



SURFACE VEHICLE RECOMMENDED PRACTICE

J126

APR2015

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Superseding J826 JUN1986

Selecting and Specifying Hot and Cold Rolled Steel Sheet and Strip

RATIONALE

J826 has been reaffirmed to comply with the SAE five-year review policy.

1. **Scope**—This SAE Recommended Practice outlines a procedure for selecting the proper specification for carbon steel sheet and strip which are purchased to make an identified part. Specifications considered are:

ASTM A109—Steel, Carbon, Cold Rolled Strip.
ASTM A569—Steel, Carbon (0.15 maximum percent), Hot Rolled Sheet, Commercial Quality (HRCQ).
ASTM A621—Steel, Sheet, Carbon, Hot Rolled, Drawing Quality (HRDQ).
ASTM A622—Steel, Sheet, Carbon, Hot Rolled, Drawing Quality, Special Killed (HRDQSK).
ASTM A568—Steel, Carbon and High-Strength Low-Alloy Hot Rolled Sheet, and Cold Rolled Sheet, General Requirements.
ASTM A366—Steel, Carbon, Cold Rolled Sheet, Commercial Quality (CRCQ).
ASTM A619—Steel, Sheet, Carbon, Cold Rolled, Drawing Quality (CRDQ).
ASTM A620—Steel, Sheet, Carbon, Cold Rolled, Drawing Quality, Special Killed (CRDQSK).
ASTM A749M—Steel, Carbon and High-Strength Low-Alloy, Hot Rolled Strip, General Requirements.
ASTM A635—Steel Sheet and Strip, Carbon, Hot Rolled Commercial Quality, Heavy Thickness Coils.
(Metric ASTM documents are designated by suffix M)

It also describes how codes or symbols for specifying certain characteristics may be used in electronic data processing systems. Characteristics covered are:

- Hot or cold rolled.
- Sheet or strip.
- Severity of draw (quality of steel).
- Surface condition (finish, etc.).
- Edge condition.
- Dimensions.

It is intended that other characteristics and part identification be covered by a supplement to the specification, as necessary.

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Documents

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2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A109—Steel, Carbon, Cold Rolled Strip.

ASTM A569—Steel, Carbon (0.15 maximum percent), Hot Rolled Sheet, Commercial Quality (HRCQ).

ASTM A621—Steel, Sheet, Carbon, Hot Rolled, Drawing Quality (HRDQ).

ASTM A622—Steel, Sheet, Carbon, Hot Rolled, Drawing Quality, Special Killed (HRDQSK).

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ASTM A620—Steel, Sheet, Carbon, Cold Rolled, Drawing Quality, Special Killed (CRDQSK).

ASTM A749M—Steel, Carbon and High-Strength Low-Alloy, Hot Rolled Strip, General Requirements.

ASTM A635—Steel Sheet and Strip, Carbon, Hot Rolled Commercial Quality, Heavy Thickness Coils.
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3. Procedure—Evaluate the part to determine the requirements for characteristics A-F, as follows:

3.1 A - Hot or Cold Rolled Product—Normally the finish or thickness of the metal required for a part will determine whether hot-rolled or cold-rolled product should be specified. (See Table 1A, Table 1B, and Table 4.)

3.2 B - Sheet or Strip—Principal factors to consider in determining whether sheet or strip should be specified are:

Size of part, or more specifically, size of flat steel required to develop part.

Thickness of metal required for the part.

Hot or cold rolled steel.

Selection and specification of temper for cold rolled strip. (See Table 3A, Table 3B.)

Equipment on which the metal will be handled and fabricated.

Steel industry product classification by size. (See Table 1A, Table 1B.)

3.3 C - Selection of Sheet Steel for Formability—For Cold Rolled Carbon Sheet and Hot Rolled Carbon Sheet and Strip, three levels of formability or drawability (called quality in the steel industry) are available as indicated in the Scope. They are commonly referred to as CQ, DQ, and DQSK.

The following procedure is based on a Forming Severity Index (FSI) which has been developed through experience in production forming of sheet metal stampings. The procedure is recommended for determining the quality needed for a specific part and fabrication operation.

1. Form a sample or prototype part from a specimen of known quality of steel using the gridding procedure outlined in SAE J863. (For the most accurate description of the quality of steel used for the gridded blank, the mechanical properties of a sample taken from material adjacent to the blank used for the gridded part should be known. This can be from the same blank, or the sheet preceding or following the sheet to be gridded.) If the specimen fractures, form another sample from the next better quality of steel.
2. Measure the e_1 and e_2 strains as described in SAE J863. (This should be done on a sample part which has not fractured during forming.)
3. Calculate the Forming Severity Index (FSI), for the critical area or areas of the sample part, using the following formulae:

NOTE—The e_2 strain is the associated strain (minor) measured perpendicular to the major strain, e_1 . When the e_2 strain as measured on the grid in the maximum stretch area is 0 to +30%.

$$FSI = (0.6e_2 + 15 + 350t) - e_1 \quad (\text{Eq. 1})$$

When the e_2 strain is 0 to -30% (biaxial tension compression forming).

$$FSI = (1.5e_2 + 15 + 350t) - e_1 \quad (\text{Eq. 2})$$

where:

t = thickness of gridded panel in inches.

e_1 = major strain expressed as a percent (not a decimal value).

e_2 = minor strain expressed as a percent (not a decimal value).

The sign of e_2 is disregarded (an e_2 of -30 is expressed as 30 in the formula).

NOTE:

- a. The thickness t in the above formulae is only a correction factor for calculation of the FSI. Material formability may not be dependent on the sheet metal thickness.
 - b. If t is expressed in millimeters, the multiplier will be 13.8 instead of 350.
 - c. The reliability of the equations for stock over 0.125 in or 3 mm has not been established.
 - d. The constant 15 in the above formulae can be modified by mutual consent of the supplier and user to provide the desired degree of risk of breakage. A constant of 15 approximates a safety factor of ten percentage of strain points for die, lubricant, press, and material variance of e_1 strain (major strain). A constant of 20 gives a safety factor of 5, and a constant of 10 gives a safety factor of 15.
4. Select the quality of steel sheet needed for the part from Table 2. When a change in material is indicated by Table 2, the selection should be verified using the new quality of sheet metal to form another sample part.
 5. After a sufficient production history has been obtained through the use of the SAE Recommended Practice J424, Determination of Breakage Allowance for Steel Sheets, the quality of steel being used should be reviewed. For a given part an unusually high scrap rate indicates either a tool, lubricant, or material quality selection problem. If material quality is found to be the problem, upgrading should be considered. Conversely, an unusually low scrap rate indicates a less expensive quality should be considered. SAE Recommended Practice J863 should be followed to determine the most beneficial material change.

EXAMPLE—In the case of 0.080 in or 2.00 mm thick sheet steel with e_1 strain of 33% and e_2 strain of +10%, the Forming Severity Index (FSI) would be:

$$FSI = \left[0.6(10) + \frac{(in)}{15} + 350(0.080) \right] - 33 \quad (\text{Eq. 3})$$

$$FSI = 16$$

$$FSI = \left[0.6(10) + \frac{(mm)}{15} + 13.8(2.0) \right] - 33 \quad (\text{Eq. 4})$$

$$FSI = 16$$

If the gridded panel was CRCQ steel, the FSI indicates the selection of a lower quality steel such as HRDQ (A621). Note that in cases such as this where the FSI is greater than +6 there are other factors than material which should be investigated to obtain the most economical production.

If the gridded panel was HRDQ, the indicated selection would be HRCQ (A569).

In the case of 0.036 in or 0.9 mm thick stock with an e_1 strain of 55% and an e_2 strain of -15%, the FSI would be:

$$FSI = \left[1.5(15) + \frac{(\text{in})}{15} + 350(0.036) \right] - 55 \quad (\text{Eq. 5})$$

$$FSI = -5$$

$$FSI = \left[1.5(15) + \frac{(\text{mm})}{15} + 13.8(0.09) \right] - 55 \quad (\text{Eq. 6})$$

$$FSI = -5$$

If the gridded panel was CRCQ and trouble was being encountered in forming production parts, the indicated selection would be to upgrade to CRDQ (A619). If the gridded panel was CRDQ, the indicated selection would be to upgrade to CRDQSK (A620) and if the panel was CRDQSK some other changes may be required in the forming operations or in the design of the part (comments in Table 2).

3.4 D - Surface Condition (Finish, etc.)—Consider any surface conditions required for the part. Consult Table 4 for a description of surfaces applicable to the product selected in A, B, and C above. Designate surface, finish, coating, etc. by symbol shown.

3.5 E - Edge Condition—Consider any necessary edge conditions required for the part. Consult Table 5 for a description of edges applicable to the product selected in A, B, and C above. Designate the required edge condition by the symbol shown.

3.6 F - Dimensions—Consider all dimensions required for the part.

Refer to ASTM A568 for thickness tolerance tables.

Designate dimensions in the following order: thickness, width, and length. (Note: Use the symbol C for length of material purchased in coil form.) When the measuring unit is inches, all fractions thereof shall be expressed as decimals and not as common fractions (for example, 1.25 in, not 1-1/4 in). State the thickness to three decimal places and width and length to two decimal places.

When metric units are used for dimensions, the thickness, width, and length should be expressed in millimeters. State thickness to one decimal place and width and length in whole numbers.

EXAMPLE—

For cut length:	0.035 x 36.25 x 84.75 (in)	0.9 x 900 x 2153 (mm)
For coil length:	0.047 x 47.37 x C (in)	1.2 x 1200 x C(mm)

(These units are not intended to indicate conversion of inch to metric units.)