SURFACE VEHICLE STANDARD

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Coolant System Hoses

RATIONALE

Tables 6a and 6b revised for nominal size mm; changed to nominal hose size and clarified note for in-between hose sizes. Added 3.6.4. Added Section 14 for fatigue resistant designator which defines the pressue cycle requirements and wave form.

1. SCOPE

This SAE Standard covers reinforced and flexible hoses intended for use in water and ethylene glycol-based engine-coolant system applications.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1231 Beaded Ends for Hose Connections and Hose Fittings

SAE J1508 Hose Clamp Specifications

SAE J1610 Test Method for Evaluating the Sealing Capability of Hose Connections with a PVT Test Facility

SAE J1638 Compression Set of Hoses or Solid Discs

SAE J1684 Test Method for Evaluating the Electrochemical Resistance of Coolant System Hoses and Materials

SAE J2370 Geometric Dimensions and Tolerancing for Curved Hose

SAE J2387 Dimensions and Tolerances for Coolant System Hoses

SAE J2605 Non-Contact Hose Measurement Study 1

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org

For more information on this standard, visit
https://www.sae.org/standards/content/J20_202202/

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D380 Methods of Testing Rubber Hose

ASTM D395 Test Methods for Rubber Property Compression Set

ASTM D412 Test Method for Rubber Properties in Tension

ASTM D413 Test Methods for Rubber Property Adhesion to Flexible Substrate

ASTM D471 Test Method for Rubber Property Effect of Liquids

ASTM D573 Test Method for Rubber Deterioration in an Air Oven

ASTM D1149 Test Method for Rubber Deterioration Surface Ozone Cracking in a Chamber (Flat Specimens)

ASTM D2240 Test Method for Rubber Property Durometer Hardness

2.1.3 Military Specification Publications

Available from Department of Defense Specification, Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094, Tel: 215-697-2179, http://assist.daps.mil or http://stinet.dtic.mil.

MIL-HDBK-695 Rubber Products: Recommended Shelf Life

2.1.4 ARPM Publications

Available from Association for Rubber Products Manufacturers, 7321 Shadeland Station Way, Suite 285, Indianapolis, IN 46256, Tel: 317-863-4072, www.arpminc.com.

IP-2 Hose Handbook

2.1.5 ISO Publications

Copies of these documents are available online at http://webstore.ansi.org/.

ISO 9001 Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation and Servicing

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J20-1 Coolant Hose (Supplement to SAE J20 for Government Use Replacing Part of MS52130)

SAE J20-2 Coolant Hose - Normal Service Type Convoluted, Wire Support Hose (Supplement to SAE J20 for Government Use Replacing Part of MS51008)

3. DEFINITIONS OF HOSE TYPES

3.1 SAE 20R1

Heavy-duty type for service in heavy-duty application. This type is available in two wall thicknesses as indicated in 6.3.

3.2 SAE 20R2

Flexible heavy-duty wire embedded type for the same service as SAE 20R1.

3.3 SAE 20R3

Heater hose for normal service.

3.4 SAE 20R4

Radiator hose for normal service.

3.5 SAE 20R5

Convoluted wire supported type for normal service.

3.6 HOSE SPECIAL DESIGNATORS FOR SAE 20RXY

X refers to the hose type. Y designators may be used for hoses with special features. Multiple Y designators may be used if needed.

3.6.1 HT

This high temperature designation is for any hose type, SAE 20R1 to SAE 20R5, which is required to operate in an environment above 125 °C. (See Section 11.)

3.6.2 EC

This electrochemical designation is for any hose type, SAE 20R1 to SAE 20R5, which is required to have electrochemical resistance as defined by SAE J1684. (See Section 12.)

3.6.3 LT

This low temperature designation is for any hose type, SAE 20R1 to SAE 20R5, which is required to operate in an environment down to -55 °C. (See Section 13.)

3.6.4 FR

This fatigue resistant designation is for any pre-shaped hose type SAE 20R1, 20R3, or 20R4 which is required to operate in a high-fatigue pressure cycling environment. (See Section 14.)

3.7 HOSE CLASSES

Compounds based on different synthetic rubber grades are specified and designated (see 5.2 for test methods):

Class A—High-temperature resistant
Class B—High oil resistant
Class C—Medium oil resistant
Class D-1—Low oil resistant, improved service
Class D-2—Low oil resistant, standard service
Class D-3—Low oil resistant, high-temperature resistant, premium service
Class E—Low oil resistant, fiber elastomer composite

Physical characteristics for each hose class are shown in Table 1.

Table 1 - Coolant system hose elastomeric material, physical properties

SAE Designation Typical Elastomer	Class A Silicone	Class B NBR	Class C CR	Class D-1 EPDM	Class D-2 EPDM	Class D-3 EPDM	Class E EPDM/Fiber
Typical Temperature Range, °C	-55 to 175	-40 to 100	-40 to 100	-40 to 125	-40 to 125	-40 to 150	-40 to 125
Original Properties							
Durometer, points Shore A	55 to 75	55 to 75	55 to 75	55 to 75	55 to 75	55 to 75	65 to 85
Tensile, min, MPa	5.5	8.5	7.0	7.0	5.0	7.0	5.0
Elongation, min, %	200	250	200	250	150	250	100
Oven Aging Conditions							
Change Limits, Hours/°C	70/175	70/100	70/100	70/125	70/125	168/150	70/125
Durometer, points Shore A	+10	+15	+20	+15	+15	+15	+15
Tensile, max %	-15	-15	-20	-20	-20	-35	-20
Elongation, max %	-40	-50	-50	-50	-50	-65	-50
Oil Immersion Change Limits							
ASTM No. 3 Oil or IRM 903							
(IRM 903 is being phased in to replace ASTM No. 3)							
Hours/°C	70/100	70/100	70/100	—	—	—	—
Volume, max, %	0 to +45	-5 to +25	+80	—	—	—	—
Tensile, max, %	-40	-20	-50	—	—	—	—
Coolant Immersion (Tube only)							
Change Limits							
Hours/at Boiling Point	70	70	70	70	70	168	70
Volume, %	0 to +40	0 to +20	0 to +20	-5 to +20	-5 to +20	-5 to +20	-5 to +20
Durometer, points Shore A	-10 to +10	-10 to +10	-10 to +10	-10 to +10	-10 to +10	-10 to +10	-10 to +10
Tensile, max, %	-30	-20	-20	-20	-20	-20	-20
Elongation, max, %	-25	-40	-40	-50	-25	-25	-25
Compression Set °C	125	100	100	125	125	125	125
70 h, max, %	40	50	75	75	85	75	85
Cold Flexibility (°C)[1]	-40	-40	-40	-40	-40	-40	-40

[1] LT designator extends the low temperature flexibility to -55 °C.

3.8 MARKING

The outer cover will be printed with the designation SAE 20RXY (the X being the hose type and Y any special designator(s) such as “LT”), class, size of the inside diameter in millimeters, hose manufacturer’s code marking, and any other identification as agreed upon between user and manufacturer/supplier. It is recommended that this marking shall appear on the outer cover of the hose at intervals not greater than 380 mm.

3.8.1 SMALL ID OR SHORT HOSE

If there is insufficient space on the hose for the required marking due to size or configuration, the marking shall be agreed upon by the customer and the manufacturer/supplier.

4. DIMENSIONAL REQUIREMENTS

Geometric dimensioning and tolerancing requirements are outlined in SAE J2370. The following requirements are minimal standards:

4.1 Tube and Cover Thickness

Minimum thickness shall be 1.6 mm for the tube and 0.8 mm for the cover.

NOTE: This requirement does not apply for hoses without distinctive tube and cover construction.

4.2 Length Tolerance

a. Straight hose: Unless otherwise specified by the customer or manufacturer, commercial tolerances will be used. See Table 2.

Table 2 - Length tolerance

Length mm	Precision Tolerance mm	Commercial Tolerance mm
0-300	±3.2	+9.7-3.2
>300	±1%	+3%-1%

b. Curved hose: The tolerances on arm lengths, measured from end to intersection of nearest centerline, shall be as shown in Table 3.

Table 3 - Tolerance on arm length

Arm Length mm	Precision Tolerance mm	Commercial Tolerance mm
0-300.0	±4.0	±6.4
300.1-610.0	±4.8	±7.2
610.1-910.0	±6.4	±9.7
910.1-1220.0	±9.7	±11.2
1220.1-1830.0	±12.7	±15.9
Over 1830	±1%	±2%

4.3 General Layout Tolerances, Curved Hose

Dimensions locating bend intersections and centerline radii are to establish the theoretical design centerline of the hose. Actual outside contour of hose must be held within a total range of 9.6 mm of all planes with respect to theoretical outside contour of hose. For hose check, hose ends should first be placed in theoretical design position before checking (hose may have to be flexed to correct for any distortion caused by handling or during shipment). SAE arm length tolerances shall apply.

Tolerances apply to all arm and body lengths in addition to contour tolerances. Dimensions covering more than one arm or body length are reference only and have no tolerances. The wall thickness within bends of a curved hose may differ from the wall thickness of the straight by no more than 33%.

When an alignment mark is required for assembly operations, the basic identifier in Figure 1 is recommended.

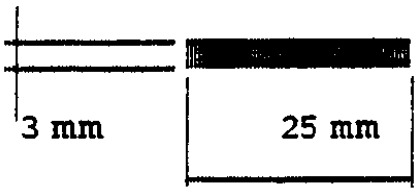

Figure 1 - Alignment mark

Location of the alignment mark and/or additional information shall be determined by the customer and the manufacturer.

4.4 Enlarged Ends

When the ID of one end of the hose is enlarged, normally the ID of the enlarged end should not exceed the ID of the rest of the hose by more than 33%. Enlarged ends should be considered arm lengths for tolerance purposes. The wall thickness normally changes with enlarged ends.

4.5 End Squareness

All points on the hose end surface must lie within a tolerance zone consisting of two parallel planes perpendicular to the hose axis. The tolerance zone is determined by Table 4.

Table 4 - End squareness

Hose ID	Precision Tolerance	Commercial Tolerance
25.4 mm and larger	10% of ID	15% of ID
Smaller than 25.4 mm	2.54 mm	3.75 mm

4.6 Finish and Roundness on Connections

Users of coolant hose should take every precaution to obtain connections as smooth and round as practical. (Refer to SAE J1231.)

4.7 Clamps

Refer to SAE J1508 for available clamp types.

5. PHYSICAL TEST REQUIREMENTS AND PROCEDURES

5.1 Finished Product

5.1.1 Adhesion

When applicable, use test procedure ASTM D413. The minimum requirement is 1400 N/m between all elastomer or elastomer-coated plies.

5.1.2 Cold Flexibility

The following procedure shall be used:

For hose 25.4 mm ID and smaller, specimen shall consist of a complete hose of length sufficient to perform bend test described as follows: the hose shall be placed in a cold box for 5 hours at the temperature specified in Table 1. The hose shall then be flexed in the cold chamber through 180 degrees from the centerline to a diameter of 10 times the maximum outside diameter of the hose within 4 seconds. The hose shall not fracture and shall not show any cracks or breaks in the tube or cover.

For hose larger than 25.4 mm ID, specimens are to be 25.4 mm long sections of the complete hose. The specimen and test fixture shall be placed in a cold box for 5 hours at the temperature specified in Table 1. The specimen is then compressed to 50% of its original inside diameter between parallel plates within 4 seconds. The specimen shall not crack or break. The testing fixture shall be in the cold box during the entire test.

NOTE: For LT hose, see Section 13 for specific cold flexibility requirements.

5.1.3 Ozone Test and Requirements

The following test and requirements apply:

When applicable, use test procedure ASTM D1149.

For hose 25.4 mm ID and smaller, a specimen of hose of sufficient length shall be bent around a mandrel with an outside diameter equal to eight times the specified OD of the sample. The two ends shall be tied at their crossing with enameled copper or aluminum wire. After mounting, the specimen shall be allowed to rest in an ozone-free atmosphere for 24 hours at standard laboratory test temperature. The mounted specimen shall be placed in a test chamber containing ozone at a partial pressure of 50 mPa ± 5 mPa at a temperature of 40 °C ± 1 °C.

After 100 hours of exposure, the specimen shall be removed and allowed to cool to standard laboratory test temperature and then be inspected visually under 7X magnification. The sample must not show any cracks except for the area immediately adjacent to the wire, which shall be ignored.

For hose larger than 25.4 mm ID, prepare a specimen by cutting a strip of the whole hose 12.7 x 100 mm and tie specimen (cover out) around a 12.7 mm diameter mandrel. Condition in the same manner as specified previously for the whole hose and apply the same conditions and requirements. This test applies to the cover only and cracks in the exposed tube or cut edges of the cover shall be ignored.

5.1.4 Kink Test

This test applies to SAE 20R3 hose only. (Not recommended for formed hoses.)

5.1.4.1 Test Procedure

Condition specimen length of hose at standard laboratory test temperature for at least 2 hours. Measure the minimum OD at the approximate center of the specimen length. When a sufficient length of hose is available, it is permissible and suggested that a length in excess of the specimen length be used in an effort to minimize the handling variable and overbending. Insert one end of the hose into one hole of the specified test fixture, carefully bend the hose (in direction of natural curvature), and insert the other hose end into the second test fixture hole. Do not overbend or bend hose with sharp motion to prevent excessive kinking or collapse. Within 30 seconds, measure the minimum diameter at the point of greatest collapse.

5.1.4.2 Test Fixture

Shall consist of 25.4 mm thick flat plate drilled with holes not to exceed the hose OD by more than 1.6 mm and separated by the specified center distances.

5.1.4.3 Test Requirements

See Table 5.

Table 5 - Kink test requirements for SAE 20R3 hose

Nominal Hose ID mm	Specimen Length mm	Center Distance mm	Collapse of Hose Allowed, %
15 and larger	24 x ID	10 x ID	25
Smaller than 15	24 x ID	8 x ID	25

5.1.5 Vacuum Collapse Test

When practical, the entire hose shall be tested as specified in Tables 6A and 6B. The minimum outside diameter shall decrease by no more than 20% during application of vacuum for 15 seconds and not to exceed 30 seconds.

5.1.6 Burst

This test shall be performed on a straight length of hose in accordance with ASTM D380 to meet the requirement in Tables 6A and 6B.

For curved 20R3 and 20R4 hose, the same reference applies, except that the test shall be performed on the individual curved hose with one end free and unrestrained and the rate of application of pressure shall be not less than 2.0 MPa nor more than 7.0 MPa/min. The aged burst requirement (11.2.2) will apply to all HT hoses.

5.1.7 Pressure Vibration and Temperature or Pressure and Temperature Test

This test shall be used when agreed upon between customer and manufacturer/supplier, using SAE J1610 as the referenced test method. If required, test limits can be modified if agreed upon by the customer and manufacturer/supplier.

Table 6A - Burst and vacuum values (20R1 and 20R2)

Nominal Hose Size,	20R1 Heavy-Duty Standard Wall Min Burst, MPa	20R1 Heavy-Duty Standard Wall Min Vacuum, kPa	20R1 Heavy-Duty Heavy Wall Min Burst, MPa	20R1 Heavy-Duty Heavy Wall Min Vacuum, kPa	20R2 Wire Inserted Min Burst, MPa	20R2 Wire Inserted Min Vacuum, kPa
10	3.29	33.8				
13	2.93	33.8				
16	2.59	27.0				
19	2.24	27.0				
22	2.24	23.6				
25	2.06	23.6			2.06	84.4
29	2.06	20.3				
32	1.90	16.9	3.45	33.8	1.90	84.4
35	1.90	13.5				
38	1.72	10.1	3.10	33.8	1.72	84.4
41	1.72	6.8				
44	1.55	3.4	2.76	16.9	1.55	84.4
51	1.38		2.41	10.1	1.38	84.4
57	1.21		2.41	3.4	1.21	84.4
60	1.21					
64	1.03		2.06		1.03	84.4
70	0.86		1.72		0.86	84.4
76	0.60		1.72		0.69	84.4
83						
89	0.52		1.38		0.52	84.4
102	0.34		1.03		0.34	84.4

NOTE: For hose sizes between nominal sizes listed, use the values for the nearest nominal size.

Table 6B - Burst and vacuum values (20R3, 20R4, and 20R5)

Nominal Hose Size,	20R3 Heater Min Burst, MPa	20R3 Heater Min Vacuum, kPa	20R4 Radiator Min Burst, MPa	20R4 Radiator Min Vacuum, kPa	20R5 Wire Supported Min Burst, MPa	20R5 Wire Supported Min Vacuum, kPa
5	1.72	33.8				
6	1.72	33.8				
7	1.72	33.8				
8	1.72	33.8				
9	1.72	33.8				
10	1.72	33.8	1.24			
13	1.72	33.8	1.17			
16	1.72	27.0	1.10			
19	1.38	23.6	1.03			
22						
25	1.21	20.3	0.97		0.97	
29						
32	1.21	16.9	0.90		0.90	
35						
38			0.83		0.83	
41						
44			0.76		0.76	
51			0.69		0.69	
57			0.62		0.62	
60						
64			0.55		0.55	
70			0.48			
76			0.41			
83			0.34			
89			0.27			
102						

NOTE: For hose sizes between nominal sizes listed, use the values for the next larger nominal size.

5.2 Physical Properties are to be Obtained from Specimens Removed from Hose

Refer to ASTM D380 for procedure. For thin specimens (less than 1.5 mm), use ASTM slab testing per ASTM D380.

NOTE: For 20R5 hoses, test specimens are to be taken from the cuffs.

5.2.1 Durometer Hardness

Hardness shall be measured with a Shore A durometer according to ASTM D2240.

5.2.2 Tensile Strength and Elongation

Test according to ASTM D412.

5.2.3 Oven Aging

Shall conform to ASTM D573.

5.2.4 Coolant Immersion

Volume change, tensile, elongation, and durometer changes shall be observed after immersion in the following mixture maintained at the boiling point under a water-cooled reflux condenser. Maintain the fluid level during the test by adding distilled water as needed.

a. 1/2 by volume, distilled water

b. 1/2 by volume, ethylene glycol-based coolant agreed to between supplier and customer

Measurements of tensile, elongation, durometer, and volume change shall be made in accordance with appropriate ASTM methods.

5.2.5 Oil Immersion

Shall conform to ASTM D471.

5.2.6 Compression Set

Test to be performed per ASTM D395, Method B. For cover specimens, ply to 8.9 mm ± 1 mm, not to exceed seven plies where applicable. For tube specimens, ply to 12.7 mm ± 1 mm, not to exceed seven plies. When unable to meet the required thickness, use standard ASTM slabs cured at similar cure conditions as the hose.

NOTE: SAE J1638 may be considered as an alternate test method with criteria to be agreed upon between customer and manufacturer.

6. SAE 20R1 HEAVY-DUTY TYPE

6.1 Scope

This type of hose is primarily for heavy-duty service of which the diesel-locomotive application is a typical example. The hose is intended to withstand the effects of higher pressure systems. When desired, hose with one class of material in the tube and another in the cover may be obtained. In such cases, the physical properties specified for respective parts shall apply.

6.2 Reinforcement

The reinforcement may consist of multiple plies of woven or cord fabric, or ply or plies of braided, knit, or spiraled yarn, and shall be such that the hose meets the minimum burst and vacuum requirements as given in Table 6A.

6.3 Dimensions

The ID tolerance is ±0.8 mm for sizes smaller than 51 mm, and ±1.6 mm for sizes 51 mm and larger. The wall thickness range for standard wall thickness hose is 4.3 to 5.6 mm. The wall thickness range for heavy wall thickness hose is 5.8 to 7.1 mm. These dimensions shall be measured at a section not including a lap.

7. SAE 20R2 HEAVY-DUTY WIRE EMBEDDED TYPE

7.1 Scope

This is similar to SAE 20R1 hose, except that it utilizes wire helix or helices built into the wall of the hose. The hose is intended to withstand high vacuum and/or some forced curvature.

7.2 Reinforcement

The reinforcement is typically multiple plies of woven or cord fabric or ply or plies of braided or knot yarn and wire helix or helices such that the hose will meet the minimum vacuum and burst requirements as given in Table 6A.

7.3 Dimensions

The ID tolerance is ±0.8 mm for sizes smaller than 51 mm and ±1.6 mm for sizes 51 mm and larger. The wall thickness range at hose ends exclusive of wire gauge is 4.3 to 6.4 mm.

8. SAE 20R3 HEATER HOSE

8.1 Scope

This type of hose is used in connecting heater systems and other components in the coolant circulating systems of ground vehicles.

8.2 Reinforcement

The reinforcement typically consists of one or more plies of woven, braided, knit, or spiraled yarn, or class E material, and shall be such that the hose will meet the minimum burst and vacuum requirements in Table 6B.

8.3 Dimensions and Tolerances

Target dimensions and tolerances are shown in Tables 7A and 7B. Contact or non-contact measurement method must be agreed upon by manufacturer and customer. Since expanded ends may cause wall thickness to change, ODs and tolerances for the expanded ends must also be agreed upon by the manufacturer and customer. Tolerances and dimensions other than those listed as follows must be agreed upon by manufacturer and customer. The values in Tables 7A and 7B are standard wall dimensions and commercial tolerances. If thin-wall dimensions or precision tolerances are required, refer to SAE J2387.

Table 7A - Standard dimensions and commercial tolerances for SAE 20R3 tolerances and method for contact measurement

ID, mm	ID Tolerance, mm	Target OD[(1)], mm	OD Tolerance, mm	Reference Wall, mm	Maximum Wall Thickness Variation, mm
5.0 to <9.0	±0.8	ID plus 7 mm	±0.8	3.5	1.0
9.0 to <25.4	±0.8	ID plus 8 mm	±0.8	4.0	1.0
25.4	±0.8	34	±1.2	4.3	1.0
>25.4	±0.8	ID plus 9.9 mm	±1.6	4.95	1.0

(1) The target OD should be measured over a plug gauge equal to the specified maximum ID.

Table 7B - Standard dimensions and commercial tolerances for SAE 20R3 tolerances for non-contact measurement (refer to SAE J2605)

ID, mm	ID Tolerance, mm	Target Wall Thickness, mm	Wall Thickness Tolerance, mm	Maximum Wall Thickness Variation, mm
5.0 to <9.0	±0.8	3.5	±0.4	1.0
9.0 to <25.4	±0.8	4.0	±0.4	1.0
25.4	±0.8	4.3	±0.6	1.0
>25.4	±0.8	4.95	±0.8	1.0

9. SAE 20R4 RADIATOR HOSE NORMAL SERVICE TYPE

9.1 Scope

This is a hose for coolant circulating systems of automotive type engines, commonly known as radiator hose. When resistance to vacuum collapse is a requirement, an inserted wire helix may be specified if desired.

9.2 Reinforcement

The reinforcement typically consists of one or more plies of woven, braided, knit, or spiraled yarn, or Class E material, and shall be such that the hose will meet the minimum burst and vacuum requirements in Table 6B.

9.3 Dimensions

Target dimensions and tolerances are shown in 9.3.1. Measurement method must be agreed upon by manufacturer and customer. Since expanded ends may cause wall thickness to change, ODs and tolerances for the expanded ends must also be agreed upon by the manufacturer and customer. Tolerances and dimensions other than those listed as follows must be agreed upon by the manufacturer and customer. Since the wall thickness may change due to bends near the end of hoses, the wall thickness reported will be the average of four readings taken 90 degrees apart. The values in 9.3.1 are standard wall dimensions and commercial tolerances. If thin-wall dimensions or precision tolerances are required, refer to SAE J2387.

9.3.1 Dimensions and Tolerances

The ID tolerance is ±0.8 mm for hose sizes smaller than 70 mm and ±1.6 mm for hose sizes 70 mm and larger. The wall thickness and tolerance is 4.95 mm ± 0.65 mm (4.3 to 5.6 mm) for hose sizes smaller than 50.8 mm, and 5.35 mm ± 1.05 mm (4.3 to 6.4 mm) for hose sizes 50.8 mm and larger.

10. SAE 20R5 NORMAL SERVICE TYPE CONVOLUTED, WIRE SUPPORTED HOSE

10.1 Scope

This is a wire reinforced hose for coolant circulating systems of automotive type engines, commonly known as universal type hose. This hose consists of a convoluted section with plain ends. The hose shall contain a wire helix or helices in the convoluted section.

10.2 Reinforcement

The reinforcement is typically a ply or plies of woven or cord fabric, braided, knot, or spiraled yarn. The hose must meet the minimum burst requirements listed in Table 6B.

10.3 Dimensions

The ID tolerance is +0.8 to -1.6 mm. The wall thickness range is 3.6 to 4.8 mm.

11. HIGH-TEMPERATURE SERVICE HOSE HT

11.1 Scope

Any hose type SAE 20R1 to SAE 20R5 which is required to be operated in an environment above 125 °C. The letters HT will be used to designate this new requirement, for example, SAE 20R1 HT Class A standard wall.

11.2 Requirements

11.2.1 Tube and Cover

The tube and cover compounds must be Class A or Class D-3.

11.2.2 Aged Burst

The reinforcement yarn or fabric must be such that the hose passes the minimum burst requirements given on the appropriate table after aging 168 hours at 150 °C in a hot air oven.

12. ELECTROCHEMICAL RESISTANT HOSE EC

12.1 Scope

Any hose type SAE 20R1 to SAE 20R5 which is required to have electrochemical resistance. The letters EC will be used to designate this requirement, for example SAE 20R1 EC.

12.2 Requirement

Hoses shall be tested in accordance with SAE J1684. Test method 1 shall be utilized to determine the electrochemical resistance of the hose assembly.

13. LOW-TEMPERATURE SERVICE HOSE LT

13.1 Scope

Any hose type SAE 20R1 to SAE 20R5 and any hose class which is required to be operated in an environment down to -55 °C. The letters LT will be used to designate this requirement, for example, SAE 20R1 LT Class A standard wall.

13.2 Requirements

13.2.1 Resistance to Vibration

This applies to SAE 20R2 wire embedded hoses only. The requirements of 5.1.7 shall apply, using SAE J1610, Test Procedure #1, as the recommended practice.

13.2.2 Proof Pressure

This test shall be performed on a straight length of hose in accordance with ASTM D380 with the pressure being equal to 50% of the burst pressure requirement in Tables 6A and 6B. For curved 20R3 and 20R4 hose, the same reference applies, except that the test shall be performed on the individual curved hose with one end free and unrestrained and the rate of application of pressure shall be not less than 2.0 MPa/min nor more than 7.0 MPa/min.

13.2.3 Cold Flexibility

The test temperature shall be -55 °C. Test per 5.1.2.

14. FATIGUE RESISTANT SERVICE HOSE FR

14.1 Scope

Any pre-shaped hose type SAE 20R1, 20R3, or SAE 20R4 which maybe operated in a high-fatigue pressure cycling environment. The letters FR will be used to designate this requirement, for example, SAE 20R3 FR Class D-3.

14.2 Requirements

14.2.1 Pressure Cycle Test

Hose must not rupture, separate layers, or leak when subjected to the pressure cycle test parameter list in Table 8.

Table 8 - Pressure cycle requirements

	SAE 20 R3	SAE 20 R1 or 20 R4
Fluid	50/50 coolant	
Pressure Range	0.035 to 0.552 MPa	0.035 to 0.241 MPa
Cycles	300000	100000
Pressure Profile	See Figure 2	
Fluid Test Temperature	100 °C ± 3 °C	100 °C ± 3 °C
Minimum Flow	To maintain test temperature	
Mounting	Hose ports are fixed and hose supports its own weight(1)	
Number of Samples	Four for each nominal hose diameter	

(1) Standard hose shape for production qualification should be at least 600 mm long with a minimum of two bends of at least 90 degree bend angle at a centerline radius of no more than 1.25 times the hose ID.

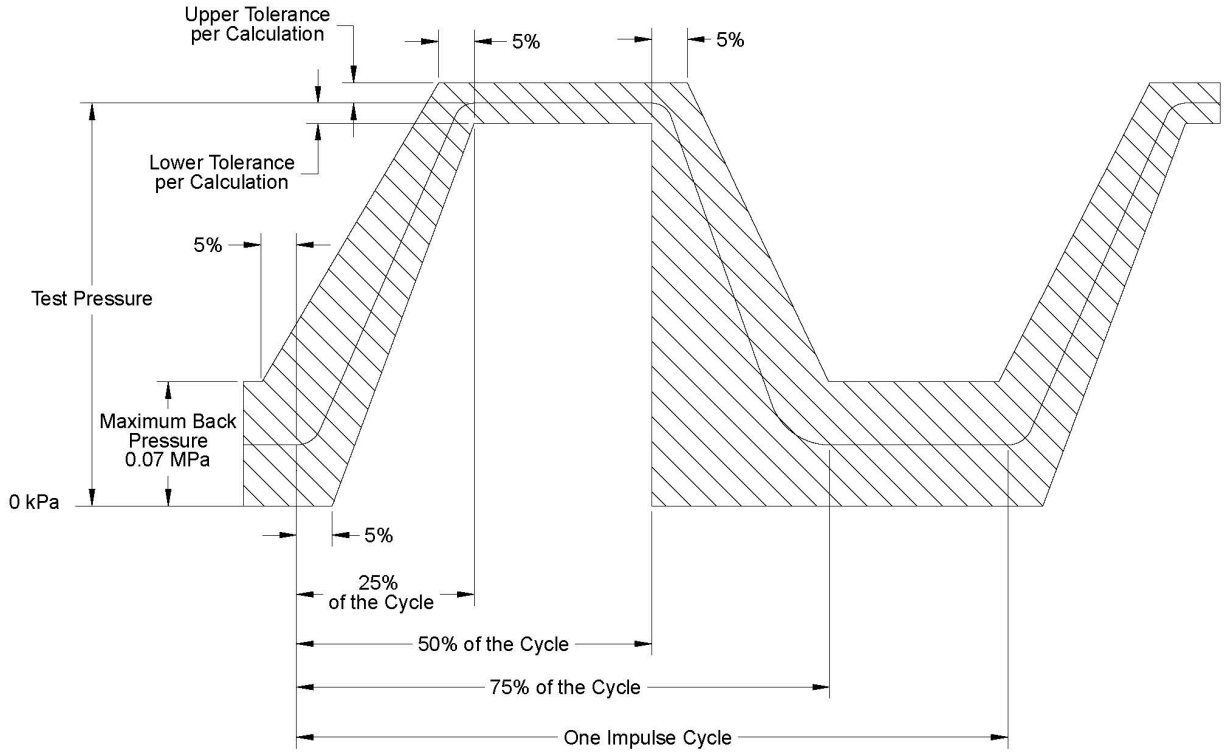

Figure 2 - Pressure impulse wave form envelope

NOTE 1: Cycle rate shall be uniform between 0.25 to 0.125 Hz.

NOTE 2: The nominal rate of pressure rise shall be equal to that shown in Equation 1.

$$R = f(4p) \quad \text{(Eq. 1)}$$

where:

R = rate of pressure rise in megapascals per second (MPa/s)

f = frequency in hertz (Hz)

p = nominal impulse test pressure in megapascals (MPa)

NOTE 3: The upper and lower pressure tolerance is dependent on the back pressure per the formulas as shown in Equations 2 and 3. Equation 2 will define the upper pressure limit and Equation 3 will define the lower pressure limit as noted in Figure 2.

$$\text{Upper Tolerance} = ([\text{Test Press}*0.1]*[\text{Back Press}/0.07]) \quad \text{(Eq. 2)}$$

$$\text{Lower Tolerance} = ([\text{Test Press}*0.1]*\text{ABS}[\{\text{Back Press}-0.07\}/0.07]) \quad \text{(Eq. 3)}$$

NOTE 4: This is a destructive test. Assemblies, which have been subjected to this test, shall be destroyed.

15. SHELF LIFE

Refer to military specification MIL-HDBK-695 for SAE J20 hose shelf life, and ARPM Handbook IP-2 for hose storage conditions.

16. NOTES

16.1 Revision Indicator

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE NON-HYDRAULIC HOSE COMMITTEE