

DAIMLERCHRYSLER CORPORATION
Material Standard
Category Code: B-1
EASL Req.: No
Restricted: No

No: MS-STEEL<S>
Date Published: 2004-07-21
Change: L

HOT AND COLD - ROLLED STEEL SHEET, STRIP AND WELDED MECHANICAL TUBING

1.0 GENERAL

CAUTION: Fasteners, springs or clips manufactured from this material, that are surface treated to improve their cleanliness, appearance or corrosion resistance, may become hydrogen embrittled when exposed to the chemicals and coating methods used in processing. Consequently, if these parts are surface treated, it is required that they be hydrogen embrittlement relieved according to the procedures described in PS 9500.

1.1 Purpose of the Standard

This standard describes the general requirements for carbon and alloy hot and cold-rolled steel sheet, strip and welded tubing.

1.2 Purpose of the Material

1.2.1 Coverage of this standard

The materials covered by this standard are:

MS-	66	MS-	331	MS-	388	MS-	466	MS-	1917	MS-	2485
	67		335		389		467		2015		2875
	210		345		402		498		2108		3339
	213		374		410		501		2116		3413
	231		375		434		519		2130		3414
	301		381		459		1560		2364		6896
											10176

2.0 REQUIREMENTS OF THE MATERIAL

2.1 General Requirements

Each type of steel product shall meet the minimum requirements specified by the latest issue of the appropriate ASTM standard (s) listed below in Table 1, and the requirements noted in the Table 2 - Material Standard Numbers and Chemistries. Use of SAE J126, Selecting and Specifying Hot and Cold-Rolled Sheet and Strip, is suggested as a recommended practice for clarification of the types of products and how they are specified.

TABLE 1: ASTM STANDARDS	
STEEL PRODUCT	ASTM STANDARD #

TABLE 1: ASTM STANDARDS	
STEEL PRODUCT	ASTM STANDARD #
Carbon and HSLA Steel, Hot-Rolled and Cold-Rolled Sheet, General Requirements for	A568
Carbon and HSLA Steel, Hot-Rolled Strip, General Requirements for	A749
Carbon Steel (.16% to .25% max.), Hot-Rolled Sheet and Strip, Commercial Steel	A659
Carbon Steel, Hot-Rolled Sheet and Strip, Heavy-Thickness Coils	A635
Carbon Steel, Cold-Rolled Strip	A109
High-Carbon Steel, Cold-Rolled Strip, Spring Quality, General requirements for	A682
High-Carbon Steel, Cold-Rolled Strip, soft, Un-tempered Spring Quality	A684
Alloy Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, General Requirements for	A505
Alloy Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, Regular Quality	A506
Alloy Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, Drawing Quality	A507
Cold-Drawn Buttweld Carbon Steel Mechanical Tubing	A512
Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing	A513
Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability	A1008
Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability	A1011
NOTE: Metric ASTM documents are designated by the Suffix M	

3.0 MATERIALS CHARACTERISTICS

3.1 Residual Chemical Elements

Restricted maximums or minimums for residual or incidental elements are not a requirement of this standard except for tin (Sn) on cold rolled products - MS-67 (refer to 4.0 Chemical Composition). However, restrictions may be specified on the engineering drawing, the purchase order, or by negotiation between the producer and user. Residual or incidental elements include those not normally specified including but not limited to nickel, chromium, molybdenum and copper. High residuals are common in electric furnace steel melted from scrap. Lower residuals are typical of mills that use molten iron to make steel. In certain parts applications high or low residuals can be either beneficial or detrimental to heat treatment and/or part manufacturing. Care should be exercised to avoid these problems with the various steel mills.

3.2 Grain Size

The austenitic grain size of the steel shall be as specified in Table 2 - Material Standard Numbers and Chemistries. If no grain size is listed there is no Engineering requirement. Coarse grain is considered to be size 1 through 5, while fine grain is considered to be size 5 or finer. The procedure for determining grain size shall be that designated in the latest issue of ASTM E112.

4.0 CHEMICAL COMPOSITION <S>

The chemical compositions of the products covered by this standard are listed in the Table 2 – Material Standard Numbers and Chemistries. Each steel grade is identified by a DaimlerChrysler Materials Standard (MS) number, which is used on DaimlerChrysler engineering drawings. The Society of Automotive Engineer's (SAE) grade is also listed in the Table 2 for information purposes. The SAE grade represents chemistry only and is not an adequate specification for material to be supplied to or used by DaimlerChrysler Corporation.

If silicon is not specified in Table 2, on the purchase order, or by agreement between the supplier and user, the silicon level shall meet one of the recognized standard ranges such as 0.10% max., 0.10% to 0.20%, or 0.15% to 0.35% as is appropriate for the type (deoxidation practice) of the steel and the grade. The tin (Sn) content must not exceed 0.010 (weight %) for cold rolled steel MS-67.

The heat or ladle chemistry is to be supplied by the producer to the user along with the steel mill heat number. Heat or ladle chemistries are subject to product or check analysis limits as specified in ASTM A-568 or the SAE J-409 Standard of latest issue.

5.0 MANUFACTURING REQUIREMENTS OF THE MATERIAL

5.1 Steel Making Practices

5.1.1 Melting

The basic oxygen, open hearth, and the electric furnace process are approved. Use of any other process or new technique requires the approval of Materials Engineering.

5.1.2 Type of Steel - Deoxidation Practice

The type of steel or deoxidation practice (i.e., killed, semi-killed, rimmed, and capped) is restricted by the specified chemistry or is indicated in the column in Table 2 listing the type of steel required for that grade.

If the chemistry is not restrictive and the type of steel is not listed, there is no Engineering restriction as to the deoxidation practice used. The part manufacturer may specify deoxidation practice for manufacturing purposes if there is no conflict with the Material Standard or the Engineering Drawing.

5.2 Material Quality

Material quality levels are to be specified by the part manufacturer as necessary to make the part (when not dictated by Engineering).

Steel and parts deemed to be unacceptable for the intended use by the user are subject to rejection and subsequent negotiation for a claim.

The part manufacturer may specify additional requirements such as restricted chemistry, special cleanliness, as received grain size, mechanical properties etc., if deemed necessary by the part manufacturer to minimize manufacturing problems, costs, and high levels of part rejects.

Additional restrictive requirements are noted in this standard, on the appropriate engineering drawing or on the purchase order. Restrictions on the engineering drawing of the part take precedence over the material standard or purchase order. Conflicts among the material standard, the purchase order, and the engineering drawing must be resolved by Materials Engineering and the receiving plant. Any deviations from the material standard must be approved by Materials Engineering.

5.3 Cleanability - Body-In-White Parts

To assure clean metal surfaces for satisfactory phosphatability, parts must be formed using only metal forming lubricants defined by DaimlerChrysler Non-Productive Standard NP 6024. This requirement is intended only for stampings that become part of the body-in-white prior to cleaning, phosphating, and painting. A list of approved lubricants can be obtained from Non-Productive Materials Department. Use of any other metal forming lubricants must have prior approval of the Manager, Non-Productive Standards and Manufacturing Engineering, DaimlerChrysler Corporation.

5.4 Mechanical Tubing

5.4.1 Weld Condition

Welded tubing covered by this standard shall have weld flash removed from the outside diameter. Inside diameter weld flash shall not exceed the limits called out in the applicable ASTM Standard, on the engineering drawing, or on the purchase requisition. Tube welds are expected to be functional for the intended use and, where necessary shall meet the appropriate weld tests detailed in ASTM A-513 or A-512 Supplementary Requirements.

5.4.2 Method of Manufacture

Tubing supplied to this standard is to be electric-resistance-welded unless otherwise specified or allowed on the engineering drawing. Deviations require specific written engineering approval for each part number application.

TABLE 2: MATERIAL STANDARD NUMBERS AND CHEMISTRIES FOR CARBON AND ALLOY STEEL HOT AND COLD-ROLLED SHEET, STRIP, AND WELDED TUBING. ***

<S> Daimler Chrysler MS No.	Change Letter	SAE Grade	<S> % C	<S> % Mn	% P	% S	% Si	<S> % Cr	<S> % Mo	Type of Steel	Grain Size	Additional Requirements
66	Q		Hot Rolled (Part Manufacturer specifies quality when not dictated by Engineering) - See Section 5.5 MS-66 shall have minimum yield strength of 25 ksi									
	Q		.13 max	.60 max	.030 max	.035 max						
67	V		Cold Rolled (Part manufacturer specifies quality level when not dictated by Engineering) - See Sections 5.5 and 5.6.2									
	V		.13 max	.60 max	.030 max	.035 max						Sn=0.010 max
210	J	1020	Use either 210A or 210B as options									
210A	J	1020	.17/.23	.30/.60	.030 max	.035 max	.10 max					
210B	J	1020	.17/.23	.30/.60	.030 max	.035 max				Killed	Fine	
213	-		.10/.20	.30/.60	.030 max	.035 max						
			(Cold rolled full hard 85 HRB min. A-611) (Unless otherwise specified on drawing)									
231	-	1030	.27/.34	.60/.90	.030 max	.035 max						

**TABLE 2: MATERIAL STANDARD NUMBERS AND CHEMISTRIES FOR CARBON AND ALLOY STEEL
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<S> Daimler Chrysler MS No.	Change Letter	SAE Grade	<S> % C	<S> % Mn	% P	% S	% Si	<S> % Cr	<S> % Mo	Type of Steel	Grain Size	Additional Requirements
			Bend Iron – Cold Rolled and treated to 80 ksi (552 MPa) minimum tensile strength, hardness 90-100 HRB.									
301	A	1016	.12/.18	.60/.90	.030 max	.035 max				Killed	Fine	
331	A	1040	.36/.44	.60/.90	.030 max	.035 max				Killed	Fine	
335	O	1022	Use either 335A or 335B as options									
335A	"	"	.17/.25	.70/ 1.00	.030 max	.035 max	.10 ma x					
335B	"	"	"	"	"	"				Killed	Fine	
345	G	MT 1020	.15/.25	.30/.60	.040 max	.050 max						Mech. Tubing Only
374	C	4140	.38/.43	.75/ 1.00	.040 max	.040 max		.80/ 1.1 0	.15/ .25	Killed	Fine	
375	A	1080	.74/.88	.60/.90	.030 max	.035 max				Killed	Fine	
381	D	6150	.48/.53	.70/.90	.040 max	.040 max		.80/ 1.1 0		Killed	Fine	V = 0.15 min.
388	F	1015	Use either 388A or 388B as options.									
388A	"	"	.12/.18	.30/.60	.030 max	.035 max	.10 ma x					
388B	"	"	"	"	"	"				Killed	Fine	
388C	F	1012	.10/.15	.30/.60	.030 max	.035 max						
			(Where road wheel discs are specified as MS-388, grades A & B or C are acceptable)									
389	H	1050	.47/.55	.60/.90	.030 max	.035 max				Killed	Fine	See Section 5.6.2
402	G	1060	.55/.66	"	"	"				"	"	
410	K	1030	.27/.34	"	"	"				"	"	
410A	"	"	"	"	"	"				"	"	
410B	K	1030	.27/.34	.50/.80	.030 max	.035 max				Killed	Fine	
			When Grade B is specified Grade A may be substituted if required									
434	A	1045	.42/.50	.60/.90	.030 max	.035 max				Killed	Fine	

**TABLE 2: MATERIAL STANDARD NUMBERS AND CHEMISTRIES FOR CARBON AND ALLOY STEEL
HOT AND COLD-ROLLED SHEET, STRIP, AND WELDED TUBING. *****

<S> Daimler Chrysler MS No.	Change Letter	SAE Grade	<S> % C	<S> % Mn	% P	% S	% Si	<S> % Cr	<S> % Mo	Type of Steel	Grain Size	Additional Requirements
459	A	4130	.28/.33	.40/.60	.040 max	.040 max		.80/ 1.1 0	.15/ .25	Kille d	Fine	
466	A	1046	.42/.50	.70/ 1.00	.030 max	.035 max				Kille d	Fine	
467	M	1035	.31/.38	.60/.90	"	"				Kille d	Fine	
498	A	1566	.40/.71	.85/ 1.15	.040 max	.050 max				Kille d	Fine	
501	E	Use either MS-501A, 501B, or 501C.										
501A	E	1006	.08 max	.45 max	.030 max	.035 max	.10 ma x					
501B	E	1008	.10 max	.50 max	"	"	"					
501C	E	1010	.08/.13	.30/.60	"	"	"					
519	B		.08/.12	.30/.50	.030 max	.035 max				Hot Rolled		Frame cross members, T.S. = 310 – 379 MPa (45 - 55 ksi), and Y.S. = 213 – 262 MPa (31 – 38 ksi), 40 to 46% Elong. in 2".
1560	L	MT 1010	.05/.15	.30/.60	.040 max	.050 max						Mech. Tubing Only
1917	J	1026	Use either 1917A or 1917B as options									
1917A	J	1026	.22/.28	.60/.90	.030 max	.035 max	.10 ma x					
1917B	J	1026	.22/.29	.40/.90	.030 max	.035 max				Kille d	Fine	
2015	A	1070	.65/.74	.60/.90	.030 max	.035 max				Kille d	Fine	
2108	H	1030	.28/.34	.60/.90	.030 max	.035 max						
2116	E	1025	.22/.28	.30/.60	.030 max	.035 max						
2130	A	1090	.84/.98	.60/.90	"	"				Kille d	Fine	
2364	H		Use either 2364A or 2364B as options.									
2364A	H		.70/.85	.30/.40	.030 max	.035 max				Kille d	Fine	
2364B	H		.45/.80	.50/.80	"	"				"	"	
2485	H	1018	Use either 2485A or 2485B as options.									

**TABLE 2: MATERIAL STANDARD NUMBERS AND CHEMISTRIES FOR CARBON AND ALLOY STEEL
HOT AND COLD-ROLLED SHEET, STRIP, AND WELDED TUBING. *****

<S> Daimler Chrysler MS No.	Change Letter	SAE Grade	<S> % C	<S> % Mn	% P	% S	% Si	<S> % Cr	<S> % Mo	Type of Steel	Grain Size	Additional Requirements
2485A	H	1018	.15/.20	.60/.90	.030 max	.035 max	.10 ma x					
2485B	H	1018	.15/.20	.60/.90	.030 max	.035 max				Kille d	Fine	
2875	D	MT 1015	.10/.20	.30/.60	.040 max	.050 max						Mech. Tubing Only
3339	C	1524	.18/.25	1.3/ 1.45	"	"				Kille d	Fine	
3413	G	1010 HR	.08/.13	.30/.60	.030 max	.035 max	.10 ma x			Kille d		Hot rolled See Section 5.5
3414	F	1010 CR	"	"	"	"	"			Kille d		Cold rolled See Section 5.5 and 5.6.2
6896	-	1017/ 1020	.14/.23	.30/.60	.030 max	.035 max				Al Kille d		Prop Shaft, Cold Rolled Steel, HRB = 90 max, Y.S. = 441 MPa (64 ksi) min, 5% Min. elong. in 2" (in trans. Direction)
10176	—	15B22 Mod.	.20/.25	1.0/1.3	.025 max	.015 max	.20/ .35	.15/ .25		Al Kille d		B = 0.0015 – 0.0050, Ti = 0.015 – 0.045

All % are weight %

5.5 Additional Requirements for Materials in Table 2

Requirements listed in this section are for MS-66, MS-67, MS-3413, & MS-3414.

5.5.1 Formability ***

This steel shall be purchased for a particular part specified by part number and name on the Purchase Requisition and shall be suitable in surface, temper and drawing qualities for that part. Any necessary "extras" shall also be specified on the Purchase Requisition or be negotiated between supplier and user.

MS-66 and MS-67 are classified according to forming quality level as follows:

CS – Commercial Steel – intended for parts where bending, moderate forming or drawing is required.

DS – Drawing Steel – Special killed steel intended for parts having severe deformations and freedom from aging is required.

DDS – Deep Drawing Steel – special killed steel intended for parts where extremely severe forming or freedom from aging is required.

*** For Material Standard specified as MS-66, it shall have a minimum yield strength of 25 ksi regardless

of thickness. ***

5.5.2 Surface Texture and Finish

5.5.2.1 Surface Condition - Code "E" (Exposed Quality)

When Code E is specified, the surface quality shall be suitable for critically exposed (Class 1) surfaces and shall be free from any surface defect or discontinuity, which will detract from subsequent surface inspection or the final painted appearance of the part. The substrate steel shall not exhibit yield point elongation (Lüders bands or stretcher strain). The steel sheet shall meet the surface texture requirements for critical exposed applications as shown in Figures 1 and 2.

5.5.2.2 Surface Condition - Code "F" (Semi-Exposed Quality)

When Code F is specified the surface quality shall be suitable for non-critical or semi-exposed applications. Acceptability of surface defects or discontinuities shall be negotiated between the user and the supplier. The substrate steel shall not exhibit yield point elongation (Lüders bands or stretcher strain). The steel sheet shall meet the surface texture requirements for non-critical exposed applications as shown in Figures 1 and 2.

5.5.2.3 Surface Condition – Code "U" (Unexposed Quality)

Steel sheet, purchased for the manufacture of unexposed parts such as hood inners and floor pans designated as "U" (Class 2 - not temper rolled), shall have no specific surface requirements.

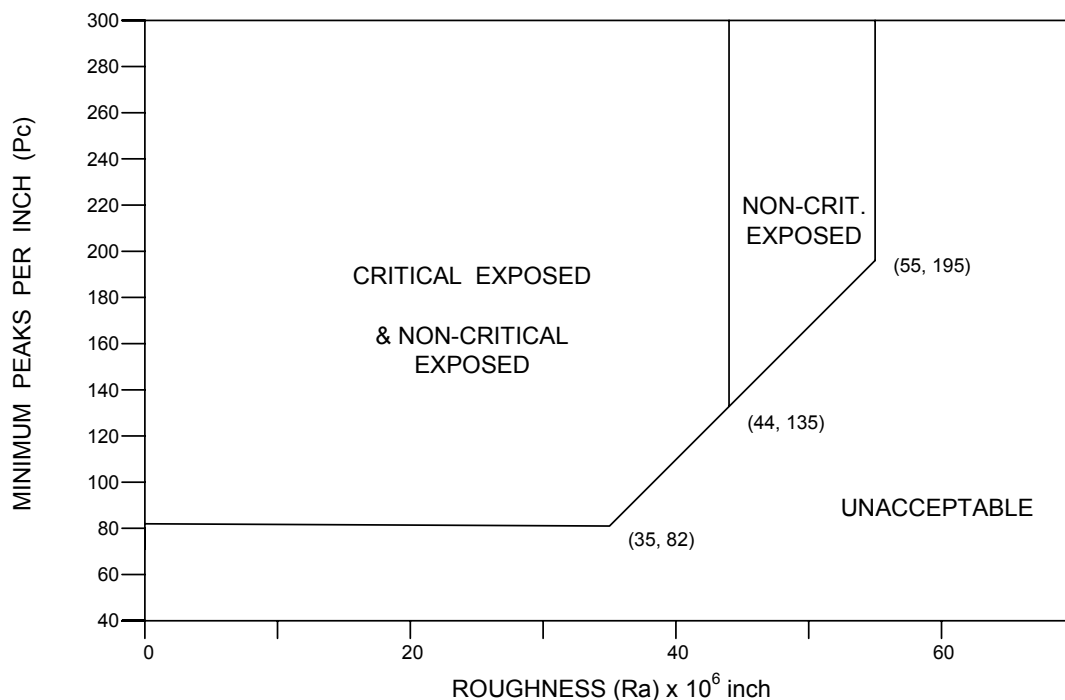


FIGURE 1: SURFACE ROUGHNESS REQUIREMENTS (ENGLISH UNITS)

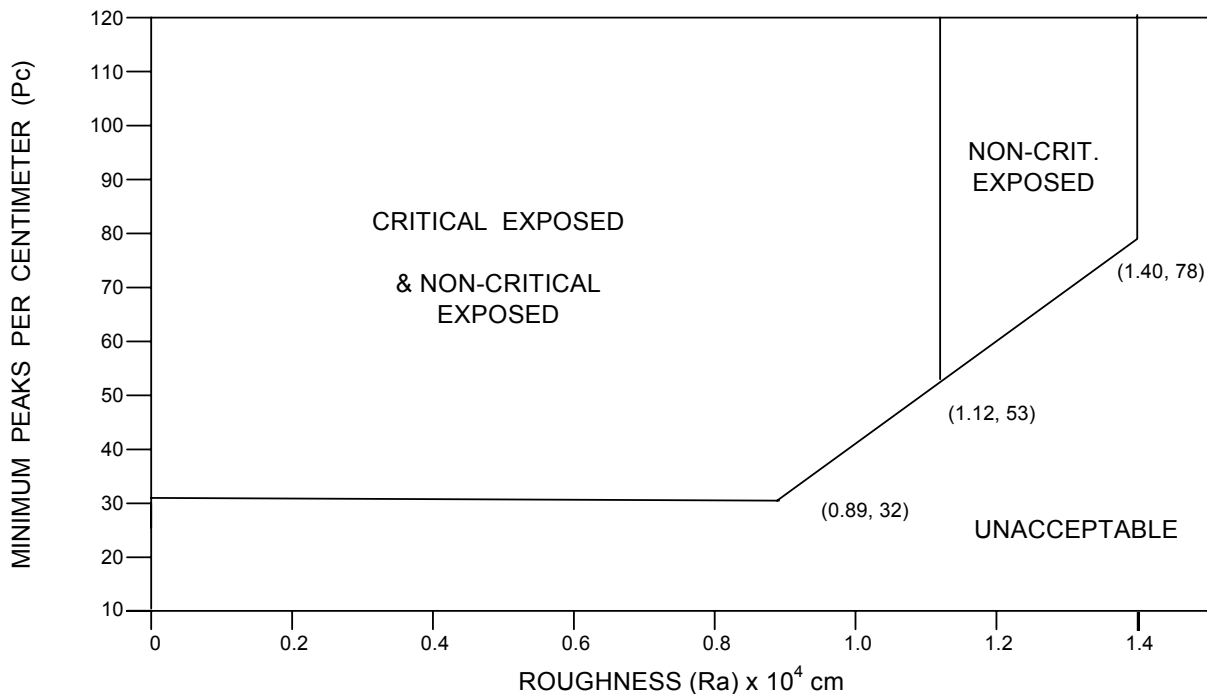


FIGURE 2: SURFACE ROUGHNESS REQUIREMENTS (METRIC UNITS)

5.5.2.4 Material with a Thin Nickel Coating

Cold rolled steel with a thin non-continuous nickel coating can be added to bare cold rolled steel to provide in-transit corrosion protection. The Ni coating is electrolytically applied to the surface of the sheet steel. This coating will be applied at the steel mill with coating mass of 12 mg +/- 3 mg (9 to 15mg) per square meter (m²) per side. The Ni coating on the steel surface shall be determined using the X-Ray fluorescence method, in accordance with ASTM E1621.

This material will be identified as MS-XX-Ni (e.g. MS-67-Ni). The Ni coating is not a substitute for galvanized or galvanized coatings used for vehicle corrosion protection. It's purpose is exclusively for the prevention of in-transit corrosion.

5.5.2.5 Surface Roughness Measurement

Surface roughness and peak count shall be measured in accordance with Chrysler Process Standard PS-899, with a 0.8 mm (0.030 inch) cut-off and a 25.4 mm (1 inch) stroke. Peak count measurements are to be made with a 12.5x10⁻⁴mm (50x10⁻⁶ in) threshold.

5.6 Special Instructions

5.6.1 Material substitution MS-67 for MS-66 ***

If the material is originally released as MS-66 (hot rolled steel - 25 ksi min. yield strength), it can be substituted with MS-67 (cold rolled steel). However, it is required that the substituted MS-67 product must meet the 25 ksi min. yield strength, as per the released spec MS-66 regardless of thickness specified.

5.6.2 Material Substitution MS-420 for MS-66

When hot rolled bar is desired, the applicable material standard is MS-420.

5.6.3 Additional Requirements for MS-67 and MS-3414

Material for decorative parts to be subsequent chromium plated in accordance with Process Standard ***PS-8908 or PS-415<D> *** shall be purchased with a finish suitable for the intended application and shall be identified to insure proper handling during manufacturing operations.

5.6.4 Additional Requirements for MS-389

When small flat springs, clips or fasteners are made from this material, the manganese range may be adjusted to a .40 minimum by the supplying source to conform to manufacturing techniques. The finished part in each case shall meet the mechanical requirements specified and must function as intended during installation and use.

6.0 CONTROL

6.1 Identification

Steel orders must include the appropriate DaimlerChrysler Corporation Material Standard (MS) number, the part application and the part number.

6.2 Certification

Heat or ladle chemistry is to be supplied by the producer and certified to the appropriate material standard to the user along with the steel mill heat number. Any changes in steel manufacturing and processing made by the supplier that affect properties, manufacturing, and performance are done at the producer's risk and the material is subject to rejection.

6.3 Inspection ***

Sheet products supplied to this standard to DaimlerChrysler Corporation plants shall be inspected in accordance with PS-5570. This standard is intended for use only between DaimlerChrysler Corporation and its steel suppliers who supply steel directly to DaimlerChrysler plants. The steel must meet any additional requirements detailed on the Stamping Metal Parts Specification Sheet and/or the additional manufacturing requirements specified by outside part manufacturers as is appropriate.

Changes to the production process are not allowed without the prior notification and approval of DaimlerChrysler Corporation.

7.0 GENERAL INFORMATION

Three asterisks “***” after the section/paragraph header denotes multiple technical changes to the section/paragraph. A triple asterisk before and after a string of text (***text***) identifies a single change.

Certain important information relative to this standard has been included in separate standards. To assure the materials submitted meet all of DaimlerChrysler requirements, it is mandatory that the requirements in the following standards be met.

CS-9800 - Application of this standard, the subscription service, and approved sources

CS-9003 - Regulated substances and recyclability

Within Engineering Standards, the Regulatory (Government-mandated) requirements are designated by <S>, <E> and <H> which correspond to Safety, Emission and Homologation Shields respectively. The DCC-mandated requirements are designated by <D>, <A> and <T> and correspond to the Diamond, Appearance and Traceability symbols respectively.

For specific information on this document, please refer to the contact person shown in the "Publication Information" Section of this document. For general information on obtaining Engineering Standards and Laboratory Procedures, see CS-9800 or contact the Engineering Standards Department at engstds@dcx.com.

8.0 REFERENCES ***

The text of the standard refers to the following standards:

American Society for Testing and Materials:

ASTM - A109	ASTM - A507	ASTM - A568	ASTM - A682	ASTM - A1008
A370	A512	A635	A684	A1011
A505	A513	A659	A749	E112
A506				

(Metric ASTM Documents have the suffix M)

Society of Automotive Engineers:

SAE J126 SAE J409

DaimlerChrysler Standards:

*** PS-415<D> ***	PS-899	PS-5570	PS-5570	*** PS-8908 ***
CS-9003	CS-9800	CS-9801	*** PF-Safety<S> ***	

DaimlerChrysler Non-Productive Material Standard

NP-6024

9.0 ENGINEERING APPROVED SOURCE LIST

Not applicable.

10.0 PUBLICATION INFORMATION

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Dept. Name & Dept. No./Tech Club/Organization: Body Materials Engineering, Dept 5820

Date Standard Originally (Initially) Published: 1984-03-27

Date Published: 2004-07-21

Change Notice:

Description of Change:

- TABLE 2 – corrected MS-213, MS-498, MS-2485B, MS-3413, and MS-3414;
- Section 5.5.1 – reworded a sentence;
- Section 5.6.1 – reworded;
- Section 5.6.3 – replaced PS-1570 with PS-8908, added <D> for MS-415;
- Section 6.3 – reworded with deletion of PS-5569;
- Section 8.0 – added <D> for MS-415, added PS-Safety<S>, deleted PS-5569; added PS-8908
- Section 10 – changed alternate contact.

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