

TOYOTA ENGINEERING STANDARD

NO. : TSG3100G

TITLE : COLD ROLLED STEEL SHEETS

CLASS : C1

Established/Revised : Rev.10(Feb.2005)

This standard has been revised in consequence of the following changes:
(1) expressions have been corrected; and
(2) a statement has been added that conformance to prohibitions and restrictions for substances of environmental concern in TS20001C is required.

Engineering Information
Planning Dept.
Engineering Administration Div.
TOYOTA MOTOR CORPORATION



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| TOYOTA ENGINEERING STANDARD | TSG3100G | CLASS |
| | | C1 |

COLD ROLLED STEEL SHEETS

1. Scope

This standard covers cold rolled steel sheets (hereinafter referred to as "steel sheets") which comprised automobile parts. The parts made of materials provided by this standard shall conform to prohibitions and restrictions for substances of environmental concern in TS2001G. Exempt uses specified by EU ELV Directive shall conform to the latest version of the Directive.

2. Classification and Codes

The classification and codes for steel sheets shall be as specified in Table 1.

Table 1

| Steel code | (Reference) Corresponding old code | (Reference) JIS standards | Usage |
|-------------------------|--|---------------------------|---|
| SPC270A | SCP270A | --- | For moderate formed inner panel (low grade material) ⁽¹⁾ |
| SPC270C | SCP270B | SPCC, SPCD | For general forming |
| SPC270D ⁽¹⁾ | SCP270C, CY, D | | For drawing |
| SPC270F ⁽²⁾ | SCP270DY, F ₁ | SPCE | For deep drawing |
| SPC270F ⁽²⁾ | SCP270E, F ₂ , F ₃ | SPCEN | For ultra deep drawing |
| SPC270BH ⁽³⁾ | SCP270DBH, EBH | --- | Bake hardenable type for dent-resisting parts |
| SPC340 | SCP340 | SPFC340 | For structural members |
| SPC340BH ⁽³⁾ | SCP340BH | SPFC340H | Bake hardenable type for dent-resisting parts |
| SPC340HR ⁽⁴⁾ | SCP340HR | --- | High r value type for structural members |
| SPC390 | SCP390 | SPFC390 | For structural members |
| SPC390HR ⁽⁴⁾ | SCP390HR | --- | High r value type for structural members |
| SPC440 | SCP440 | SPFC440 | For structural members |
| SPC440HR ⁽⁴⁾ | SCP440HR | --- | High r value type for structural members |
| SPC590 | SCP590 | SPFC590 | For structural members |
| SPC590DU | SCP590DU | SPFC590Y | Low yield point type for structural members |
| SPC780DU | SCP780DU | SPFC780Y | |
| SPC980DU | SCP980DU | SPFC980Y | |
| SPC1180DU | SCP1180DU | -- | |
| (SPC440HY) | SCP440 | SPFC440 | High yield point type for structural members |

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TOYOTA ENGINEERING STANDARD

TSG3100G

Note: (1)

Non-ageing property (Slow ageing property is also acceptable.)

Note: (2)

Non-ageing property

Note: (3)

Slow ageing property

Note: (4)

The scrap material from stamping of (large-sized) parts, the material which has been downgraded during production of higher grade material at the steel maker, etc.

Remark 1:

Non-ageing property is a property which satisfies the mechanical properties of Section 3 for 12 months after the steel sheets are manufactured and it does not cause a pattern called "stretcher strain" to form during processing.

Remark 2:

Slow-ageing property is a property which does not form stretcher strain for at least 3 months of storage at normal temperature after the steel sheets are delivered. (It is preferable that the materials be used as soon as practicable from the date of delivery.)

Remark 3:

Since the types of steel mentioned in () are planned to be abandoned in future, any of those materials may not be newly adopted.

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Established/ 10 Revised.
 Feb.2005

TOYOTA ENGINEERING STANDARD TSG3100G

3. Quality

3.1 Mechanical Properties

The mechanical properties of steel sheets shall be as specified in Table 2.

Table 2

| Steel code | Tensile strength (MPa) | Yield point or 0.2 % yield strength (MPa) | | | Lankford value (\bar{r} value) | | RH ⁽¹⁾ (MPa) |
|------------|------------------------|---|---------------|---------------|-----------------------------------|---------------|-------------------------|
| | | Thickness (mm) | | | Thickness (mm) | | |
| | | 0.4 ≤ t < 0.8 | 0.8 ≤ t < 1.0 | 1.0 ≤ t ≤ 1.2 | 0.5 ≤ t ≤ 1.0 | 1.0 < t ≤ 1.6 | |
| SPC270A | 270 to 370 | --- | | | --- | | --- |
| SPC270C | 270 min. | 165 to 265 | 135 to 255 | 175 to 245 | | | |
| SPC270D | | 135 to 225 | 125 to 215 | 115 to 205 | 1.2 min. | 1.1 min. | |
| SPC270E | | 130 to 205 | 120 to 195 | 110 to 185 | 1.4 min. | 1.3 min. | |
| SPC270F | | 120 to 185 | 110 to 175 | 100 to 165 | 1.6 min. | 1.5 min. | |
| SPC270BH | 340 min. | 135 to 225 | 125 to 215 | 115 to 205 | 1.4 min. | 1.3 min. | 30 min. |
| SPC340 | | 205 to 305 | 195 to 295 | 185 to 295 | --- | | |
| SPC340RH | | 185 to 285 | 175 to 275 | 165 to 265 | 1.1 min. | 1.0 min. | 30 min. |
| SPC340HR | | 165 to 255 | 155 to 245 | 145 to 235 | 1.4 min. | 1.3 min. | --- |
| SPC390 | 390 min. | 245 to 335 | 235 to 345 | 225 to 335 | --- | | |
| SPC390HR | | 205 to 305 | 195 to 295 | 185 to 285 | 1.4 min. | 1.3 min. | |
| SPC440 | | 285 to 390 | 275 to 380 | 265 to 370 | --- | | |
| SPC440HR | 440 min. | 245 to 355 | 235 to 345 | 225 to 335 | 1.3 min. | 1.2 min. | |
| SPC590 | | 430 to 580 | 420 to 570 | 410 to 560 | --- | | |
| SPC590DU | 780 min. | 325 to 470 | 315 to 460 | 305 to 450 | --- | | |
| SPC780DU | | 420 to 645 | 410 to 635 | 400 to 625 | --- | | |
| SPC980DU | 980 min. | --- | 590 to 930 | 580 to 920 | --- | | |
| SPC1180DU | | --- | 835 to 1225 | 825 to 1215 | --- | | |
| (SPC440HY) | 640 min. | 355 to 460 | 345 to 450 | 335 to 440 | --- | | |

Note: (5)

The amount of increase in yield point or 0.2 % yield strength by the 170 °C×20 min ageing treatment after the application of 2 % permanent strain.

Remark 1:

Lankford value $\bar{r} = (r_0 + r_{90} + 2r_{45}) / 4$

Remark 2:

When SPC270BH or 340BH is applied to dent-resisting parts, ensure the 170 °C×20 min ageing treatment condition.

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Feb.2005

TOYOTA ENGINEERING STANDARD TSG3100G

Table 2 (Continued)

| Steel code | Total elongation (%) | | | | | | | |
|-------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| | Thickness (mm) | | | | | | | |
| | 0.4 ≤ t < 0.6 | 0.6 ≤ t < 0.8 | 0.8 ≤ t < 1.0 | 1.0 ≤ t < 1.2 | 1.2 ≤ t < 1.6 | 1.6 ≤ t < 2.0 | 2.0 ≤ t < 2.5 | 2.5 ≤ t ≤ 3.2 |
| SPC270A | --- | | | | | | | |
| SPC270C | 36 to 46 (37 to 46) | 37 to 47 (38 to 47) | 38 to 48 (39 to 48) | 39 to 49 (40 to 49) | 40 to 50 (41 to 50) | 41 to 53 (42 to 53) | 42 to 55 (43 to 55) | 43 to 57 (44 to 57) |
| SPC270D | 39 to 49 (40 to 49) | 40 to 50 (41 to 50) | 41 to 51 (42 to 51) | 42 to 52 (43 to 52) | 43 to 53 (44 to 53) | 44 to 55 (45 to 55) | 45 to 57 (46 to 57) | 46 to 59 (47 to 59) |
| SPC270E | 41 to 51 (42 to 50) | 42 to 52 (43 to 51) | 43 to 53 (44 to 52) | 44 to 54 (45 to 53) | 45 to 55 (46 to 54) | 46 to 56 (47 to 56) | 47 to 58 (48 to 58) | 48 to 60 (49 to 60) |
| SPC270F | 43 to 53 (44 to 52) | 44 to 54 (45 to 53) | 45 to 55 (46 to 54) | 46 to 56 (47 to 55) | 47 to 57 (48 to 56) | 48 to 58 (49 to 58) | 49 to 60 (50 to 60) | --- |
| SPC270RH | 40 to 50 | 41 to 51 | 42 to 52 | 43 to 53 | 44 to 54 | 45 min. | | |
| SPC340 | 33 to 43 | 34 to 44 | 35 to 45 | 36 to 46 | 37 to 47 | 38 min. | | |
| SPC340RH | 34 to 44 | 35 to 45 | 36 to 46 | 37 to 47 | 38 to 48 | 39 min. | | |
| SPC340HR | 35 to 45 | 36 to 46 | 37 to 47 | 38 to 48 | 39 to 49 | 40 min. | | |
| SPC390 | 29 to 40 | 30 to 41 | 31 to 42 | 32 to 43 | 33 to 44 | 34 min. | | |
| SPC390HR | 31 to 42 | 32 to 43 | 33 to 44 | 34 to 45 | 35 to 46 | 36 min. | | |
| SPC440 | 26 to 38 | 27 to 39 | 28 to 40 | 29 to 41 | 30 to 42 | 31 min. | | |
| SPC440HR | 28 to 39 | 29 to 40 | 30 to 41 | 31 to 42 | 32 to 43 | 33 min. | | |
| SPC590 | 17 to 32 | | 18 to 33 | | | 18 min. | | |
| SPC590DU | 17 to 32 | | 18 to 33 | 19 to 34 | 20 to 35 | 21 min. | | |
| SPC780DU | 12 to 25 | | 13 to 26 | 14 to 27 | 15 to 28 | 16 min. | | |
| SPC980DU | 9 to 20 | | 10 to 21 | 11 to 22 | 12 min. | | | |
| SPC1180DU | 5 to 16 | | 6 to 17 | 7 to 18 | 8 min. | | | |
| (SPC440DRY) | 23 to 35 | 24 to 36 | 25 to 37 | 26 to 38 | 27 to 39 | 28 min. | | |

Note: (6)

SPC590, SPC590DU and SPC780DU can only be manufactured to the thickness of 0.6 mm or more. SPC980DU and SPC1180DU can only be manufactured to the thickness of 0.8 mm or more.

Remark:

Values in parentheses are the target values.

3.2 Surface and Internal Defects

Dull finish shall be the standard surface finish for steel sheets. Steel sheets shall have no surface or internal abnormality causing problems during actual use.

3.3 Chemical Composition

Although the chemical composition is not specified for steel sheets, representative examples of chemical composition values based on actual values are given in Table 3 for reference.

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Feb.2005

TOYOTA ENGINEERING STANDARD TSG3100G

Table 3 Reference value (Unit: mass %)

| Steel code | C | Si | Mn | P | S | As | Major strengthening mechanism | |
|-------------|-------|------|------|------|-------|------|--|--|
| SPC270C | 0.02 | 0.02 | 0.22 | 0.01 | 0.010 | 0.05 | --- Low-carbon steel | |
| SPC270D | | | | | | | | Extra-low-carbon or low-carbon steel |
| SPC270E | | | | | | | | Extra-low-carbon steel |
| SPC270F | ≤0.01 | | 0.17 | | 0.008 | 0.03 | | Extra-low-carbon steel |
| SPC270BH | | | --- | | | | Extra-low-carbon or low-carbon steel | |
| SPC340 | 0.06 | 0.02 | 0.25 | 0.07 | 0.011 | 0.05 | Solid solution strengthening Low-carbon steel | |
| SPC340BH | 0.01 | | 0.35 | | 0.009 | --- | | Extra-low-carbon or low-carbon steel |
| SPC340HR | | | --- | | | | | Low or medium-carbon steel |
| SPC390 | 0.06 | 0.02 | 0.45 | 0.09 | 0.008 | | | Extra-low-carbon or low-carbon steel |
| SPC390HR | ≤0.01 | 0.01 | 0.65 | 0.07 | 0.006 | | | Low or medium-carbon steel |
| SPC440 | 0.08 | 0.20 | 0.60 | 0.03 | | | | Extra-low-carbon or low-carbon steel |
| SPC440HR | | | --- | | | | | Low or medium-carbon steel |
| SPC590 | 0.14 | 0.25 | 1.4 | 0.02 | 0.006 | | | Solid solution + precipitation strengthening Dual phase Low or medium-carbon steel |
| SPC590DU | 0.09 | 0.28 | 2.0 | | 0.004 | | | |
| SPC780DU | | 0.80 | 2.5 | 0.01 | 0.001 | | | |
| SPC980DU | 0.17 | 1.40 | 2.0 | 0.02 | 0.002 | | | |
| SPC1180DU | 0.14 | 0.45 | | 0.01 | 0.003 | | | |
| {SPC440HY } | | | --- | | | | Solid solution + precipitation strengthening | |

4. Standard Dimensions

4.1 Standard Sheet Thickness

The standard thickness of steel sheets shall be as specified in Table 4.

Table 4 (Unit: mm)

| Tensile strength classification | Standard sheet thickness |
|--|---|
| Specification lower limit of tensile strength is 270 MPa or less | 0.4, 0.5, 0.6, 0.65, 0.7, 0.75, 0.8, 0.85, 0.9, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0, 2.3, 2.6, 2.8, 2.9, 3.2 |
| Specification lower limit of tensile strength exceeds 270 MPa | 0.6, 0.65, 0.7, 0.75, 0.8, 0.9, 1.0, 1.2, 1.4, 1.6 |

Remark:

Consult with concerned departments since the availability of sheet thickness is limited for certain types (strength level) of high tensile strength steel sheets (steel sheets whose specification lower limit of tensile strength is 340 MPa or more).

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TOYOTA ENGINEERING STANDARD TSG3100G

4.2 Permissible Deviation on Steel Sheet Thickness

The permissible deviation on the thickness of steel sheets shall be as specified in Table 5.

Table 5 (Unit: mm)

| Tensile strength classification | Nominal thickness | Nominal width | | | | |
|---|-------------------|---------------|------------|-------------|-------------|--------|
| | | w<630 | 630≤w<1000 | 1000≤w<1250 | 1250≤w<1600 | 1600≤w |
| Specification lower limit of tensile strength is 270 MPa or less | 0.40≤t<0.60 | ±0.05 | | | ±0.06 | ±0.07 |
| | 0.60≤t<0.80 | ±0.06 | | | | |
| | 0.80≤t<1.00 | ±0.06 | | ±0.07 | ±0.08 | ±0.09 |
| | 1.00≤t<1.25 | ±0.07 | | ±0.08 | ±0.09 | ±0.11 |
| | 1.25≤t<1.60 | ±0.08 | ±0.09 | ±0.10 | ±0.11 | ±0.13 |
| | 1.60≤t<2.00 | ±0.10 | ±0.11 | ±0.12 | ±0.13 | ±0.15 |
| | 2.00≤t<2.50 | ±0.12 | ±0.13 | ±0.14 | ±0.15 | ±0.17 |
| Specification lower limit of tensile strength is over 270 MPa and under 780 MPa | 0.40≤t<0.60 | ±0.05 | | | ±0.07 | ±0.08 |
| | 0.60≤t<0.80 | ±0.06 | | | | |
| | 0.80≤t<1.00 | ±0.07 | | ±0.08 | ±0.09 | ±0.10 |
| | 1.00≤t<1.25 | ±0.08 | | ±0.09 | ±0.10 | ±0.12 |
| | 1.25≤t<1.60 | ±0.09 | ±0.10 | ±0.11 | ±0.12 | ±0.14 |
| | 1.60≤t<2.00 | ±0.10 | ±0.11 | ±0.12 | ±0.14 | ±0.16 |
| | 2.00≤t<2.50 | ±0.12 | ±0.13 | ±0.14 | ±0.16 | ±0.18 |
| Specification lower limit of tensile strength is 780 MPa or more | 0.60≤t<0.80 | ±0.08 | | | ±0.09 | --- |
| | 0.80≤t<1.00 | ±0.09 | | | ±0.10 | --- |
| | 1.00≤t<1.25 | ±0.10 | | | ±0.12 | --- |
| | 1.25≤t<1.60 | ±0.12 | | | ±0.14 | --- |
| | 1.60≤t<2.00 | ±0.14 | | | ±0.16 | --- |
| 2.00≤t≤2.30 | ±0.16 | | | ±0.18 | --- | |

Remark 1:

The measurement point of the steel sheet thickness shall be 15 mm or more from the edge of the sheet.

Remark 2:

The permissible deviation on the sheet thickness not listed above shall be determined as necessary upon consultation with the department concerned.

5. Test Methods

5.1 Tensile Test

Use #5 test piece specified in TSG2204G as the steel sheet for the tensile test conducted in accordance with TSG2300G.

The test piece shall be sampled parallel to the rolling direction if the specification lower limit of tensile strength is 270 MPa or less, and perpendicularly to the rolling direction if the specification lower limit of tensile strength is over 270 MPa (except \bar{Y} value).

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Feb.2005

TOYOTA ENGINEERING STANDARD

TSG3100G

5.2 Coating Bake-Hardening Amount Test

The coating bake-hardening amount test of the steel sheet shall be conducted in accordance with TSG2308G by using No.5 test specimens specified in TSG2204G.

5.3 Chemical Composition

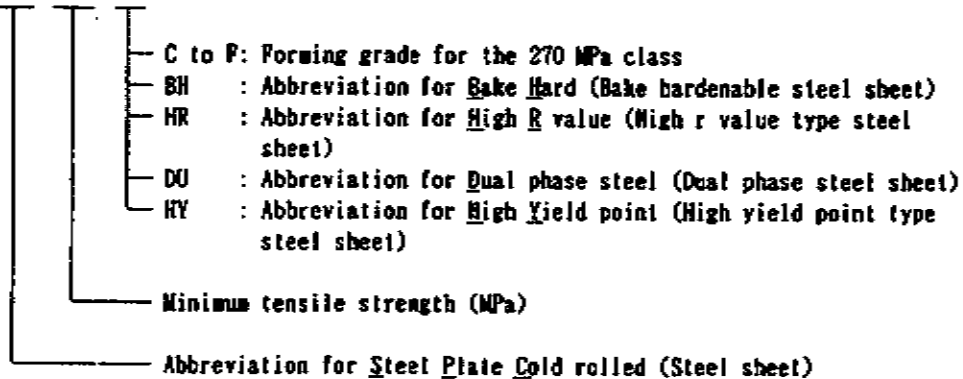
The chemical composition of steel sheets shall be analyzed in accordance with TSG1000G.

6. Indication in Drawings and Explanation of Code

The indications in drawings, and the explanation of code shall be as shown below.

Example: SPC 270 C

SPC 390 HR



Applicable Standards

| | |
|----------|---|
| TSG1000G | General Rules for Chemical Analysis of Steel Materials |
| TSG2204G | Test Pieces for Tensile Test of Metallic Materials |
| TSG2300G | Method of Tensile Test for Metal Sheet |
| TSG2308G | Test Method for Amount of Coating Bake-Hardening on Steel Sheet |
| TSZ0001G | Control Method for Substances of Environmental Concern |

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