |
| a1004010-5 | 16         | 16  | 16   | 0.3    | 16  | 0.0  | 17↑  | 0.0  | 5.9  | 16  | 0.1  | 0.0  | 16    | 0.1   | 1    | 0.0  | 16    | 0.1   | 1        | 0.0  |
| a1004025-1 | 78         | 78  | 78   | 11.9   | 78  | 0.0  | 80↑  | 0.0  | 2.5  | 78  | 0.2  | 0.0  | 78    | 0.2   | 1    | 0.0  | 78    | 0.2   | 1        | 0.0  |
| a1004025-2 | 54         | 54  | 54   | 1.4    | 54  | 0.0  | 56↑  | 0.0  | 3.6  | 54  | 0.0  | 0.0  | 54    | 0.0   | 1    | 0.0  | 54    | 0.0   | 1        | 0.0  |
| a1004025-3 | 64         | 64  | 64   | 5.0    | 64  | 0.0  | 64   | 0.0  | 0.0  | 64  | 0.1  | 0.0  | 64    | 0.1   | 1    | 0.0  | 64    | 0.1   | 1        | 0.0  |
| a1004025-4 | 45         | 45  | 45   | 0.4    | 45  | 0.0  | 45   | 0.0  | 0.0  | 45  | 0.0  | 0.0  | 45    | 0.0   | 1    | 0.0  | 45    | 0.0   | 1        | 0.0  |
| a1004025-5 | 73         | 73  | 73   | 1.4    | 73  | 0.0  | 74↑  | 0.0  | 1.4  | 75↑ | 0.2  | 2.7  | 73    | 0.7   | 4    | 0.0  | 73    | 0.8   | 4        | 0.0  |
| a1004050-1 | 184        | 211 | 210↓ | 1657.0 | 200 | 4.8  | 214↑ | 0.0  | 6.5  | 211 | 0.2  | 5.2  | 210↓  | 2.1   | 9    | 4.8  | 210↓  | 2.4   | 9        | 4.8  |
| a1004050-2 | 165        | 182 | 182  | 616.0  | 182 | 0.0  | 184↑ | 0.0  | 1.1  | 182 | 0.1  | 0.0  | 182   | 0.1   | 1    | 0.0  | 182   | 0.1   | 1        | 0.0  |
| a1004050-3 | 181        | 206 | 206  | 1175.6 | 197 | 4.4  | 209↑ | 0.0  | 5.7  | 206 | 0.3  | 4.4  | 206   | 0.3   | 1    | 4.4  | 206   | 0.3   | 1        | 4.4  |
| a1004050-4 | 161        | 169 | 169  | 145.7  | 169 | 0.0  | 170↑ | 0.0  | 0.6  | 169 | 0.1  | 0.0  | 169   | 0.1   | 1    | 0.0  | 169   | 0.1   | 1        | 0.0  |
| a1004050-5 | 178        | 206 | 205↓ | 2423.1 | 197 | 3.9  | 208↑ | 0.0  | 5.3  | 206 | 0.6  | 4.4  | 205↓  | 1.9   | 3    | 3.9  | 205↓  | 1.9   | 3        | 3.9  |
| a1008010-1 | 22         | 22  | 22   | 4.4    | 22  | 0.0  | 23↑  | 0.0  | 4.3  | 22  | 0.0  | 0.0  | 22    | 0.0   | 1    | 0.0  | 22    | 0.0   | 1        | 0.0  |
| a1008010-2 | 34         | 34  | 34   | 1.4    | 34  | 0.0  | 34   | 0.0  | 0.0  | 34  | 0.1  | 0.0  | 34    | 0.1   | 1    | 0.0  | 34    | 0.1   | 1        | 0.0  |
| a1008010-3 | 36         | 39  | 39   | 4.4    | 39  | 0.0  | 39   | 0.0  | 0.0  | 39  | 0.2  | 0.0  | 39    | 0.2   | 1    | 0.0  | 39    | 0.2   | 1        | 0.0  |
| a1008010-4 | 16         | 16  | 16   | 0.8    | 16  | 0.0  | 18↑  | 0.0  | 11.1 | 16  | 0.0  | 0.0  | 16    | 0.0   | 1    | 0.0  | 16    | 0.0   | 1        | 0.0  |
| a1008010-5 | 29         | 29  | 29   | 2.2    | 29  | 0.0  | 29   | 0.0  | 0.0  | 29  | 0.1  | 0.0  | 29    | 0.1   | 1    | 0.0  | 29    | 0.1   | 1        | 0.0  |
| a1008025-1 | 77         | 87  | 87   | 3524.3 | 84  | 3.4  | 87   | 0.0  | 3.4  | 87  | 0.1  | 3.4  | 87    | 0.1   | 1    | 3.4  | 87    | 0.1   | 1        | 3.4  |
| a1008025-2 | 103        | 117 | 117  | 710.7  | 113 | 3.4  | 120↑ | 0.0  | 5.8  | 117 | 0.1  | 3.4  | 117   | 0.1   | 1    | 3.4  | 117   | 0.1   | 1        | 3.4  |
| a1008025-3 | 102        | 126 | 129↑ | 3595.5 | 111 | 14.0 | 126  | 0.0  | 11.9 | 126 | 0.7  | 11.9 | 126   | 0.7   | 1    | 11.9 | 126   | 0.7   | 1        | 11.9 |
| a1008025-4 | 98         | 113 | 113  | 3563.6 | 107 | 5.3  | 114↑ | 0.0  | 6.1  | 113 | 0.1  | 5.3  | 113   | 0.1   | 1    | 5.3  | 113   | 0.1   | 1        | 5.3  |
| a1008025-5 | 91         | 109 | 109  | 362.2  | 101 | 7.3  | 111↑ | 0.0  | 9.0  | 109 | 0.1  | 7.3  | 109   | 0.1   | 1    | 7.3  | 109   | 0.1   | 1        | 7.3  |
| a1008050-1 | 248        | 367 | 369↑ | 150.7  | 286 | 22.5 | 367  | 0.0  | 22.1 | 367 | 0.3  | 22.1 | 366↓  | 164.8 | 275  | 21.9 | 366↓  | 459.2 | 275      | 21.9 |
| a1008050-2 | 296        | 433 | 436↑ | 805.6  | 339 | 22.2 | 438↑ | 0.0  | 22.6 | 433 | 2.6  | 21.7 | 433   | 2.6   | 1    | 21.7 | 433   | 2.6   | 1        | 21.7 |
| a1008050-3 | 306        | 419 | 425↑ | 546.0  | 341 | 19.8 | 428↑ | 0.0  | 20.3 | 419 | 8.6  | 18.6 | 418↓  | 291.9 | 27   | 18.4 | 418↓  | 221.9 | 27       | 18.4 |
| a1008050-4 | 240        | 321 | 326↑ | 114.4  | 267 | 18.1 | 324↑ | 0.0  | 17.6 | 321 | 0.1  | 16.8 | 321   | 0.1   | 1    | 16.8 | 321   | 0.1   | 1        | 16.8 |
| a1008050-5 | 264        | 376 | 381↑ | 597.3  | 301 | 21.0 | 390↑ | 0.0  | 22.8 | 376 | 0.2  | 19.9 | 376   | 0.2   | 1    | 19.9 | 376   | 0.2   | 1        | 19.9 |

**Table EC.17** MMR-GAP results for type-B instances

| instance   | Best Known |     | B&C  |        |     |      | Fix  |      |      | DS   |        |      | iDS-H |        |      |      | iDS-B |        |      |      |
|------------|------------|-----|------|--------|-----|------|------|------|------|------|--------|------|-------|--------|------|------|-------|--------|------|------|
|            | LB         | UB  | obj  | time   | LB  | %gap | obj  | time | %gap | obj  | time   | %gap | obj   | time   | iter | %gap | obj   | time   | iter | %gap |
| b0504010-1 | 18         | 18  | 18   | 1.1    | 18  | 0.0  | 18   | 0.0  | 0.0  | 24↑  | 0.1    | 25.0 | 18    | 0.2    | 2    | 0.0  | 18    | 0.2    | 2    | 0.0  |
| b0504010-2 | 19         | 19  | 19   | 0.6    | 19  | 0.0  | 22↑  | 0.0  | 13.6 | 19   | 0.1    | 0.0  | 19    | 0.1    | 1    | 0.0  | 19    | 0.1    | 1    | 0.0  |
| b0504010-3 | 12         | 12  | 12   | 0.4    | 12  | 0.0  | 13↑  | 0.0  | 7.7  | 12   | 0.1    | 0.0  | 12    | 0.1    | 1    | 0.0  | 12    | 0.1    | 1    | 0.0  |
| b0504010-4 | 25         | 25  | 25   | 0.3    | 25  | 0.0  | 28↑  | 0.0  | 10.7 | 28↑  | 0.1    | 10.7 | 25    | 0.4    | 4    | 0.0  | 25    | 0.3    | 4    | 0.0  |
| b0504010-5 | 22         | 22  | 22   | 1.0    | 22  | 0.0  | 23↑  | 0.1  | 4.3  | 23↑  | 0.1    | 4.3  | 22    | 0.4    | 2    | 0.0  | 22    | 0.5    | 2    | 0.0  |
| b0504025-1 | 84         | 84  | 84   | 3.4    | 84  | 0.0  | 84   | 0.0  | 0.0  | 84   | 0.3    | 0.0  | 84    | 0.3    | 1    | 0.0  | 84    | 0.3    | 1    | 0.0  |
| b0504025-2 | 64         | 64  | 64   | 4.1    | 64  | 0.0  | 64   | 0.0  | 0.0  | 64   | 0.1    | 0.0  | 64    | 0.1    | 1    | 0.0  | 64    | 0.1    | 1    | 0.0  |
| b0504025-3 | 38         | 38  | 38   | 0.7    | 38  | 0.0  | 45↑  | 0.0  | 15.6 | 38   | 0.1    | 0.0  | 38    | 0.1    | 1    | 0.0  | 38    | 0.1    | 1    | 0.0  |
| b0504025-4 | 66         | 66  | 66   | 0.7    | 66  | 0.0  | 66   | 0.0  | 0.0  | 68↑  | 0.1    | 2.9  | 66    | 1.9    | 11   | 0.0  | 66    | 1.6    | 10   | 0.0  |
| b0504025-5 | 77         | 77  | 77   | 6.8    | 77  | 0.0  | 77   | 0.1  | 0.0  | 77   | 0.2    | 0.0  | 77    | 0.2    | 1    | 0.0  | 77    | 0.2    | 1    | 0.0  |
| b0504050-1 | 248        | 248 | 248  | 29.6   | 248 | 0.0  | 252↑ | 0.0  | 1.6  | 248  | 0.6    | 0.0  | 248   | 0.6    | 1    | 0.0  | 248   | 0.6    | 1    | 0.0  |
| b0504050-2 | 227        | 227 | 227  | 2.1    | 227 | 0.0  | 227  | 0.0  | 0.0  | 227  | 1.1    | 0.0  | 227   | 1.1    | 1    | 0.0  | 227   | 1.1    | 1    | 0.0  |
| b0504050-3 | 108        | 108 | 108  | 2.1    | 108 | 0.0  | 108  | 0.0  | 0.0  | 108  | 0.1    | 0.0  | 108   | 0.1    | 1    | 0.0  | 108   | 0.1    | 1    | 0.0  |
| b0504050-4 | 215        | 215 | 215  | 2.4    | 215 | 0.0  | 215  | 0.0  | 0.0  | 215  | 0.7    | 0.0  | 215   | 0.7    | 1    | 0.0  | 215   | 0.7    | 1    | 0.0  |
| b0504050-5 | 191        | 191 | 191  | 2.9    | 191 | 0.0  | 200↑ | 0.0  | 4.5  | 191  | 0.4    | 0.0  | 191   | 0.4    | 1    | 0.0  | 191   | 0.4    | 1    | 0.0  |
| b0508010-1 | 31         | 31  | 31   | 5.4    | 31  | 0.0  | 33↑  | 0.1  | 6.1  | 31   | 0.9    | 0.0  | 31    | 0.9    | 1    | 0.0  | 31    | 0.9    | 1    | 0.0  |
| b0508010-2 | 29         | 29  | 29   | 1.2    | 29  | 0.0  | 29   | 0.0  | 0.0  | 29   | 0.2    | 0.0  | 29    | 0.2    | 1    | 0.0  | 29    | 0.2    | 1    | 0.0  |
| b0508010-3 | 30         | 30  | 30   | 3.1    | 30  | 0.0  | 30   | 0.0  | 0.0  | 30   | 0.1    | 0.0  | 30    | 0.1    | 1    | 0.0  | 30    | 0.1    | 1    | 0.0  |
| b0508010-4 | 45         | 45  | 45   | 18.1   | 45  | 0.0  | 47↑  | 0.1  | 4.3  | 45   | 2.2    | 0.0  | 45    | 2.2    | 1    | 0.0  | 45    | 2.2    | 1    | 0.0  |
| b0508010-5 | 31         | 31  | 31   | 1.5    | 31  | 0.0  | 31   | 0.0  | 0.0  | 31   | 0.2    | 0.0  | 31    | 0.2    | 1    | 0.0  | 31    | 0.2    | 1    | 0.0  |
| b0508025-1 | 94         | 111 | 111  | 1493.1 | 111 | 0.0  | 111  | 0.1  | 0.0  | 111  | 15.3   | 0.0  | 111   | 15.3   | 1    | 0.0  | 111   | 15.3   | 1    | 0.0  |
| b0508025-2 | 113        | 122 | 122  | 68.5   | 122 | 0.0  | 122  | 0.0  | 0.0  | 122  | 4.2    | 0.0  | 122   | 4.2    | 1    | 0.0  | 122   | 4.2    | 1    | 0.0  |
| b0508025-3 | 123        | 147 | 147  | 1111.7 | 138 | 6.1  | 151↑ | 0.2  | 8.6  | 147  | 10.6   | 6.1  | 147   | 10.6   | 1    | 6.1  | 147   | 10.6   | 1    | 6.1  |
| b0508025-4 | 113        | 131 | 131  | 2613.5 | 131 | 0.0  | 134↑ | 0.4  | 2.2  | 131  | 8.0    | 0.0  | 131   | 49.0   | 1    | 0.0  | 131   | 8.0    | 1    | 0.0  |
| b0508025-5 | 95         | 107 | 107  | 284.0  | 107 | 0.0  | 110↑ | 0.0  | 2.7  | 107  | 3.4    | 0.0  | 107   | 3.4    | 1    | 0.0  | 107   | 3.4    | 1    | 0.0  |
| b0508050-1 | 258        | 346 | 352↑ | 774.8  | 302 | 14.2 | 346  | 0.0  | 12.7 | 346  | 54.1   | 12.7 | 345↓  | 99.6   | 3    | 12.5 | 345↓  | 135.3  | 3    | 12.5 |
| b0508050-2 | 298        | 415 | 423↑ | 1314.3 | 362 | 14.4 | 416↑ | 0.0  | 13.0 | 415  | 49.2   | 12.8 | 415   | 49.2   | 1    | 12.8 | 415   | 49.2   | 1    | 12.8 |
| b0508050-3 | 292        | 402 | 432↑ | 3387.7 | 351 | 18.8 | 406↑ | 0.2  | 13.5 | 402  | 63.7   | 12.7 | 402   | 63.7   | 1    | 12.7 | 402   | 63.7   | 1    | 12.7 |
| b0508050-4 | 293        | 421 | 433↑ | 2516.4 | 355 | 18.0 | 426↑ | 0.1  | 16.7 | 421  | 71.0   | 15.7 | 421   | 71.0   | 1    | 15.7 | 421   | 71.0   | 1    | 15.7 |
| b0508050-5 | 269        | 398 | 417↑ | 1489.0 | 335 | 19.7 | 398  | 0.0  | 15.8 | 398  | 55.1   | 15.8 | 398   | 55.1   | 1    | 15.8 | 398   | 55.1   | 1    | 15.8 |
| b1004010-1 | 21         | 21  | 21   | 0.6    | 21  | 0.0  | 22↑  | 0.0  | 4.5  | 24↑  | 0.2    | 12.5 | 21    | 0.6    | 4    | 0.0  | 21    | 0.7    | 4    | 0.0  |
| b1004010-2 | 16         | 16  | 16   | 0.5    | 16  | 0.0  | 16   | 0.0  | 0.0  | 18↑  | 0.1    | 11.1 | 16    | 0.3    | 3    | 0.0  | 16    | 0.3    | 3    | 0.0  |
| b1004010-3 | 16         | 16  | 16   | 1.2    | 16  | 0.0  | 16   | 0.0  | 0.0  | 16   | 0.2    | 0.0  | 16    | 0.2    | 1    | 0.0  | 16    | 0.2    | 1    | 0.0  |
| b1004010-4 | 14         | 14  | 14   | 0.8    | 14  | 0.0  | 14   | 0.0  | 0.0  | 14   | 0.1    | 0.0  | 14    | 0.1    | 1    | 0.0  | 14    | 0.1    | 1    | 0.0  |
| b1004010-5 | 28         | 28  | 28   | 0.6    | 28  | 0.0  | 28   | 0.1  | 0.0  | 31↑  | 0.3    | 9.7  | 28    | 0.9    | 3    | 0.0  | 28    | 1.1    | 4    | 0.0  |
| b1004025-1 | 100        | 103 | 102↓ | 58.1   | 102 | 0.0  | 108↑ | 0.0  | 5.6  | 103  | 2.4    | 1.0  | 102↓  | 7.8    | 3    | 0.0  | 102↓  | 9.5    | 3    | 0.0  |
| b1004025-2 | 71         | 71  | 71   | 3.4    | 71  | 0.0  | 72↑  | 0.0  | 1.4  | 72↑  | 0.4    | 1.4  | 71    | 1.0    | 3    | 0.0  | 71    | 1.1    | 3    | 0.0  |
| b1004025-3 | 63         | 63  | 63   | 1.2    | 63  | 0.0  | 63   | 0.0  | 0.0  | 69↑  | 0.3    | 8.7  | 63    | 0.8    | 2    | 0.0  | 63    | 0.7    | 2    | 0.0  |
| b1004025-4 | 58         | 58  | 58   | 3.1    | 58  | 0.0  | 65↑  | 0.1  | 10.8 | 58   | 0.3    | 0.0  | 58    | 0.3    | 1    | 0.0  | 58    | 0.3    | 1    | 0.0  |
| b1004025-5 | 76         | 76  | 76   | 6.8    | 76  | 0.0  | 76   | 0.1  | 0.0  | 79↑  | 1.2    | 3.8  | 76    | 4.1    | 3    | 0.0  | 76    | 3.9    | 3    | 0.0  |
| b1004050-1 | 184        | 194 | 193↓ | 190.6  | 193 | 0.0  | 194  | 0.0  | 0.5  | 194  | 3.5    | 0.5  | 193↓  | 6.9    | 2    | 0.0  | 193↓  | 7.2    | 2    | 0.0  |
| b1004050-2 | 189        | 189 | 189  | 40.9   | 189 | 0.0  | 198↑ | 0.0  | 4.5  | 189  | 0.7    | 0.0  | 189   | 0.7    | 1    | 0.0  | 189   | 0.7    | 1    | 0.0  |
| b1004050-3 | 186        | 188 | 187↓ | 21.8   | 187 | 0.0  | 197↑ | 0.1  | 5.1  | 192↑ | 5.5    | 2.6  | 187↓  | 39.9   | 7    | 0.0  | 187↓  | 40.0   | 7    | 0.0  |
| b1004050-4 | 190        | 199 | 199  | 379.1  | 199 | 0.0  | 203↑ | 0.1  | 2.0  | 199  | 4.2    | 0.0  | 199   | 4.2    | 1    | 0.0  | 199   | 4.2    | 1    | 0.0  |
| b1004050-5 | 185        | 197 | 195↓ | 46.6   | 195 | 0.0  | 200↑ | 0.1  | 2.5  | 197  | 9.6    | 1.0  | 195↓  | 21.8   | 2    | 0.0  | 195↓  | 18.9   | 2    | 0.0  |
| b1008010-1 | 24         | 24  | 24   | 1.5    | 24  | 0.0  | 24   | 0.0  | 0.0  | 24   | 0.3    | 0.0  | 24    | 0.3    | 1    | 0.0  | 24    | 0.3    | 1    | 0.0  |
| b1008010-2 | 40         | 40  | 40   | 21.6   | 40  | 0.0  | 40   | 0.2  | 0.0  | 41↑  | 4.0    | 2.4  | 40    | 10.2   | 2    | 0.0  | 40    | 10.1   | 2    | 0.0  |
| b1008010-3 | 42         | 42  | 42   | 34.2   | 42  | 0.0  | 44↑  | 0.1  | 4.5  | 44↑  | 3.6    | 4.5  | 42    | 130.4  | 19   | 0.0  | 42    | 123.7  | 18   | 0.0  |
| b1008010-4 | 25         | 25  | 25   | 4.3    | 25  | 0.0  | 28↑  | 0.1  | 10.7 | 26↑  | 0.6    | 3.8  | 25    | 1.5    | 2    | 0.0  | 25    | 1.3    | 2    | 0.0  |
| b1008010-5 | 25         | 25  | 25   | 5.6    | 25  | 0.0  | 29↑  | 0.1  | 13.8 | 25   | 0.7    | 0.0  | 25    | 0.7    | 1    | 0.0  | 25    | 0.7    | 1    | 0.0  |
| b1008025-1 | 83         | 91  | 91   | 322.0  | 91  | 0.0  | 95↑  | 0.0  | 4.2  | 91   | 5.0    | 0.0  | 91    | 5.1    | 1    | 0.0  | 91    | 5.1    | 1    | 0.0  |
| b1008025-2 | 123        | 171 | 171  | 1452.2 | 136 | 20.5 | 175↑ | 0.1  | 22.3 | 171  | 829.7  | 20.5 | 170↓  | 1967.5 | 2    | 20.0 | 170↓  | 1785.7 | 2    | 20.0 |
| b1008025-3 | 113        | 124 | 124  | 515.4  | 124 | 0.0  | 124  | 0.0  | 0.0  | 125↑ | 5.8    | 0.8  | 124   | 11.9   | 2    | 0.0  | 124   | 13.0   | 2    | 0.0  |
| b1008025-4 | 97         | 116 | 116  | 3318.6 | 104 | 10.3 | 119↑ | 0.0  | 12.6 | 116  | 23.3   | 10.3 | 116   | 23.3   | 1    | 10.3 | 116   | 23.3   | 1    | 10.3 |
| b1008025-5 | 96         | 116 | 116  | 2745.5 | 102 | 12.1 | 116  | 0.0  | 12.1 | 116  | 29.2   | 12.1 | 116   | 29.2   | 1    | 12.1 | 116   | 29.2   | 1    | 12.1 |
| b1008050-1 | 236        | 338 | 355↑ | 3137.3 | 270 | 23.9 | 338  | 0.0  | 20.1 | 338  | 1083.2 | 20.1 | 338   | 1083.2 | 1    | 20.1 | 338   | 1083.2 | 1    | 20.1 |
| b1008050-2 | 293        | 444 | 506↑ | 2822.9 | 349 | 31.0 | 444  | 0.1  | 21.4 | 445↑ | 3600.0 | 21.6 | 445↑  | 3600.0 | 1    | 21.6 | 445↑  | 3600.0 | 1    | 21.6 |
| b1008050-3 | 291        | 409 | 478↑ | 3420.5 | 338 | 29.3 | 422↑ | 0.4  | 19.9 | 409  | 2621.9 | 17.4 | 409   | 2621.9 | 1    | 17.4 | 409   | 2621.9 | 1    | 17.4 |
| b1008050-4 | 259        | 381 | 410↑ | 1444.5 | 293 | 28.5 | 381  | 0.0  | 23.1 | 381  | 3600.0 | 23.1 | 381   | 3600.0 | 1    | 23.1 | 381   | 3600.0 | 1    | 23.1 |
| b1008050-5 | 238        | 346 | 392↑ | 1237.2 | 282 | 28.1 | 356↑ | 0.1  | 20.8 | 346  | 3600.0 | 18.5 | 346   | 3600.0 | 1    | 18.5 | 346   | 3600.0 | 1    | 18.5 |

**Table EC.18**     **MMR-GAP results for type-C instances**

| instance   | Best Known |     | B&C  |        |     |      | Fix  |      |      | DS   |        |      | iDS-H |        |      |      | iDS-B |        |           |      |
|------------|------------|-----|------|--------|-----|------|------|------|------|------|--------|------|-------|--------|------|------|-------|--------|-----------|------|
|            | LB         | UB  | obj  | time   | LB  | %gap | obj  | time | %gap | obj  | time   | %gap | obj   | time   | iter | %gap | obj   | time   | iter      | %gap |
| c0504010-1 | 18         | 18  | 18   | 0.8    | 18  | 0.0  | 18   | 0.1  | 0.0  | 18   | 0.1    | 0.0  | 18    | 0.1    | 1    | 0.0  | 18    | 0.1    | 1         | 0.0  |
| c0504010-2 | 16         | 16  | 16   | 0.6    | 16  | 0.0  | 16   | 0.0  | 0.0  | 16   | 0.1    | 0.0  | 16    | 0.1    | 1    | 0.0  | 16    | 0.1    | 1         | 0.0  |
| c0504010-3 | 14         | 14  | 14   | 1.3    | 14  | 0.0  | 14   | 0.1  | 0.0  | 14   | 0.1    | 0.0  | 14    | 0.1    | 1    | 0.0  | 14    | 0.1    | 1         | 0.0  |
| c0504010-4 | 17         | 17  | 17   | 0.6    | 17  | 0.0  | 17   | 0.1  | 0.0  | 17   | 0.1    | 0.0  | 17    | 0.1    | 1    | 0.0  | 17    | 0.1    | 1         | 0.0  |
| c0504010-5 | 23         | 23  | 23   | 0.8    | 23  | 0.0  | 23   | 0.0  | 0.0  | 23   | 0.2    | 0.0  | 23    | 0.2    | 1    | 0.0  | 23    | 0.2    | 1         | 0.0  |
| c0504025-1 | 47         | 47  | 47   | 1.6    | 47  | 0.0  | 47   | 0.0  | 0.0  | 47   | 0.2    | 0.0  | 47    | 0.2    | 1    | 0.0  | 47    | 0.2    | 1         | 0.0  |
| c0504025-2 | 60         | 60  | 60   | 1.9    | 60  | 0.0  | 60   | 0.0  | 0.0  | 60   | 0.2    | 0.0  | 60    | 0.2    | 1    | 0.0  | 60    | 0.2    | 1         | 0.0  |
| c0504025-3 | 103        | 103 | 103  | 13.1   | 103 | 0.0  | 103  | 0.1  | 0.0  | 103  | 0.3    | 0.0  | 103   | 0.3    | 1    | 0.0  | 103   | 0.3    | 1         | 0.0  |
| c0504025-4 | 83         | 83  | 83   | 0.4    | 83  | 0.0  | 83   | 0.0  | 0.0  | 83   | 0.2    | 0.0  | 83    | 0.2    | 1    | 0.0  | 83    | 0.2    | 1         | 0.0  |
| c0504025-5 | 85         | 85  | 85   | 3.4    | 85  | 0.0  | 93↑  | 0.1  | 8.6  | 85   | 0.3    | 0.0  | 85    | 0.3    | 1    | 0.0  | 85    | 0.3    | 1         | 0.0  |
| c0504050-1 | 160        | 160 | 160  | 19.9   | 160 | 0.0  | 160  | 0.0  | 0.0  | 160  | 1.4    | 0.0  | 160   | 1.4    | 1    | 0.0  | 160   | 1.4    | 1         | 0.0  |
| c0504050-2 | 202        | 202 | 202  | 28.9   | 202 | 0.0  | 212↑ | 0.0  | 4.7  | 202  | 2.9    | 0.0  | 202   | 2.9    | 1    | 0.0  | 202   | 2.9    | 1         | 0.0  |
| c0504050-3 | 217        | 217 | 217  | 35.3   | 217 | 0.0  | 232↑ | 0.1  | 6.5  | 217  | 2.8    | 0.0  | 217   | 2.8    | 1    | 0.0  | 217   | 2.8    | 1         | 0.0  |
| c0504050-4 | 173        | 173 | 173  | 0.9    | 173 | 0.0  | 176↑ | 0.0  | 1.7  | 173  | 0.5    | 0.0  | 173   | 0.5    | 1    | 0.0  | 173   | 0.5    | 1         | 0.0  |
| c0504050-5 | 244        | 269 | 269  | 504.7  | 269 | 0.0  | 269  | 0.1  | 0.0  | 269  | 3.6    | 0.0  | 269   | 3.6    | 1    | 0.0  | 269   | 3.6    | 1         | 0.0  |
| c0508010-1 | 25         | 25  | 25   | 2.1    | 25  | 0.0  | 27↑  | 0.1  | 7.4  | 25   | 0.7    | 0.0  | 25    | 0.7    | 1    | 0.0  | 25    | 0.7    | 1         | 0.0  |
| c0508010-2 | 28         | 28  | 28   | 1.5    | 28  | 0.0  | 28   | 0.1  | 0.0  | 28   | 0.2    | 0.0  | 28    | 0.2    | 1    | 0.0  | 28    | 0.2    | 1         | 0.0  |
| c0508010-3 | 35         | 35  | 35   | 8.7    | 35  | 0.0  | 35   | 0.1  | 0.0  | 35   | 0.7    | 0.0  | 35    | 0.7    | 1    | 0.0  | 35    | 0.7    | 1         | 0.0  |
| c0508010-4 | 39         | 39  | 39   | 2.7    | 39  | 0.0  | 39   | 0.1  | 0.0  | 39   | 0.9    | 0.0  | 39    | 0.9    | 1    | 0.0  | 39    | 0.9    | 1         | 0.0  |
| c0508010-5 | 28         | 28  | 28   | 3.1    | 28  | 0.0  | 28   | 0.1  | 0.0  | 28   | 0.3    | 0.0  | 28    | 0.3    | 1    | 0.0  | 28    | 0.3    | 1         | 0.0  |
| c0508025-1 | 118        | 132 | 132  | 747.9  | 132 | 0.0  | 132  | 0.0  | 0.0  | 132  | 0.9    | 0.0  | 132   | 0.9    | 1    | 0.0  | 132   | 0.9    | 1         | 0.0  |
| c0508025-2 | 107        | 112 | 112  | 60.7   | 112 | 0.0  | 112  | 0.1  | 0.0  | 112  | 2.4    | 0.0  | 112   | 2.4    | 1    | 0.0  | 112   | 2.4    | 1         | 0.0  |
| c0508025-3 | 114        | 131 | 131  | 4.6    | 131 | 0.0  | 131  | 0.1  | 0.0  | 131  | 5.6    | 0.0  | 131   | 5.7    | 1    | 0.0  | 131   | 5.7    | 1         | 0.0  |
| c0508025-4 | 119        | 142 | 141↓ | 527.1  | 136 | 3.5  | 149↑ | 0.1  | 8.7  | 142  | 20.8   | 4.2  | 141↓  | 62.3   | 3    | 3.5  | 141↓  | 72.2   | 3         | 3.5  |
| c0508025-5 | 103        | 116 | 113↓ | 146.2  | 113 | 0.0  | 120↑ | 0.1  | 5.8  | 116  | 3.8    | 2.6  | 113↓  | 9.4    | 2    | 0.0  | 113↓  | 8.9    | 2         | 0.0  |
| c0508050-1 | 275        | 402 | 418↑ | 602.7  | 338 | 19.1 | 412↑ | 0.1  | 18.0 | 402  | 59.7   | 15.9 | 402   | 59.7   | 1    | 15.9 | 402   | 59.7   | 1         | 15.9 |
| c0508050-2 | 283        | 389 | 416↑ | 1822.9 | 336 | 19.2 | 393↑ | 0.0  | 14.5 | 389  | 18.8   | 13.6 | 389   | 18.8   | 1    | 13.6 | 389   | 18.8   | 1         | 13.6 |
| c0508050-3 | 284        | 418 | 434↑ | 3199.1 | 351 | 19.1 | 418  | 0.1  | 16.0 | 419↑ | 41.2   | 16.2 | 418   | 96.1   | 2    | 16.0 | 418   | 107.6  | 2         | 16.0 |
| c0508050-4 | 326        | 503 | 532↑ | 1724.4 | 410 | 22.9 | 503  | 0.0  | 18.5 | 503  | 88.7   | 18.5 | 503   | 88.7   | 1    | 18.5 | 503   | 88.7   | 1         | 18.5 |
| c0508050-5 | 261        | 365 | 388↑ | 3374.6 | 315 | 18.8 | 365  | 0.0  | 13.7 | 365  | 15.0   | 13.7 | 365   | 15.1   | 1    | 13.7 | 365   | 15.1   | 1         | 13.7 |
| c1004010-1 | 20         | 20  | 20   | 1.0    | 20  | 0.0  | 23↑  | 0.0  | 13.0 | 21↑  | 0.2    | 4.8  | 20    | 2.1    | 9    | 0.0  | 20    | 1.8    | <b>8</b>  | 0.0  |
| c1004010-2 | 15         | 15  | 15   | 1.6    | 15  | 0.0  | 17↑  | 0.0  | 11.8 | 15   | 0.2    | 0.0  | 15    | 0.2    | 1    | 0.0  | 15    | 0.2    | 1         | 0.0  |
| c1004010-3 | 24         | 24  | 24   | 1.3    | 24  | 0.0  | 24   | 0.1  | 0.0  | 28↑  | 0.2    | 14.3 | 24    | 0.5    | 2    | 0.0  | 24    | 0.5    | 2         | 0.0  |
| c1004010-4 | 26         | 26  | 26   | 1.3    | 26  | 0.0  | 26   | 0.0  | 0.0  | 26   | 0.1    | 0.0  | 26    | 0.1    | 1    | 0.0  | 26    | 0.1    | 1         | 0.0  |
| c1004010-5 | 25         | 25  | 25   | 1.8    | 25  | 0.0  | 28↑  | 0.1  | 10.7 | 25   | 0.1    | 0.0  | 25    | 0.1    | 1    | 0.0  | 25    | 0.1    | 1         | 0.0  |
| c1004025-1 | 67         | 67  | 67   | 3.9    | 67  | 0.0  | 72↑  | 0.0  | 6.9  | 68↑  | 0.3    | 1.5  | 67    | 1.8    | 5    | 0.0  | 67    | 1.8    | 5         | 0.0  |
| c1004025-2 | 58         | 58  | 58   | 4.1    | 58  | 0.0  | 59↑  | 0.1  | 1.7  | 61↑  | 0.3    | 4.9  | 58    | 1.2    | 4    | 0.0  | 58    | 1.1    | 4         | 0.0  |
| c1004025-3 | 70         | 70  | 70   | 2.3    | 70  | 0.0  | 75↑  | 0.0  | 6.7  | 70   | 0.4    | 0.0  | 70    | 0.4    | 1    | 0.0  | 70    | 0.4    | 1         | 0.0  |
| c1004025-4 | 65         | 65  | 65   | 3.1    | 65  | 0.0  | 73↑  | 0.1  | 11.0 | 66↑  | 0.3    | 1.5  | 65    | 7.8    | 17   | 0.0  | 65    | 8.4    | 17        | 0.0  |
| c1004025-5 | 83         | 83  | 83   | 5.8    | 83  | 0.0  | 85↑  | 0.0  | 2.4  | 85↑  | 0.6    | 2.4  | 83    | 4.6    | 6    | 0.0  | 83    | 4.6    | 6         | 0.0  |
| c1004050-1 | 202        | 212 | 212  | 109.8  | 212 | 0.0  | 212  | 0.1  | 0.0  | 216↑ | 5.5    | 1.9  | 212   | 318.0  | 34   | 0.0  | 212   | 343.7  | 34        | 0.0  |
| c1004050-2 | 219        | 219 | 219  | 50.5   | 219 | 0.0  | 219  | 0.0  | 0.0  | 219  | 1.6    | 0.0  | 219   | 1.6    | 1    | 0.0  | 219   | 1.6    | 1         | 0.0  |
| c1004050-3 | 189        | 199 | 197↓ | 58.7   | 197 | 0.0  | 199  | 0.1  | 1.0  | 201↑ | 6.2    | 2.0  | 197↓  | 18.0   | 3    | 0.0  | 197↓  | 17.4   | 3         | 0.0  |
| c1004050-4 | 187        | 187 | 187  | 22.8   | 187 | 0.0  | 187  | 0.0  | 0.0  | 187  | 1.3    | 0.0  | 187   | 1.3    | 1    | 0.0  | 187   | 1.3    | 1         | 0.0  |
| c1004050-5 | 202        | 226 | 225↓ | 728.3  | 225 | 0.0  | 227↑ | 0.1  | 0.9  | 230↑ | 14.7   | 2.2  | 225↓  | 1013.4 | 48   | 0.0  | 225↓  | 1056.1 | <b>46</b> | 0.0  |
| c1008010-1 | 29         | 29  | 29   | 4.1    | 29  | 0.0  | 32↑  | 0.1  | 9.4  | 29   | 0.7    | 0.0  | 29    | 0.7    | 1    | 0.0  | 29    | 0.7    | 1         | 0.0  |
| c1008010-2 | 40         | 40  | 40   | 196.1  | 40  | 0.0  | 43↑  | 0.4  | 7.0  | 43↑  | 19.6   | 7.0  | 40    | 913.5  | 28   | 0.0  | 40    | 889.4  | <b>27</b> | 0.0  |
| c1008010-3 | 33         | 33  | 33   | 3.4    | 33  | 0.0  | 38↑  | 0.1  | 13.2 | 34↑  | 0.6    | 2.9  | 33    | 1.3    | 2    | 0.0  | 33    | 1.3    | 2         | 0.0  |
| c1008010-4 | 37         | 37  | 37   | 12.6   | 37  | 0.0  | 37   | 0.2  | 0.0  | 41↑  | 2.4    | 9.8  | 37    | 11.1   | 3    | 0.0  | 37    | 7.8    | 3         | 0.0  |
| c1008010-5 | 32         | 32  | 32   | 10.4   | 32  | 0.0  | 32   | 0.1  | 0.0  | 32   | 1.1    | 0.0  | 32    | 1.1    | 1    | 0.0  | 32    | 1.1    | 1         | 0.0  |
| c1008025-1 | 85         | 87  | 87   | 111.5  | 87  | 0.0  | 89↑  | 0.1  | 2.2  | 87   | 4.7    | 0.0  | 87    | 4.7    | 1    | 0.0  | 87    | 4.7    | 1         | 0.0  |
| c1008025-2 | 121        | 157 | 158↑ | 3344.5 | 134 | 15.2 | 157  | 0.3  | 14.6 | 159↑ | 329.8  | 15.7 | 155↓  | 1024.1 | 3    | 13.5 | 155↓  | 908.1  | 3         | 13.5 |
| c1008025-3 | 111        | 129 | 128↓ | 3275.7 | 121 | 5.5  | 132↑ | 0.1  | 8.3  | 129  | 52.7   | 6.2  | 128↓  | 146.6  | 3    | 5.5  | 128↓  | 135.1  | 3         | 5.5  |
| c1008025-4 | 112        | 120 | 120  | 504.6  | 120 | 0.0  | 129↑ | 0.1  | 7.0  | 120  | 7.2    | 0.0  | 120   | 7.2    | 1    | 0.0  | 120   | 7.2    | 1         | 0.0  |
| c1008025-5 | 111        | 142 | 144↑ | 2722.3 | 120 | 16.7 | 149↑ | 0.2  | 19.5 | 142  | 257.1  | 15.5 | 142   | 257.1  | 1    | 15.5 | 142   | 257.1  | 1         | 15.5 |
| c1008050-1 | 250        | 346 | 384↑ | 2125.1 | 286 | 25.5 | 356↑ | 0.1  | 19.7 | 346  | 804.5  | 17.3 | 346   | 805.6  | 1    | 17.3 | 346   | 805.6  | 1         | 17.3 |
| c1008050-2 | 285        | 436 | 492↑ | 1648.6 | 340 | 30.9 | 444↑ | 0.3  | 23.4 | 436  | 3600.0 | 22.0 | 436   | 3600.0 | 1    | 22.0 | 436   | 3600.0 | 1         | 22.0 |
| c1008050-3 | 283        | 393 | 418↑ | 1125.4 | 326 | 22.0 | 410↑ | 0.1  | 20.5 | 393  | 1335.0 | 17.0 | 393   | 1335.0 | 1    | 17.0 | 393   | 1335.0 | 1         | 17.0 |
| c1008050-4 | 293        | 418 | 460↑ | 2114.3 | 341 | 25.9 | 440↑ | 0.2  | 22.5 | 418  | 1355.0 | 18.4 | 418   | 1355.0 | 1    | 18.4 | 418   | 1355.0 | 1         | 18.4 |
| c1008050-5 | 264        | 390 | 423↑ | 1904.6 | 304 | 28.1 | 396↑ | 0.2  | 23.2 | 390  | 3600.0 | 22.1 | 390   | 3600.0 | 1    | 22.1 | 390   | 3600.0 | 1         | 22.1 |

**Table EC.19** MMR-GAP results for type-E instances

| instance   | Best Known |      | B&C   |        |      |      | Fix   |      |      | DS    |        |      | iDS-H |        |      |      | iDS-B        |        |      |      |
|------------|------------|------|-------|--------|------|------|-------|------|------|-------|--------|------|-------|--------|------|------|--------------|--------|------|------|
|            | LB         | UB   | obj   | time   | LB   | %gap | obj   | time | %gap | obj   | time   | %gap | obj   | time   | iter | %gap | obj          | time   | iter | %gap |
| e0504010-1 | 224        | 224  | 224   | 7.3    | 224  | 0.0  | 229↑  | 0.1  | 2.2  | 224   | 0.4    | 0.0  | 224   | 0.4    | 1    | 0.0  | 224          | 0.4    | 1    | 0.0  |
| e0504010-2 | 184        | 184  | 184   | 4.2    | 184  | 0.0  | 191↑  | 0.2  | 3.7  | 184   | 0.7    | 0.0  | 184   | 0.7    | 1    | 0.0  | 184          | 0.7    | 1    | 0.0  |
| e0504010-3 | 133        | 133  | 133   | 0.4    | 133  | 0.0  | 133   | 0.0  | 0.0  | 133   | 0.2    | 0.0  | 133   | 0.2    | 1    | 0.0  | 133          | 0.2    | 1    | 0.0  |
| e0504010-4 | 190        | 190  | 190   | 3.4    | 190  | 0.0  | 190   | 0.0  | 0.0  | 190   | 0.8    | 0.0  | 190   | 0.8    | 1    | 0.0  | 190          | 0.8    | 1    | 0.0  |
| e0504010-5 | 221        | 221  | 221   | 11.8   | 221  | 0.0  | 237↑  | 0.2  | 6.8  | 225↑  | 2.9    | 1.8  | 221   | 12.4   | 4    | 0.0  | 221          | 14.8   | 4    | 0.0  |
| e0504025-1 | 826        | 826  | 826   | 55.7   | 826  | 0.0  | 860↑  | 0.1  | 4.0  | 826   | 11.0   | 0.0  | 826   | 11.0   | 1    | 0.0  | 826          | 11.0   | 1    | 0.0  |
| e0504025-2 | 706        | 706  | 706   | 42.1   | 706  | 0.0  | 707↑  | 0.1  | 0.1  | 706   | 6.5    | 0.0  | 706   | 6.5    | 1    | 0.0  | 706          | 6.5    | 1    | 0.0  |
| e0504025-3 | 659        | 659  | 659   | 71.8   | 659  | 0.0  | 663↑  | 0.1  | 0.6  | 660↑  | 3.6    | 0.2  | 659   | 77.9   | 13   | 0.0  | 659          | 79.4   | 13   | 0.0  |
| e0504025-4 | 639        | 639  | 639   | 75.4   | 639  | 0.0  | 690↑  | 0.1  | 7.4  | 639   | 7.4    | 0.0  | 639   | 7.4    | 1    | 0.0  | 639          | 7.4    | 1    | 0.0  |
| e0504025-5 | 670        | 670  | 670   | 286.0  | 670  | 0.0  | 670   | 0.1  | 0.0  | 670   | 15.9   | 0.0  | 670   | 15.9   | 1    | 0.0  | 670          | 15.9   | 1    | 0.0  |
| e0504050-1 | 1689       | 2056 | 2056  | 3338.7 | 1882 | 8.5  | 2092↑ | 0.1  | 10.0 | 2056  | 20.7   | 8.5  | 2056  | 20.7   | 1    | 8.5  | 2056         | 20.7   | 1    | 8.5  |
| e0504050-2 | 1562       | 2028 | 2028  | 3070.0 | 1786 | 11.9 | 2028  | 0.3  | 11.9 | 2028  | 129.1  | 11.9 | 2028  | 129.1  | 1    | 11.9 | 2028         | 129.1  | 1    | 11.9 |
| e0504050-3 | 1312       | 1519 | 1519  | 2560.7 | 1436 | 5.5  | 1519  | 0.0  | 5.5  | 1519  | 4.4    | 5.5  | 1519  | 4.4    | 1    | 5.5  | 1519         | 4.4    | 1    | 5.5  |
| e0504050-4 | 1365       | 1689 | 1670↓ | 1498.3 | 1501 | 10.1 | 1754↑ | 0.2  | 14.4 | 1689  | 18.4   | 11.1 | 1670↓ | 362.7  | 9    | 10.1 | 1670↓        | 358.7  | 9    | 10.1 |
| e0504050-5 | 1420       | 1731 | 1744↑ | 2593.9 | 1556 | 10.8 | 1778↑ | 0.0  | 12.5 | 1731  | 13.6   | 10.1 | 1731  | 13.6   | 1    | 10.1 | 1731         | 13.6   | 1    | 10.1 |
| e0508010-1 | 290        | 331  | 331   | 2489.7 | 303  | 8.5  | 331   | 0.1  | 8.5  | 337↑  | 19.5   | 10.1 | 331   | 124.8  | 3    | 8.5  | 331          | 105.9  | 3    | 8.5  |
| e0508010-2 | 240        | 314  | 309↓  | 1938.0 | 260  | 15.9 | 316↑  | 0.2  | 17.7 | 318↑  | 29.2   | 18.2 | 309↓  | 113.6  | 3    | 15.9 | 309↓         | 79.9   | 3    | 15.9 |
| e0508010-3 | 274        | 343  | 334↓  | 3066.4 | 290  | 13.2 | 347↑  | 0.7  | 16.4 | 343   | 31.2   | 15.5 | 334↓  | 68.4   | 2    | 13.2 | 334↓         | 77.3   | 2    | 13.2 |
| e0508010-4 | 282        | 400  | 407↑  | 3259.6 | 326  | 19.9 | 418↑  | 0.3  | 22.0 | 400   | 154.0  | 18.5 | 400   | 154.0  | 1    | 18.5 | 400          | 154.0  | 1    | 18.5 |
| e0508010-5 | 264        | 264  | 264   | 80.6   | 264  | 0.0  | 277↑  | 0.5  | 4.7  | 264   | 3.4    | 0.0  | 264   | 3.4    | 1    | 0.0  | 264          | 3.4    | 1    | 0.0  |
| e0508025-1 | 833        | 1230 | 1321↑ | 2694.2 | 980  | 25.8 | 1248↑ | 0.1  | 21.5 | 1230  | 1897.3 | 20.3 | 1230  | 1905.6 | 1    | 20.3 | 1230         | 1905.6 | 1    | 20.3 |
| e0508025-2 | 775        | 1254 | 1293↑ | 1534.3 | 950  | 26.5 | 1272↑ | 0.2  | 25.3 | 1251↓ | 3600.0 | 24.1 | 1251↓ | 3600.0 | 1    | 24.1 | 1251↓        | 3600.0 | 1    | 24.1 |
| e0508025-3 | 828        | 1271 | 1340↑ | 1479.4 | 1028 | 23.3 | 1282↑ | 0.1  | 19.8 | 1271  | 268.2  | 19.1 | 1271  | 269.3  | 1    | 19.1 | 1271         | 269.3  | 1    | 19.1 |
| e0508025-4 | 941        | 1529 | 1649↑ | 3196.9 | 1167 | 29.2 | 1555↑ | 0.3  | 25.0 | 1541↑ | 3600.0 | 24.3 | 1541↑ | 3600.0 | 1    | 24.3 | 1541↑        | 3600.0 | 1    | 24.3 |
| e0508025-5 | 783        | 1122 | 1131↑ | 2983.1 | 941  | 16.8 | 1167↑ | 0.3  | 19.4 | 1122  | 31.6   | 16.1 | 1122  | 31.6   | 1    | 16.1 | 1122         | 31.6   | 1    | 16.1 |
| e0508050-1 | 2447       | 3985 | 4228↑ | 715.9  | 3026 | 28.4 | 4025↑ | 0.1  | 24.8 | 4009↑ | 3600.0 | 24.5 | 4009↑ | 3600.0 | 1    | 24.5 | 4009↑        | 3600.0 | 1    | 24.5 |
| e0508050-2 | 2173       | 3596 | 3872↑ | 1265.9 | 2659 | 31.3 | 3608↑ | 0.3  | 26.3 | 3603↑ | 3600.0 | 26.2 | 3603↑ | 3600.0 | 1    | 26.2 | 3603↑        | 3600.0 | 1    | 26.2 |
| e0508050-3 | 2194       | 3655 | 3932↑ | 648.3  | 2736 | 30.4 | 3696↑ | 0.1  | 26.0 | 3655  | 3600.0 | 25.1 | 3655  | 3600.0 | 1    | 25.1 | 3655         | 3600.0 | 1    | 25.1 |
| e0508050-4 | 2337       | 3711 | 4059↑ | 622.2  | 2862 | 29.5 | 3822↑ | 0.3  | 25.1 | 3711  | 3600.0 | 22.9 | 3711  | 3600.0 | 1    | 22.9 | 3711         | 3600.0 | 1    | 22.9 |
| e0508050-5 | 2103       | 3448 | 3706↑ | 2215.5 | 2629 | 29.1 | 3548↑ | 0.4  | 25.9 | 3448  | 1899.9 | 23.8 | 3448  | 1899.9 | 1    | 23.8 | 3448         | 1899.9 | 1    | 23.8 |
| e1004010-1 | 257        | 266  | 266   | 155.0  | 266  | 0.0  | 285↑  | 1.2  | 6.7  | 273↑  | 94.4   | 2.6  | 272↑  | 1757.5 | 14   | 2.2  | 272↑         | 1678.9 | 14   | 2.2  |
| e1004010-2 | 223        | 223  | 223   | 93.0   | 223  | 0.0  | 251↑  | 1.0  | 11.2 | 278↑  | 21.4   | 19.8 | 223   | 186.3  | 6    | 0.0  | 223          | 149.3  | 6    | 0.0  |
| e1004010-3 | 259        | 270  | 270   | 844.8  | 270  | 0.0  | 270   | 1.0  | 0.0  | 277↑  | 58.9   | 2.5  | 270   | 190.8  | 3    | 0.0  | 270          | 190.6  | 3    | 0.0  |
| e1004010-4 | 250        | 250  | 250   | 263.6  | 250  | 0.0  | 255↑  | 2.1  | 2.0  | 255↑  | 21.0   | 2.0  | 250   | 870.8  | 21   | 0.0  | 250          | 839.6  | 21   | 0.0  |
| e1004010-5 | 191        | 191  | 191   | 66.1   | 191  | 0.0  | 198↑  | 0.3  | 3.5  | 202↑  | 4.8    | 5.4  | 191   | 18.2   | 3    | 0.0  | 191          | 22.1   | 3    | 0.0  |
| e1004025-1 | 629        | 778  | 780↑  | 3390.0 | 673  | 13.7 | 778   | 0.4  | 13.5 | 793↑  | 708.8  | 15.1 | 779↑  | 2102.1 | 2    | 13.6 | 779↑         | 2488.2 | 2    | 13.6 |
| e1004025-2 | 573        | 674  | 631↓  | 1202.4 | 631  | 0.0  | 677↑  | 1.2  | 6.8  | 674   | 113.5  | 6.4  | 642↓  | 1030.1 | 5    | 1.7  | 642↓         | 844.2  | 5    | 1.7  |
| e1004025-3 | 566        | 676  | 676   | 3542.1 | 604  | 10.7 | 689↑  | 0.9  | 12.3 | 676   | 1029.3 | 10.7 | 676   | 1029.3 | 1    | 10.7 | 676          | 1029.3 | 1    | 10.7 |
| e1004025-4 | 690        | 829  | 832↑  | 911.1  | 750  | 9.9  | 832↑  | 0.2  | 9.9  | 829   | 515.0  | 9.5  | 824↓  | 957.7  | 2    | 9.0  | 824↓         | 1126.3 | 2    | 9.0  |
| e1004025-5 | 562        | 629  | 629   | 2076.5 | 629  | 0.0  | 654↑  | 0.4  | 3.8  | 629   | 187.3  | 0.0  | 629   | 187.3  | 1    | 0.0  | 629          | 187.3  | 1    | 0.0  |
| e1004050-1 | 1312       | 1651 | 1686↑ | 3347.6 | 1422 | 15.7 | 1706↑ | 0.1  | 16.6 | 1651  | 1005.9 | 13.9 | 1651  | 1005.9 | 1    | 13.9 | <b>1647↑</b> | 3600.0 | 4    | 13.7 |
| e1004050-2 | 1318       | 1656 | 1680↑ | 2865.5 | 1443 | 14.1 | 1734↑ | 1.0  | 16.8 | 1656  | 836.7  | 12.9 | 1656  | 836.7  | 1    | 12.9 | 1656         | 836.7  | 1    | 12.9 |
| e1004050-3 | 1289       | 1667 | 1786↑ | 1727.9 | 1401 | 21.6 | 1737↑ | 1.0  | 19.3 | 1667  | 1963.4 | 16.0 | 1667  | 1963.4 | 1    | 16.0 | 1667         | 1963.4 | 1    | 16.0 |
| e1004050-4 | 1470       | 1988 | 2037↑ | 3503.0 | 1649 | 19.0 | 1988  | 0.5  | 17.1 | 2006↑ | 3600.0 | 17.8 | 2006↑ | 3600.0 | 1    | 17.8 | 2006↑        | 3600.0 | 1    | 17.8 |
| e1004050-5 | 1222       | 1456 | 1456  | 2894.8 | 1340 | 8.0  | 1580↑ | 0.6  | 15.2 | 1456  | 136.9  | 8.0  | 1456  | 136.9  | 1    | 8.0  | 1456         | 136.9  | 1    | 8.0  |
| e1008010-1 | 391        | 572  | 614↑  | 3515.6 | 407  | 33.7 | 590↑  | 1.9  | 31.0 | 577↑  | 3600.0 | 29.5 | 577↑  | 3600.0 | 1    | 29.5 | 577↑         | 3600.0 | 1    | 29.5 |
| e1008010-2 | 362        | 574  | 654↑  | 1442.4 | 386  | 41.0 | 579↑  | 7.5  | 33.3 | 578↑  | 3600.0 | 33.2 | 578↑  | 3600.0 | 1    | 33.2 | 578↑         | 3600.0 | 1    | 33.2 |
| e1008010-3 | 312        | 427  | 515↑  | 2140.4 | 328  | 36.3 | 427   | 0.6  | 23.2 | 428↑  | 3600.0 | 23.4 | 428↑  | 3600.0 | 1    | 23.4 | 428↑         | 3600.0 | 1    | 23.4 |
| e1008010-4 | 396        | 578  | 690↑  | 3379.9 | 418  | 39.4 | 609↑  | 1.4  | 31.4 | 583↑  | 3600.0 | 28.3 | 583↑  | 3600.0 | 1    | 28.3 | 583↑         | 3600.0 | 1    | 28.3 |
| e1008010-5 | 370        | 538  | 533↓  | 2946.7 | 389  | 27.0 | 547↑  | 1.5  | 28.9 | 534↓  | 3600.0 | 27.2 | 534↓  | 3600.0 | 1    | 27.2 | 534↓         | 3600.0 | 1    | 27.2 |
| e1008025-1 | 1210       | 1893 | 2198↑ | 2850.4 | 1330 | 39.5 | 1903↑ | 1.0  | 30.1 | 1889↓ | 3600.0 | 29.6 | 1889↓ | 3600.0 | 1    | 29.6 | 1889↓        | 3600.0 | 1    | 29.6 |
| e1008025-2 | 1107       | 1867 | 2613↑ | 2889.0 | 1227 | 53.0 | 1879↑ | 4.2  | 34.7 | 1895↑ | 3600.0 | 35.3 | 1895↑ | 3600.0 | 1    | 35.3 | 1895↑        | 3600.0 | 1    | 35.3 |
| e1008025-3 | 1012       | 1616 | 1792↑ | 2565.0 | 1115 | 37.8 | 1616  | 0.5  | 31.0 | 1616  | 3600.0 | 31.0 | 1616  | 3600.0 | 1    | 31.0 | 1616         | 3600.0 | 1    | 31.0 |
| e1008025-4 | 1058       | 1713 | 2015↑ | 3419.0 | 1160 | 42.4 | 1732↑ | 0.7  | 33.0 | 1713  | 3600.0 | 32.3 | 1713  | 3600.0 | 1    | 32.3 | 1713         | 3600.0 | 1    | 32.3 |
| e1008025-5 | 1090       | 1726 | 2081↑ | 3593.2 | 1188 | 42.9 | 1776↑ | 1.1  | 33.1 | 1726  | 3600.0 | 31.2 | 1726  | 3600.0 | 1    | 31.2 | 1726         | 3600.0 | 1    | 31.2 |
| e1008050-1 | 2775       | 4588 | 5823↑ | 3067.1 | 3230 | 44.5 | 4681↑ | 0.7  | 31.0 | 4660↑ | 3600.0 | 30.7 | 4660↑ | 3600.0 | 1    | 30.7 | 4660↑        | 3600.0 | 1    | 30.7 |
| e1008050-2 | 2707       | 4349 | 5064↑ | 2047.9 | 3106 | 38.7 | 4461↑ | 9.2  | 30.4 | 4351↑ | 3600.0 | 28.6 | 4351↑ | 3600.0 | 1    | 28.6 | 4351↑        | 3600.0 | 1    | 28.6 |
| e1008050-3 | 2581       | 4233 | 5243↑ | 1757.2 | 2983 | 43.1 | 4283↑ | 2.5  | 30.4 | 4239↑ | 3600.0 | 29.6 | 4239↑ | 3600.0 | 1    | 29.6 | 4239↑        | 3600.0 | 1    | 29.6 |
| e1008050-4 | 2390       | 3947 | 5120↑ | 239.2  | 2763 | 46.0 | 3987↑ | 1.0  | 30.7 | 3953↑ | 3600.0 | 30.1 | 3953↑ | 3600.0 | 1    | 30.1 | 3953↑        | 3600.0 | 1    | 30.1 |
| e1008050-5 | 2394       | 4040 | 4667↑ | 126.5  | 2822 | 39.5 | 4093↑ | 7.5  | 31.1 | 4062↑ | 3600.0 | 30.5 | 4062↑ | 3600.0 | 1    | 30.5 | 4062↑        | 3600.0 | 1    | 30.5 |