

Hose Assemblies, Rubber, Hydraulic, Steel Wire Reinforced - Part 1: Procurement Document

RATIONALE

J1754-1 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

This SAE Standard covers steel wire reinforced rubber hose assemblies using connectors specified in SAE J516 for use in hydraulic systems using petroleum based hydraulic fluids with maximum working pressures of 1.7 to 42 MPa. See Part 2, Table 7 for hose operating temperature ranges and identification codes.

NOTE: Working pressure is defined as maximum system pressure.

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. The latest issue of the publications shall apply.

2.1.1 SAE Publications

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

SAE J343	Test and Test Procedures for SAE 100R Series Hydraulic Hose and Hose Assemblies
SAE J516	Hydraulic Hose Fittings
SAE J517	Hydraulic Hose
SAE J1176	External Leakage Classifications for Hydraulic Systems
SAE J1273	Recommended Practices for Hydraulic Hose Assemblies
SAE J1405	Optional Test Procedures for Hydraulic Hose Assemblies

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SAE J1754-2 Hose Assemblies, Rubber, Hydraulic, Steel Wire Reinforced—Part 2: Ordering Information

SAE J1754-3 Hose Assemblies, Hydraulic, J517 100R Series—Part 3: Procurement and Ordering Information

2.1.2 ASTM Publications

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

ASTM B 117 Standard Test Method of Salt Spray (Fog) Testing

ASTM D 380 Methods of Testing Rubber Hose

ASTM D 471 Test Method for Rubber Property—Effect of Liquids

2.1.3 ISO Publications

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 4397 Fluid power systems and components—Connectors and associated components—Nominal outside diameters of tubes and nominal inside diameters of hoses

ISO 4406 Hydraulic fluid power—Fluids—Method of coding level of contamination by solid particles

2.2 Related Publications

The following publications are for information purposes only and are not a required part of this document.

2.2.1 SAE Publications

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

SAE J846 Coding Systems for Identification of Fluid Conductors and Connectors

2.2.2 ISO Publications

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 3448 Industrial liquid lubricants—ISO viscosity classification

ISO 12151-1 Connections for hydraulic fluid power and general use—Hose fittings—Part 1: Hose fittings with ISO 8434-3 O-ring face seal ends

ISO 12151-2 Connections for hydraulic fluid power and general use—Hose fittings—Part 2: Hose fittings with ISO 8434-1 24° cone ends

ISO 12151-3 Connections for hydraulic fluid power and general use—Hose fittings—Part 3: Hose fittings with ISO 6162 flange ends

ISO 12151-4 Connections for hydraulic fluid power and general use—Hose fittings—Part 4: Hose fittings with ISO 6149 metric stud ends

ISO 12151-5 Connections for hydraulic fluid power and general use—Hose fittings—Part 5: Hose fittings with ISO 8434-2 37° flare ends

ISO 12151-6 Connections for hydraulic fluid power and general use—Hose fittings—Part 6: Hose fittings with ISO 8434-6 60° cone ends

3. REQUIREMENTS

3.1 Hose Assembly Construction

Hose used in assemblies shall have an elastomeric, oil resistant tube; wire reinforcement; and an elastomeric oil and weather resistant black cover, unless otherwise specified by the purchaser. Connectors shall be permanent and shall be capable of meeting the performance requirements of this document. For connector material, see SAE J1754-2.

3.2 Dimensions

Hose shall conform to all the dimensions in Tables 1 to 10. Hose concentricity shall be in accordance with Table 11. Connector dimensions shall be per SAE J516. Hose assemblies shall conform to the applicable part standard or engineering drawing. Double bent tube (double elbow) assemblies are not recommended and are considered non-standard due to the detrimental effects of twist on the hose.

TABLE 1 - 1.7 MPA PRESSURE RATING

Metric Size ⁽¹⁾	SAE Dash Size ⁽²⁾	Maximum Hose Outside Diameter ⁽³⁾ (mm)	Minimum Burst Pressure (MPa)	Proof Pressure (MPa)	Maximum Working Pressure (MPa)	Minimum Bend Radius ⁽⁴⁾ (mm)
38	-24	54	6.8	3.4	1.7	500
51	-32	69	6.8	3.4	1.7	630

1. Metric hose size in mm per ISO 4397.

2. SAE hose dash size is equal to hose ID expressed in 1/16's of an inch.

3. Hose OD listed is largest OD of the approved hose materials. If the OD is critical (hose clamping), the OD shall be specified.

4. If a smaller bend radius is required, the bend radius shall be specified.

See Appendix A for rationalized pressure ratings and SAE J1754-2, Table 1 for maximum working pressure identification codes.

TABLE 2 - 2.8 MPA PRESSURE RATING

Metric Size ⁽¹⁾	SAE Dash Size ⁽²⁾	Maximum Hose Outside Diameter ⁽³⁾ (mm)	Minimum Burst Pressure (MPa)	Proof Pressure (MPa)	Maximum Working Pressure (MPa)	Minimum Bend Radius ⁽⁴⁾ (mm)
31.5	-20	48	11.2	5.6	2.8	420
38	-24	54	11.2	5.6	2.8	500
51	-32	69	11.2	5.6	2.8	630

1. Metric hose size in mm per ISO 4397.

2. SAE hose dash size is equal to hose ID expressed in 1/16's of an inch.

3. Hose OD listed is largest OD of the approved hose materials. If the OD is critical (hose clamping), the OD shall be specified.

4. If a smaller bend radius is required, the bend radius shall be specified.

See Appendix A for rationalized pressure ratings and SAE J1754-2, Table 1 for maximum working pressure identification codes.

TABLE 3 - 7 MPA PRESSURE RATING

Metric Size ⁽¹⁾	SAE Dash Size ⁽²⁾	Maximum Hose Outside Diameter ⁽³⁾ (mm)	Minimum Burst Pressure (MPa)	Proof Pressure (MPa)	Maximum Working Pressure (MPa)	Minimum Bend Radius ⁽⁴⁾ (mm)
16	-10	27	28	14	7	205
19	-12	31	28	14	7	240
25	-16	40	28	14	7	300
31.5	-20	53	28	14	7	420
38	-24	59	28	14	7	500
51	-32	72	28	14	7	630

1. Metric hose size in mm per ISO 4397.

2. SAE hose dash size is equal to hose ID expressed in 1/16's of an inch.

3. Hose OD listed is largest OD of the approved hose materials. If the OD is critical (hose clamping), the OD shall be specified.

4. If a smaller bend radius is required, the bend radius shall be specified.

See Appendix A for rationalized pressure ratings and SAE J1754-2, Table 1 for maximum working pressure identification codes.

TABLE 4 - 14 MPA PRESSURE RATING

Metric Size ⁽¹⁾	SAE Dash Size ⁽²⁾	Maximum Hose Outside Diameter ⁽³⁾ (mm)	Minimum Burst Pressure (MPa)	Proof Pressure (MPa)	Maximum Working Pressure (MPa)	Minimum Bend Radius ⁽⁴⁾ (mm)
10	-06	21	56	28	14	130
12.5	-08	24	56	28	14	180
16	-10	29	56	28	14	205
19	-12	33	56	28	14	240
25	-16	41	56	28	14	340
31.5	-20	53	56	28	14	460
38	-24	59	56	28	14	560
51	-32	72	56	28	14	700

1. Metric hose size in mm per ISO 4397.

2. SAE hose dash size is equal to hose ID expressed in 1/16's of an inch.

3. Hose OD listed is largest OD of the approved hose materials. If the OD is critical (hose clamping), the OD shall be specified.

4. If a smaller bend radius is required, the bend radius shall be specified.

See Appendix A for rationalized pressure ratings and SAE J1754-2, Table 1 for maximum working pressure identification codes.

TABLE 5 - 17.5 MPA PRESSURE RATING

Metric Size ⁽¹⁾	SAE Dash Size ⁽²⁾	Maximum Hose Outside Diameter ⁽³⁾ (mm)	Minimum Burst Pressure (MPa)	Proof Pressure (MPa)	Maximum Working Pressure (MPa)	Minimum Bend Radius ⁽⁴⁾ (mm)
6.3	-04	17	70	35	17.5	100
10	-06	21	70	35	17.5	130
12.5	-08	26	70	35	17.5	180
16	-10	29	70	35	17.5	205
19	-12	33	70	35	17.5	240
25	-16	41	70	35	17.5	340
31.5	-20	53	70	35	17.5	460
38	-24	59	70	35	17.5	560
51	-32	73	70	35	17.5	700

1. Metric hose size in mm per ISO 4397.

2. SAE hose dash size is equal to hose ID expressed in 1/16's of an inch.

3. Hose OD listed is largest OD of the approved hose materials. If the OD is critical (hose clamping), the OD shall be specified.

4. If a smaller bend radius is required, the bend radius shall be specified.

See Appendix A for rationalized pressure ratings and SAE J1754-2, Table 1 for maximum working pressure identification codes.

TABLE 6 - 21 MPA PRESSURE RATING

Metric Size ⁽¹⁾	SAE Dash Size ⁽²⁾	Maximum Hose Outside Diameter ⁽³⁾ (mm)	Minimum Burst Pressure (MPa)	Proof Pressure (MPa)	Maximum Working Pressure (MPa)	Minimum Bend Radius ⁽⁴⁾ (mm)
5	-03	14	84	42	21	90
6.3	-04	17	84	42	21	100
10	-06	23	84	42	21	130
12.5	-08	26	84	42	21	180
16	-10	29	84	42	21	205
19	-12	33	84	42	21	240
25	-16	41	84	42	21	340
31.5	-20	53	84	42	21	460
38	-24	59	84	42	21	560
51	-32	73	84	42	21	700

1. Metric hose size in mm per ISO 4397.

2. SAE hose dash size is equal to hose ID expressed in 1/16's of an inch.

3. Hose OD listed is largest OD of the approved hose materials. If the OD is critical (hose clamping), the OD shall be specified.

4. If a smaller bend radius is required, the bend radius shall be specified.

See Appendix A for rationalized pressure ratings and SAE J1754-2, Table 1 for maximum working pressure identification codes.

TABLE 7 - 24.5 MPA PRESSURE RATING

Metric Size ⁽¹⁾	SAE Dash Size ⁽²⁾	Maximum Hose Outside Diameter ⁽³⁾ (mm)	Minimum Burst Pressure (MPa)	Proof Pressure (MPa)	Maximum Working Pressure (MPa)	Minimum Bend Radius ⁽⁴⁾ (mm)
5	-03	14	98	49	24.5	90
6.3	-04	19	98	49	24.5	100
10	-06	23	98	49	24.5	130
12.5	-08	26	98	49	24.5	180
16	-10	29	98	49	24.5	205
19	-12	32	98	49	24.5	240
25	-16	41	98	49	24.5	340
31.5	-20	52	98	49	24.5	460
38	-24	59	98	49	24.5	560
51	-32	73	98	49	24.5	700

1. Metric hose size in mm per ISO 4397.

2. SAE hose dash size is equal to hose ID expressed in 1/16's of an inch.

3. Hose OD listed is largest OD of the approved hose materials. If the OD is critical (hose clamping), the OD shall be specified.

4. If a smaller bend radius is required, the bend radius shall be specified.

See Appendix A for rationalized pressure ratings and SAE J1754-2, Table 1 for maximum working pressure identification codes.

TABLE 8 - 28 MPA PRESSURE RATING

Metric Size ⁽¹⁾	SAE Dash Size ⁽²⁾	Maximum Hose Outside Diameter ⁽³⁾ (mm)	Minimum Burst Pressure (MPa)	Proof Pressure (MPa)	Maximum Working Pressure (MPa)	Minimum Bend Radius ⁽⁴⁾ (mm)
5	-03	17	112	56	28	90
6.3	-04	19	112	56	28	100
10	-06	23	112	56	28	130
12.5	-08	25	112	56	28	180
16	-10	29	112	56	28	250
19	-12	34	112	56	28	300
25	-16	41	112	56	28	340
31.5	-20	52	112	56	28	460
38	-24	59	112	56	28	560
51	-32	73	112	56	28	640

1. Metric hose size in mm per ISO 4397.

2. SAE hose dash size is equal to hose ID expressed in 1/16's of an inch.

3. Hose OD listed is largest OD of the approved hose materials. If the OD is critical (hose clamping), the OD shall be specified.

4. If a smaller bend radius is required, the bend radius shall be specified.

See Appendix A for rationalized pressure ratings and SAE J1754-2, Table 1 for maximum working pressure identification codes.

TABLE 9 - 35 MPA PRESSURE RATING

Metric Size ⁽¹⁾	SAE Dash Size ⁽²⁾	Maximum Hose Outside Diameter ⁽³⁾ (mm)	Minimum Burst Pressure (MPa)	Proof Pressure (MPa)	Maximum Working Pressure (MPa)	Minimum Bend Radius ⁽⁴⁾ (mm)
5	-03	17	140	70	35	90
6.3	-04	19	140	70	35	150
10	-06	24	140	70	35	180
12.5	-08	27	140	70	35	230
16	-10	29	140	70	35	250
19	-12	37	140	70	35	300
25	-16	43	140	70	35	340
31.5	-20	52	140	70	35	445
38	-24	60	140	70	35	530
51	-32	73	140	70	35	640

1. Metric hose size in mm per ISO 4397.
 2. SAE hose dash size is equal to hose ID expressed in 1/16's of an inch.
 3. Hose OD listed is largest OD of the approved hose materials. If the OD is critical (hose clamping), the OD shall be specified.
 4. If a smaller bend radius is required, the bend radius shall be specified.
- See Appendix A for rationalized pressure ratings and SAE J1754-2, Table 1 for maximum working pressure identification codes.

TABLE 10 - 42 MPA PRESSURE RATING

Metric Size ⁽¹⁾	SAE Dash Size ⁽²⁾	Maximum Hose Outside Diameter ⁽³⁾ (mm)	Minimum Burst Pressure (MPa)	Proof Pressure (MPa)	Maximum Working Pressure (MPa)	Minimum Bend Radius ⁽⁴⁾ (mm)
10	-06	24	168	84	42	180
12.5	-08	27	168	84	42	230
19	-12	37	168	84	42	280
25	-16	43	168	84	42	330
31.5	-20	52	168	84	42	445
38	-24	60	168	84	42	530

1. Metric hose size in mm per ISO 4397.
 2. SAE hose dash size is equal to hose ID expressed in 1/16's of an inch.
 3. Hose OD listed is largest OD of the approved hose materials. If the OD is critical (hose clamping), the OD shall be specified.
 4. If a smaller bend radius is required, the bend radius shall be specified.
- See Appendix A for rationalized pressure ratings and SAE J1754-2, Table 1 for maximum working pressure identification codes.

TABLE 11 - HOSE CONCENTRICITY

Metric Size ⁽¹⁾	SAE Dash Size ⁽²⁾	ID to Reinforcement Concentricity, FIR (mm)	ID to OD Concentricity, FIR (mm)
Up to 6.3 included	Up to -04 included	0.5	0.8
Over 6.3 through 19 included	Over -04 through -12 included	0.7	1.0
Over 19	Over -12	0.9	1.3

1. Metric hose size in mm per ISO 4397.
2. SAE hose dash size is equal to hose ID expressed in 1/16's of an inch.

3.3 Hose Classifications

Three classifications of hose are established: Class A, Class B and Class C.

Class of hose is determined by type of application, duty cycle, working pressure, pressure surges (spikes) above nominal system pressure, flow velocity, flexing and/or the environment in which it is used. See SAE J1273 for more details and consult hose assembly manufacturer for specific applications.

3.3.1 Class A: High frequency or severity of flexing and/or pressure impulse cycles.

3.3.2 Class B: Normal frequency or severity of flexing and/or pressure impulse cycles.

3.3.3 Class C: Meets SAE J517 impulse test requirements.

See 4.3.7 and Table 12 for test requirement details.

3.4 Performance

Hose assemblies shall satisfy the performance requirements in 4.3.

3.5 Application Factors

Hydraulic hose assemblies have a finite life. Only careful selection, installation and maintenance will insure the desired service life. Always design hydraulic systems to match hose capabilities (pressure, flow, temperature, flex, etc.) and do not specify unique hose materials unless needed for very special applications. See SAE J1273 Recommended Practices for Hydraulic Hose Assemblies for additional information on application factors.

Among factors to be avoided shall be:

- a. Flexing the hose tighter than the specified minimum bend radius.
- b. Not to be used for vacuum applications.
- c. Twisting, pulling, kinking or crushing the hose.
- d. Operating above maximum and below minimum temperature.
- e. Exposing the hose to surge pressures above the maximum working pressure.
- f. High fluid velocity in pressure lines generates heat, turbulence, pressure loss, noise, and inner tube erosion. There are no physical benefits from high fluid velocities.
- g. Intermixing hose, connectors or assembly equipment not recommended by the manufacturer or not following the manufacturer's instructions for fabricating hose assemblies.

NOTE: Surge pressures are rapid and transient rises in pressure, and the hose working pressure should allow for these pressure surges (spikes). Surge pressures will not be indicated on many common pressure gages and can best be identified on electronic measuring instruments with a high-frequency response.

3.6 First Time Suppliers

When required by the purchaser, first time suppliers of each hose assembly size may need to supply documentation that products meet the requirements of 4.3.1 through 4.3.9 of this document.

3.7 Age Control

Shelf life of rubber hose in bulk form or in hose assemblies passing visual inspection and proof test is forty quarters (ten years) from the date of vulcanization. Bulk hose and hose assemblies shall be protected from the detrimental effects of ozone, heat, ultra-violet light, moisture or swelling agents such as fuel, solvents or corrosive vapors. Suppliers who assemble from bulk hose and connectors and do not manufacture from raw products shall show proof of compliance to the requirements of this paragraph. Refer to SAE J517 and SAE J1273 for additional information on age control.

3.8 Marking

3.8.1 Each hose assembly shall have the following information permanently and clearly marked on the connector or on a tag permanently attached to the assembly:

- a. Hose assembly manufacturer's name or trademark
- b. Maximum working pressure of the hose assembly
- c. Date of manufacture of the hose assembly

3.8.2 The following information shall be permanently marked on the lay line of each hose per SAE J517 Section 8, if applicable:

- a. Manufacturer's name or trademark
- b. Manufacturer's hose part number
- c. Manufacturer's maximum working pressure of the hose
- d. Date of hose manufacture (as a minimum must identify the quarter and the year that the hose was manufactured)

NOTE: No mention of the burst pressure or design factor shall be marked on the hose.

3.9 Workmanship

Workmanship shall be of the quality necessary to produce hose assemblies free from all defects that could affect proper form, fit and function in service.

3.10 Cleanliness

Hose assemblies shall meet the cleanliness requirement of ISO 4406 Code Number 19 / 16 with no particle size exceeding 0.8 mm or the cleanliness requirement specified by the purchaser.

3.11 End Fitting Finish

External surfaces and threads of all carbon steel parts shall be plated or coated with a suitable material that meets the requirements of 4.3.9.

4. TESTS

Tests are conducted in accordance with SAE J343 unless otherwise specified.

4.1 Responsibility for Tests

Unless otherwise specified in the contract or purchase order, the supplier of the hose assembly is responsible for the performance of all test requirements as specified herein. The supplier of the hose assembly may use his own or any other facilities suitable for the performance of the test requirements unless disapproved by the customer. The customer reserves the right to perform any of the tests specified to assure supplies and services conform to the standard requirements.

4.2 Classification of Tests

a. Qualification Tests. Consist of the tests in 4.3.

b. Quality Conformance Tests. Consist of the tests in 4.4.

4.2.1 Unless otherwise stated, test quantities shall be in accordance with Table 13 or as specified in the contract or order.

4.2.2 After completion of qualification in accordance with 4.3, subsequent production of hose assemblies of the same dash size produced of the same materials and procedures shall be tested in accordance with 4.4. It is recommended that a complete qualification be accomplished at 3 year intervals.

4.3 Qualification Tests

4.3.1 Proof Test

All unaged hose assemblies to be used for qualification tests shall be proof tested in accordance with SAE J343 at the specified proof pressure in Tables 1 to 10. There shall be no indication of failure or leakage.

4.3.2 Change in Length Test

Two unaged hose assemblies of at least 500 mm in length of free hose between hose connectors shall be tested for change in length in accordance with SAE J343 at the specified maximum working pressure in Tables 1 to 10. The hose assembly shall not exceed +2% to -4% change in length for braided hoses and $\pm 2\%$ for spiral hoses.

4.3.3 Burst Test

Two unaged hose assemblies of at least 500 mm in length of free hose between hose connectors shall be burst tested in accordance with SAE J343. There shall be no leakage, hose burst or other indication of failure below the specified minimum burst pressure in Tables 1 to 10.

NOTE: The Burst Test is a destructive test. Assemblies which have been subjected to this test shall be destroyed.

4.3.4 Cold Bend Test

Two unaged hose assemblies shall be cold bend tested in accordance with SAE J343 at -40°C or colder, when specified. Reject any samples with visible cracks or leakage.

NOTE: The Cold Bend Test is a destructive test. Assemblies which have been subjected to this test shall be destroyed.

4.3.5 Oil Resistance Test

The tube and cover shall be tested in accordance with ASTM D 471, Standard Test Method for Rubber Property—Effects of Liquids. Immersions shall be for 70 h in IRM 903 oil at the maximum working temperature of the hose. The volume change of specimens taken from the hose inner tube and cover shall be between 0 and 100%.

4.3.6 Ozone Resistance Test

Hose shall be tested for resistance of the cover compound to ozone in accordance with the latest issue of ASTM D 380, except that the mandrel shall be a diameter twice the minimum bend radius specified in Tables 1 to 10 and the cover shall be examined at the completion of the test under 7X magnification. Reject any samples with visible cracks.

4.3.7 Impulse Test

Four unaged hose assemblies shall be impulse tested in accordance with SAE J343, and at the percentage stated in Table 12 of the maximum working (operating) pressure in Tables 1 to 10.

TABLE 12 - HOSE CLASSIFICATIONS

Hose Classifications	Class A ⁽¹⁾	Class B ⁽²⁾	Class C ⁽³⁾
Test Pressure	150% of maximum working pressure	133% of maximum working pressure	SAE J517 for test pressure percentage (%)
Impulse Cycles	300 000 without failures or leakage	200 000 without failures or leakage	SAE J517 for cycles without failures or leakage
Cool Down	Required	Required	Not required

1. Class A classification is used in high frequency or severity of flexing and/or high pressure impulse cycles.
2. Class B classification is used in normal frequency or severity of flexing when a cool down test is required.
3. Class C classification is in accordance with J517 and does not require the cool down test specified for Class A and B.

A cool down test shall also be conducted during the impulse test on Class A and Class B hose assemblies in accordance with SAE J1405 Option III. SAE J1176 Class 0 leakage shall be required for both Class A and Class B hose assemblies. The number of impulse cycles and the leakage classification shall be recorded. The cool down test shall be performed at the following impulse cycles:

Class A: 150 000 ± 5000 cycles and 300 000 ± 5000 cycles
 Class B: 100 000 ± 5000 cycles and 200 000 ± 5000 cycles

NOTE: The Impulse Test is a destructive test. Assemblies which have been subjected to this test shall be destroyed.

4.3.8 Leakage Test

Two unaged hose assemblies of at least 500 mm in length of free hose between hose connectors shall be subjected to the leakage test in accordance with SAE J343. There shall be no leakage or evidence of failure.

NOTE: The Leakage Test is a destructive test. Assemblies which have been subjected to this test shall be destroyed.

4.3.9 Corrosion Resistance Test

Two hose connector ends shall be subjected to the salt spray test of ASTM B 117 for 96 h. Any appearance of red rust during the 96 h salt spray test shall be considered failure, except for the following:

- a. All internal fluid passages.
- b. Edges such as hex points, serrations and crests of threads where there may be mechanical deformation of the plating or coating typical of mass-produced parts or shipping effects.
- c. Areas where there is mechanical deformation of the plating or coating caused by crimping, flaring, bending and other post-plate metal forming operations.
- d. Areas where the parts are suspended or affixed in the test chamber where condensate can accumulate.