



## **Variable Thickness Rolled Blanks (VTRB) and Tubes (VTRT) Fabricated from Sheet Steel**

### **1 Scope**

This standard defines the requirements for variable thickness rolled blanks (VTRB) and tubes (VTRT) used in the manufacture of automotive steel parts. This material is produced from continuous cast hot or cold rolled coils/strip that will subsequently be cold rolled to specific multiple thicknesses, annealed or as-rolled, and galvanized (if applicable), and then leveled and cut to specified blank sizes to produce a finished part. Variable thickness rolled blank products shall be used for cold formed stampings and hot formed stampings. Variable thickness rolled tubes shall be manufactured from variable thickness rolled blanks that are formed into circular tubes along the longitudinal direction and joined by a laser-welded seam.

**1.1 Material Description.** The material designation is specifically used for variable thickness material defined by the thickness values, GMW base metal specification number, steel product type, minimum yield and/or tensile strength, coating (if applicable) and finish type. The steel product type is designated by either Cold Rolled (CR) minimum yield strength for High Strength Low Alloy (HSLA) grades from GMW3032M-ST-S or minimum tensile strength/yield strength for Hot Stamped (HS) (or Hot Stamped Tube (HT)) grades from GMW14400M-ST-S. Applications of variable thickness rolled blanks shall be limited to unexposed parts.

**1.1.1 Material Call-Outs.** The list of material and coating designations shown in Table 1 are the only approved material call-outs that can be released unless Materials Engineering and the appropriate Global Sub-System Leadership Team approves.

**Table 1: Approved Material Call-Outs**

| <b>Product Type, Base GMW Specification</b> | <b>Grade</b>    | <b>Material Call-Out</b>                   | <b>Description</b>                                                                                                                   |
|---------------------------------------------|-----------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| GMW3032M-ST-S                               | 380LA           | GMW15619M-ST-S-380LA-EG60G60G-U            | Variable thickness rolled HSLA steel with 380 MPa minimum yield strength with 60 g/m <sup>2</sup> of zinc on both sides of the sheet |
| GMW3032M-ST-S                               | 420LA           | GMW15619M-ST-S-420LA-EG60G60G-U            | Variable thickness rolled HSLA steel with 420 MPa minimum yield strength with 60 g/m <sup>2</sup> of zinc on both sides of the sheet |
| GMW14400M-ST-S-HS                           | HS1300T/950Y-MS | GMW15619M-ST-S-HS-1300T/950Y-MS-UNCOATED-U | Variable thickness rolled hot stamped steel, uncoated                                                                                |
| GMW14400M-ST-S-HS                           | HS1300T/950Y-MS | GMW15619M-ST-S-HS-1300T/950Y-MS-AS60G60G-U | Variable thickness rolled hot stamped steel, AISi coated                                                                             |

**1.2 Symbols.** Not applicable.

**1.3 Applicability.** Typical applications for variable thickness rolled blanks include (but not limited to) body structure panels such as roof bows, cross sills, rocker panels, cross members, tunnel reinforcements, radiator support assembly tie bars, and B-pillars. Tubular applications include instrument panel cross car beams.

### **2 References**

**Note:** Only the latest approved standards are applicable unless otherwise specified.

**2.1 External Standards/Specifications.**

|           |            |           |             |
|-----------|------------|-----------|-------------|
| ASTM E8   | ASTM E646  | ISO 10113 | ISO 13919-1 |
| ASTM E517 | IATF 16949 | ISO 10275 |             |

**2.2 GM Standards/Specifications.**

|         |         |          |          |
|---------|---------|----------|----------|
| GMW11   | GMW3059 | GMW14019 | GMW14699 |
| GMW3032 | GMW3335 | GMW14400 | GMW16823 |

**2.3 Additional References.**

- Material Parts Specification (MPS) sheets.

**3 Requirements****3.1 Blank Requirements on Delivery.**

**3.1.1 Chemical Requirements.** Steel grades for variable thickness rolled blanks are selected to meet chemical requirements per Table 2 for cold stamped applications or GMW14400 for hot stamping applications.

**Table 2: Variable Thickness Rolled Blanks Chemical Requirements** Note 1, Note 2

| Base Material Designation | C     |       | Si    | Mn    |       | P     | S     | Al    | Nb    |
|---------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                           | % Min | % Max | % Max | % Min | % Max | % Max | % Max | % Min | % Max |
| S550                      | 0.04  | 0.09  | 0.40  | 0.40  | 0.80  | 0.02  | 0.010 | 0.015 | 0.04  |
| S600                      | 0.04  | 0.06  | 0.50  | 1.30  | 1.60  | 0.02  | 0.015 | 0.020 | 0.07  |

| Base Material Designation | Ti    |       | N     | V     | Cr    | Ni    | Mo    | GMW15619 Grade Designation |
|---------------------------|-------|-------|-------|-------|-------|-------|-------|----------------------------|
|                           | % Min | % Max | % Max | % Max | % Max | % Max | % Max |                            |
| S550                      | 0.08  | 0.12  | 0.015 | 0.04  | 0.15  | 0.08  | 0.06  | CR380LA                    |
| S600                      | 0.07  | 0.11  | 0.012 | 0.05  | 0.15  | 0.15  | 0.12  | CR420LA                    |

Max = maximum, Min = minimum

**Note 1:** Chemical composition based on product (coil or sheet/blank) analysis.

**Note 2:** Certification requirement – measured value shall be included on all supplied and applicable certification documents upon material delivery.

**3.1.2 Mechanical Requirements.**

**3.1.2.1 Purchased Coil Base Metal Mechanical Property Requirements.** Steel grades selected for variable thickness rolled blank applications are targeted to meet the mechanical property requirements per Table 3 for cold stamping applications, or GMW14400 for hot stamping applications.

**Table 3: Purchased Coil Base Metal Mechanical Property Requirements**

| Base Material Designation | Yield Strength at 0.2% Offset [MPa] |     | Tensile Strength [MPa] | Total Elongation in 50 mm (El/At) [%] | GMW15619 Grade Designation |
|---------------------------|-------------------------------------|-----|------------------------|---------------------------------------|----------------------------|
|                           | Min                                 | Max | Min                    | Min                                   |                            |
| S550                      | 550                                 | 700 | 620                    | 18                                    | CR380LA                    |
| S600                      | 600                                 | 750 | 675                    | 15                                    | CR420LA                    |

Max = maximum, Min = minimum

**3.1.2.2 Finished Blank Mechanical Property Requirements.** Finished blank or part mechanical properties shall meet the requirements as specified in the math data and/or MPS sheet. Tensile properties for variable thickness rolled blanks shall be measured in the longitudinal direction. ASTM E8 sub-sized tensile specimens shall be utilized if variable thicknesses rolled segment length is < 200 mm. For blanks which are further used for

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tube production longitudinal values are preferred. The supplier must be able to provide the mechanical values in both directions on request, e.g., by rolling a validation sample. Material callouts will reference the strength in the lowest reduction section of the VTRB to be cold stamped.

Hot stamped VTRB shall meet mechanical property requirements as stated in GMW14400, if applicable for indirect hot stamped applications.

The VTRB supplier shall submit final mechanical property ranges for each thickness segment to be included in the product math data and updated on the MPS sheet prior to MPS Release 3. These properties will override the material grade call-out in the case of a conflict.

**3.1.3 Blank Thickness and Dimensional Requirements.** The variable thickness rolled segments of variable thickness rolled blanks shall conform to thickness tolerance of  $\pm 0.05$  mm for all thickness segments for blanks and tubes. Thickness and thickness tolerances shall be specified by the detailed engineering math data. This information can also be found on the detailed MPS sheets issued by General Motors North America (GMNA) – Body Manufacturing Engineering for internally processed components. Minimum constant section lengths must measure at least 50 mm. Minimum thickness change between two adjoining sections is 0.2 mm.

**3.1.4 Maximum Thickness Reduction.** Variable thickness rolled blanks may vary in thickness from 0.65 mm to 3.5 mm. Variation from one constant thickness section to the next must not exceed 50% maximum reduction from the thick to the thin section depending upon the exact grade of the starting material.

**3.1.5 Maximum Widths.** The current maximum width capability of variable thickness rolled blank suppliers is 750 mm.

**3.1.6 Blank Length and Width Tolerances.** Unless otherwise specified by the Geometric Dimensioning and Tolerancing (GD&T) datum locating scheme, the permissible tolerances for blank length is  $\pm 2.0$  mm. Blank width tolerance is  $\pm 1.0$  mm.

**3.1.7 Minimum and Maximum Thickness to Length Change (Slope) of Transition Areas.** The typical maximum thickness to length change (slope) within transition areas shall not be more than 1 mm/100 mm of length. Location of transition areas can vary by  $\pm 5$  mm, thus shortening or lengthening the adjoining constant thickness section.

**3.1.8 Hot Stamped AISi-Coating.** Applications of AISi-coated VTRB for hot stamping are restricted to non-corrosion critical areas only. Exceptions must be approved by Materials Engineering. Interdiffusion layer (IDL) thickness for AISi-Coated VTRBs and coating thickness shall meet requirements specified in GMW14400.

Defects of the AISi-coating caused by the rolling operation such as inversions as shown in Figure 1 and large area break-offs (over 1mm in maximum dimension) shown in Figure 2 are not allowed.



Figure 1: Example of Inversion in AISi Coated Hot Stamped Steel