**Fig. Instrument arrangement for** **recording process parameters at the TCM site of strip steel.**

**List of process variables for strip TCR manufacturing industry**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID** | **Variable** | **Physical Description** | **Unit** | **Notes** |
| 1 | TN\L2\_TRK\_LEN\_FRM\_S1 | Distance from weld seam to STD#1 |  |  |
| 2 | TN\L2\_TRK\_LEN\_FRM\_S2 | Distance from weld seam to STD#2 |  |  |
| 3 | TN\L2\_TRK\_LEN\_FRM\_S3 | Distance from weld seam to STD#3 |  |  |
| 4 | TN\L2\_TRK\_LEN\_FRM\_S4 | Distance from weld seam to STD#4 |  |  |
| 5 | TN\L2\_TRK\_LEN\_FRM\_S5 | Distance from weld seam to STD#5 |  |  |
| 6 | TN\L2\_TRK\_LEN\_FRM\_V1 | Distance from weld seam to the thickness gauge at the entrance of STD#1 |  |  |
| 7 | TN\L2\_TRK\_LEN\_FRM\_V2 | Distance from weld seam to the thickness gauge at the exit of STD#1 |  |  |
| 8 | TN\L2\_TRK\_LEN\_FRM\_V5 | Distance from weld seam to the thickness gauge at the exit of STD#4 |  |  |
| 9 | TN\L2\_TRK\_LEN\_FRM\_H5 | Distance from weld seam to the thickness gauge at the exit ofSTD#5 |  |  |
| 10 | TN\L2\_TRK\_LEN\_FRM\_ED | Distance from weld seam to the edge drop gauge |  |  |
| 11 | TN\L2\_TRK\_LEN\_FRM\_SP | Distance from weld seam to the shape meter |  |  |
| 12 | TN\L2\_AGC\_V1THK\_ACT | Thickness at the entrance of STD#1 | mm |  |
| 13 | TN\L2\_AGC\_V2THK\_ACT | Thickness at the exit of STD#1 | mm | Target Predictive Variables  THK\_STD#1 |
| 14 | TN\L2\_AGC\_V5THK\_ACT | Thickness at the exit of STD#4 | mm | Target Predictive Variables  THK\_STD#4 |
| 15 | TN\L2\_AGC\_H5THK\_ACT | Thickness at the exit of STD#5 | mm | Target Predictive Variables  THK\_STD#5 |
| 16 | TN\L2\_TCM\_BR8\_SPD\_ACT | Roller speed of tension roller#8 | mpm |  |
| 17 | TN\L2\_TCM\_S1\_SPD\_ACT | Roller speed of STD#1 | mpm |  |
| 18 | TN\L2\_TCM\_S2\_SPD\_ACT | Roller speed of STD#2 | mpm |  |
| 19 | TN\L2\_TCM\_S3\_SPD\_ACT | Roller speed of STD#3 | mpm |  |
| 20 | TN\L2\_TCM\_S4\_SPD\_ACT | Roller speed of STD#4 | mpm |  |
| 21 | TN\L2\_TCM\_S5\_SPD\_ACT | Roller speed of STD#5 | mpm |  |
| 22 | TN\L2\_AGC\_V1SPD\_ACT | Strip speed at the entrance of STD#1 | mpm |  |
| 23 | TN\L2\_AGC\_V2SPD\_ACT | Strip speed at the exit of STD#1 | mpm |  |
| 24 | TN\L2\_AGC\_V5SPD\_ACT | Strip speed at the exit of STD#4 | mpm |  |
| 25 | TN\L2\_AGC\_H5SPD\_ACT | Strip speed at the exit of STD#5 | mpm |  |
| 26 | TN\L2\_TCM\_S1\_FWD\_SLIP | Forward slip of STD#1 |  |  |
| 27 | TN\L2\_TCM\_S2\_FWD\_SLIP | Forward slip of STD#2 |  |  |
| 28 | TN\L2\_TCM\_S3\_FWD\_SLIP | Forward slip of STD#3 |  |  |
| 29 | TN\L2\_TCM\_S4\_FWD\_SLIP | Forward slip of STD#4 |  |  |
| 30 | TN\L2\_TCM\_S5\_FWD\_SLIP | Forward slip of STD#5 |  |  |
| 31 | TN\L2\_AGC\_S1TRFC\_ACT | Rolling force of STD#1 (Hydraulic head sensor) | kN | Target Predictive Variables  RFC\_STD#1 |
| 32 | TN\L2\_AGC\_S2TRFC\_ACT | Rolling force of STD#2 (Hydraulic head sensor) | kN | Target Predictive Variables  RFC\_STD#2 |
| 33 | TN\L2\_AGC\_S3TRFC\_ACT | Rolling force of STD#3 (Hydraulic head sensor) | kN | Target Predictive Variables  RFC\_STD#3 |
| 34 | TN\L2\_AGC\_S4TRFC\_ACT | Rolling force of STD#4 (Hydraulic head sensor) | kN | Target Predictive Variables  RFC\_STD#4 |
| 35 | TN\L2\_AGC\_S5TRFC\_ACT | Rolling force of STD#5 (Hydraulic head sensor) | kN | Target Predictive Variables  RFC\_STD#5 |
| 36 | TN\L2\_AGC\_S1TLC\_ACT | Rolling force of STD#1 (Roller surface sensor) | kN |  |
| 37 | TN\L2\_AGC\_S5TLC\_ACT | Rolling force of STD#5 (Roller surface sensor) | kN |  |
| 38 | TN\L2\_AGC\_S1DRFC\_ACT | Deviation between actual and calculated rolling force of STD#1 (Hydraulic head sensor) |  |  |
| 39 | TN\L2\_AGC\_S2DRFC\_ACT | Deviation between actual and calculated rolling force of STD#2 (Hydraulic head sensor) |  |  |
| 40 | TN\L2\_AGC\_S3DRFC\_ACT | Deviation between actual and calculated rolling force of STD#3 (Hydraulic head sensor) |  |  |
| 41 | TN\L2\_AGC\_S4DRFC\_ACT | Deviation between actual and calculated rolling force of STD#4 (Hydraulic head sensor) |  |  |
| 42 | TN\L2\_AGC\_S5DRFC\_ACT | Deviation between actual and calculated rolling force of STD#5 (Hydraulic head sensor) |  |  |
| 43 | TN\L2\_AGC\_S1DLC\_ACT | Deviation between actual and calculated rolling force of STD#1 (Roller surface sensor) |  |  |
| 44 | TN\L2\_AGC\_S5DLC\_ACT | Deviation between actual and calculated rolling force of STD#5 (Roller surface sensor) |  |  |
| 45 | TN\L2\_TCM\_ENTUTEN\_ACT | Unit tension at the entrance of the rolling mill | kN/mm2 |  |
| 46 | TN\L2\_AGC\_S12UTEN\_ACT | Unit tension at the exit of STD#1 | kN/mm2 |  |
| 47 | TN\L2\_AGC\_S23UTEN\_ACT | Unit tension at the exit of STD#2 | kN/mm2 |  |
| 48 | TN\L2\_AGC\_S34UTEN\_ACT | Unit tension at the exit of STD#3 | kN/mm2 |  |
| 49 | TN\L2\_AGC\_S45UTEN\_ACT | Unit tension at the exit of STD#4 | kN/mm2 |  |
| 50 | TN\L2\_TCM\_DELUTEN\_ACT | Unit tension at the exit of STD#5 | kN/mm2 |  |
| 51 | TN\L2\_TCM\_ENTTTEN\_ACT | Total tension at the entrance of the rolling mill | kN |  |
| 52 | TN\L2\_AGC\_S12TTEN\_ACT | Total tension at the exit of STD#1 | kN |  |
| 53 | TN\L2\_AGC\_S23TTEN\_ACT | Total tension at the exit of STD#2 | kN |  |
| 54 | TN\L2\_AGC\_S34TTEN\_ACT | Total tension at the exit of STD#3 | kN |  |
| 55 | TN\L2\_AGC\_S45TTEN\_ACT | Total tension at the exit of STD#4 | kN |  |
| 56 | TN\L2\_TCM\_DELTTEN\_ACT | Total tension at the exit of STD#5 | kN |  |
| 57 | TN\L2\_TCM\_ENTDUTEN\_ACT | Deviation between actual and calculated unit tension at the entrance of the rolling mill | kN/mm |  |
| 58 | TN\L2\_AGC\_S12DUTEN\_ACT | Deviation between actual and calculated unit tension at the exit of STD#1 |  |  |
| 59 | TN\L2\_AGC\_S23DUTEN\_ACT | Deviation between actual and calculated unit tension at the exit of STD#2 |  |  |
| 60 | TN\L2\_AGC\_S34DUTEN\_ACT | Deviation between actual and calculated unit tension at the exit of STD#3 |  |  |
| 61 | TN\L2\_AGC\_S45DUTEN\_ACT | Deviation between actual and calculated unit tension at the exit of STD#4 |  |  |
| 62 | TN\L2\_TCM\_DELDUTEN\_ACT | Deviation between actual and calculated unit tension at the exit of STD#5 |  |  |
| 63 | TN\L2\_TCM\_ENTDTTEN\_ACT | Deviation between actual and calculated tension at the entrance of the rolling mill |  |  |
| 64 | TN\L2\_AGC\_S12DTTEN\_ACT | Deviation between actual and calculated total tension at the exit of STD#1 |  |  |
| 65 | TN\L2\_AGC\_S23DTTEN\_ACT | Deviation between actual and calculated total tension at the exit of STD#2 |  |  |
| 66 | TN\L2\_AGC\_S34DTTEN\_ACT | Deviation between actual and calculated total tension at the exit of STD#3 |  |  |
| 67 | TN\L2\_AGC\_S45DTTEN\_ACT | Deviation between actual and calculated total tension at the exit of STD#4 |  |  |
| 68 | TN\L2\_TCM\_DELDTTEN\_ACT | Deviation between actual and calculated total tension at the exit of STD#5 |  |  |
| 69 | TN\L2\_TCM\_BR7\_1TQ\_ACT | Torque of Tension Roller#7, Unit 1 |  |  |
| 70 | TN\L2\_TCM\_BR7\_2TQ\_ACT | Torque of Tension Roller#7, Unit 2 |  |  |
| 71 | TN\L2\_TCM\_BR8\_1TQ\_ACT | Torque of Tension Roller#8, Unit 1 |  |  |
| 72 | TN\L2\_TCM\_BR8\_2TQ\_ACT | Torque of Tension Roller#8, Unit 2 |  |  |
| 73 | TN\L2\_TCM\_S1TQ\_ACT | Motor torque of STD#1 |  |  |
| 74 | TN\L2\_TCM\_S2TQ\_ACT | Motor torque of STD#2 |  |  |
| 75 | TN\L2\_TCM\_S3TQ\_ACT | Motor torque of STD#3 |  |  |
| 76 | TN\L2\_TCM\_S4TQ\_ACT | Motor torque of STD#4 |  |  |
| 77 | TN\L2\_TCM\_S5TQ\_ACT | Motor torque of STD#5 |  |  |
| 78 | TN\L2\_TCM\_BR7\_1PW\_ACT | Motor power of Tension Roller#7, Unit 1 |  |  |
| 79 | TN\L2\_TCM\_BR7\_2PW\_ACT | Motor power of Tension Roller#7, Unit 2 |  |  |
| 80 | TN\L2\_TCM\_BR8\_1PW\_ACT | Motor power of Tension Roller#8, Unit 1 |  |  |
| 81 | TN\L2\_TCM\_BR8\_2PW\_ACT | Motor power of Tension Roller#8, Unit 2 |  |  |
| 82 | TN\L2\_TCM\_S1PW\_ACT | Motor power of STD#1 |  |  |
| 83 | TN\L2\_TCM\_S2PW\_ACT | Motor power of STD#2 |  |  |
| 84 | TN\L2\_TCM\_S3PW\_ACT | Motor power of STD#3 |  |  |
| 85 | TN\L2\_TCM\_S4PW\_ACT | Motor power of STD#4 |  |  |
| 86 | TN\L2\_TCM\_S5PW\_ACT | Motor power of STD#5 |  |  |
| 87 | TN\L2\_AGC\_S1GAP\_ACT | Roll gap of STD#1 | mm |  |
| 88 | TN\L2\_AGC\_S2GAP\_ACT | Roll gap of STD#2 | mm |  |
| 89 | TN\L2\_AGC\_S3GAP\_ACT | Roll gap of STD#3 | mm |  |
| 90 | TN\L2\_AGC\_S4GAP\_ACT | Roll gap of STD#4 | mm |  |
| 91 | TN\L2\_AGC\_S5GAP\_ACT | Roll gap of STD#5 | mm |  |
| 92 | TN\L2\_AGC\_S1LEV\_ACT | Leveling of STD#1 | mm |  |
| 93 | TN\L2\_AGC\_S2LEV\_ACT | Leveling of STD#2 | mm |  |
| 94 | TN\L2\_AGC\_S3LEV\_ACT | Leveling of STD#3 | mm |  |
| 95 | TN\L2\_AGC\_S4LEV\_ACT | Leveling of STD#4 | mm |  |
| 96 | TN\L2\_AGC\_S5LEV\_ACT | Leveling of STD#5 | mm |  |
| 97 | TN\L2\_AFC\_S1WRB\_ACT | Work roll bending force of STD#1 | kN/side |  |
| 98 | TN\L2\_AFC\_S2WRB\_ACT | Work roll bending force of STD#2 | kN/side |  |
| 99 | TN\L2\_AFC\_S3WRB\_ACT | Work roll bending force of STD#3 | kN/side |  |
| 100 | TN\L2\_AFC\_S4WRB\_ACT | Work roll bending force of STD#4 | kN/side |  |
| 101 | TN\L2\_AFC\_S5WRB\_ACT | Work roll bending force of STD#5 | kN/side |  |
| 102 | TN\L2\_AFC\_S1IRB\_ACT | Intermediate roll bending force of STD#1 | kN/side |  |
| 103 | TN\L2\_AFC\_S2IRB\_ACT | Intermediate roll bending force of STD#2 | kN/side |  |
| 104 | TN\L2\_AFC\_S3IRB\_ACT | Intermediate roll bending force of STD#3 | kN/side |  |
| 105 | TN\L2\_AFC\_S4IRB\_ACT | Intermediate roll bending force of STD#4 | kN/side |  |
| 106 | TN\L2\_AFC\_S5IRB\_ACT | Intermediate roll bending force of STD#5 | kN/side |  |
| 107 | TN\L2\_AFC\_S1TIRS\_ACT | Top intermediate roll shifting of STD#1 | mm |  |
| 108 | TN\L2\_AFC\_S1BIRS\_ACT | Bottom intermediate roll shifting of STD#1 | mm |  |
| 109 | TN\L2\_AFC\_S2TIRS\_ACT | Top intermediate roll shifting of STD#2 | mm |  |
| 110 | TN\L2\_AFC\_S2BIRS\_ACT | Bottom intermediate roll shifting of STD#2 | mm |  |
| 111 | TN\L2\_AFC\_S3TIRS\_ACT | Top intermediate roll shifting of STD#3 | mm |  |
| 112 | TN\L2\_AFC\_S3BIRS\_ACT | Bottom intermediate roll shifting of STD#3 | mm |  |
| 113 | TN\L2\_AFC\_S4TIRS\_ACT | Top intermediate roll shifting of STD#4 | mm |  |
| 114 | TN\L2\_AFC\_S4BIRS\_ACT | Bottom intermediate roll shifting of STD#4 | mm |  |
| 115 | TN\L2\_AFC\_S5TIRS\_ACT | Top intermediate roll shifting of STD#5 | mm |  |
| 116 | TN\L2\_AFC\_S5BIRS\_ACT | Bottom intermediate roll shifting of STD#5 | mm |  |
| 117 | TN\L2\_TCM\_COOL\_FL\_S1 | Emulsion flow rate of STD#1 | l/min |  |
| 118 | TN\L2\_TCM\_COOL\_FL\_S2 | Emulsion flow rate of STD#2 | l/min |  |
| 119 | TN\L2\_TCM\_COOL\_FL\_S3 | Emulsion flow rate of STD#3 | l/min |  |
| 120 | TN\L2\_TCM\_COOL\_FL\_S4 | Emulsion flow rate of STD#4 | l/min |  |
| 121 | TN\L2\_TCM\_COOL\_FL\_S5 | Emulsion flow rate of STD#5 | l/min |  |
| 122 | TN\L2\_TCM\_TR1TQ\_ACT | Motor torque of winder#1 |  |  |
| 123 | TN\L2\_TCM\_TR1PW\_ACT | Motor power of winder#1 |  |  |
| 124 | TN\G211\_122NI | Total tension of the inline accumulator (BR7-BR8) |  |  |
| 125 | TN\G301\_347NI | Position of the inline accumulator (BR7-BR8) |  |  |
| 126 | TN\L2\_AFC\_EGDWS10\_ACT | Deviation in thickness between the center and the edge of the strip, 10 mm from the operation side |  |  |
| 127 | TN\L2\_AFC\_EGDWS15\_ACT | Deviation in thickness between the center and the edge of the strip, 15 mm from the operation side |  |  |
| 128 | TN\L2\_AFC\_EGDWS20\_ACT | Deviation in thickness between the center and the edge of the strip, 20 mm from the operation side |  |  |
| 129 | TN\L2\_AFC\_EGDWS25\_ACT | Deviation in thickness between the center and the edge of the strip, 25 mm from the operation side |  |  |
| 130 | TN\L2\_AFC\_EGDWS50\_ACT | Deviation in thickness between the center and the edge of the strip, 50 mm from the operation side |  |  |
| 131 | TN\L2\_AFC\_EGDWS75\_ACT | Deviation in thickness between the center and the edge of the strip, 75 mm from the operation side |  |  |
| 132 | TN\L2\_AFC\_EGDWS100\_ACT | Deviation in thickness between the center and the edge of the strip, 100 mm from the operation side |  |  |
| 133 | TN\L2\_AFC\_EGDWS115\_ACT | Deviation in thickness between the center and the edge of the strip, 115 mm from the operation side |  |  |
| 134 | TN\L2\_AFC\_EGDDS10\_ACT | Deviation in thickness between the center and the edge of the strip, 10 mm from the drive side |  |  |
| 135 | TN\L2\_AFC\_EGDDS15\_ACT | Deviation in thickness between the center and the edge of the strip, 15 mm from the drive side |  |  |
| 136 | TN\L2\_AFC\_EGDDS20\_ACT | Deviation in thickness between the center and the edge of the strip, 20 mm from the drive side |  |  |
| 137 | TN\L2\_AFC\_EGDDS25\_ACT | Deviation in thickness between the center and the edge of the strip, 25 mm from the drive side |  |  |
| 138 | TN\L2\_AFC\_EGDDS50\_ACT | Deviation in thickness between the center and the edge of the strip, 50 mm from the drive side |  |  |
| 139 | TN\L2\_AFC\_EGDDS75\_ACT | Deviation in thickness between the center and the edge of the strip, 75 mm from the drive side |  |  |
| 140 | TN\L2\_AFC\_EGDDS100\_ACT | Deviation in thickness between the center and the edge of the strip, 100 mm from the drive side |  |  |
| 141 | TN\L2\_AFC\_EGDDS115\_ACT | Deviation in thickness between the center and the edge of the strip, 115 mm from the drive side |  |  |
| 142 | TN\L2\_AFC\_H5WID\_ACT | Strip width | mm |  |
| 143 | TN\L2\_AFC\_H5WID\_OFST | Deviation between calculated and actual strip width |  |  |
| 144 | TN\L2\_AFC\_S1WRB\_MAN | Manual adjustment of the work roll bending force in STD#1 |  |  |
| 145 | TN\L2\_AFC\_S2WRB\_MAN | Manual adjustment of the work roll bending force in STD#2 |  |  |
| 146 | TN\L2\_AFC\_BAFFC\_W\_COR | Bending AFFC (Automatic Flatness Feedback Control) for work roll bending force correction |  |  |
| 147 | TN\L2\_AFC\_LAFFC\_COR | Leveling AFFC (Automatic Flatness Feedback Control) for roll leveling correction |  |  |
| 148 | TN\L2\_AFC\_S1FFC\_W\_CMP | Force Following Control (FFC) compensation for work rolls in STD#1 |  |  |
| 149 | TN\L2\_AFC\_S2FFC\_W\_CMP | Force Following Control (FFC) compensation for work rolls in STD#2 |  |  |
| 150 | TN\L2\_AFC\_S3FFC\_W\_CMP | Force Following Control (FFC) compensation for work rolls in STD#3 |  |  |
| 151 | TN\L2\_AFC\_S4FFC\_W\_CMP | Force Following Control (FFC) compensation for work rolls in STD#4 |  |  |
| 152 | TN\L2\_AFC\_S5FFC\_W\_CMP | Force Following Control (FFC) compensation for work rolls in STD#5 |  |  |
| 153 | TN\L2\_AFC\_S1FFC\_I\_CMP | Force Following Control (FFC) compensation for intermediate rolls in STD#1 |  |  |
| 154 | TN\L2\_AFC\_S2FFC\_I\_CMP | Force Following Control (FFC) compensation for intermediate rolls in STD#2 |  |  |
| 155 | TN\L2\_AFC\_S3FFC\_I\_CMP | Force Following Control (FFC) compensation for intermediate rolls in STD#3 |  |  |
| 156 | TN\L2\_AFC\_S4FFC\_I\_CMP | Force Following Control (FFC) compensation for intermediate rolls in STD#4 |  |  |
| 157 | TN\L2\_AFC\_S5FFC\_I\_CMP | Force Following Control (FFC) compensation for intermediate rolls in STD#5 |  |  |
| 158 | TN\L2\_AGC\_V1THK\_DEV | Deviation between the actual and calculated thickness at the entrance of STD#1 |  |  |
| 159 | TN\L2\_AGC\_V2THK\_DEV | Deviation between the actual and calculated thickness at the exit of STD#1 |  |  |
| 160 | TN\L2\_AGC\_V5THK\_DEV | Deviation between the actual and calculated thickness at the exit of STD#4 |  |  |
| 161 | TN\L2\_AGC\_H5THK\_DEV | Deviation between the actual and calculated thickness at the exit of STD#5 |  |  |
| 162 | TN\L2\_TCM\_MRH | Main Reference Speed |  |  |
| 163 | TN\L2\_CPC\_DEV\_10 | Deviation of CPC (Central Line Position Control) #10 |  |  |
| 164 | TN\L2\_CPC\_DEV\_11 | Deviation of CPC (Central Line Position Control) #11 |  |  |
| 165 | TN\G111\_60NI | Feedback from the hydraulic cylinder at the outlet of inline loop at CPC (Central Line Position Control) #10 |  |  |
| 166 | TN\G111\_61NI | Feedback from the hydraulic cylinder at the outlet of CPC (Central Line Position Control) BR#11 |  |  |
| 167 | TN\L2\_AFC\_S1FFC\_LKFC | Measured value of flatness feedforward control in STD#1 |  |  |
| 168 | TN\L2\_AFC\_S2FFC\_LKFC | Measured value of flatness feedforward control in STD#2 |  |  |
| 169 | TN\L2\_TCM\_BITE\_S5\_A | Emulsion flow rate in region 12-A of STD#5 |  |  |
| 170 | TN\L2\_TCM\_BITE\_S5\_B | Emulsion flow rate in region 12-B of STD#5 |  |  |