

6.4.2	At ± 20 mm (for S. No. i), ii, v) and ± 10 mm (for S. No. iii) & iv) at constant speed of 5mm/sec, the vertical stiffness (Cz) shall be as under.	<table><tr><th rowspan="2">S. No.</th><th rowspan="2">Type of air spring</th><th colspan="2">Vertical Stiffness under load</th></tr><tr><th>Load in kN (Static)</th><th>Vertical stiffness (Cz)</th></tr><tr><td>i)</td><td>180 kN capacity</td><td></td><td></td></tr><tr><td></td><td></td><td>Additional Volume 20dm³</td><td>Additional volume 40dm³</td></tr><tr><td></td><td></td><td>50</td><td>600$\pm$100 N/mm</td></tr><tr><td></td><td></td><td>165</td><td>1200$\pm$200N/mm</td></tr><tr><td></td><td></td><td>180</td><td>1350$\pm$200N/mm</td></tr></table> <table><tr><td>ii)</td><td>160 kN capacity</td><td></td><td></td></tr><tr><td></td><td></td><td>Load in kN (Static)</td><td>Vertical stiffness (Cz)</td></tr><tr><td></td><td></td><td>50</td><td>Informative</td></tr><tr><td></td><td></td><td>60</td><td>285 $\pm$ 20 N/mm</td></tr><tr><td></td><td></td><td>90</td><td>360 $\pm$ 25 N/mm</td></tr><tr><td></td><td></td><td>120</td><td>430 $\pm$ 30 N/mm</td></tr><tr><td></td><td></td><td>160</td><td>530 $\pm$ 40 N/mm</td></tr></table> <table><tr><td>iii)</td><td>160.8 kN capacity (For VB-2 coaches)</td><td></td><td></td></tr><tr><td></td><td></td><td>Load in kN (Static)</td><td>Vertical stiffness (Cz) With Additional Volume 50dm³</td></tr><tr><td></td><td></td><td>60</td><td>Informative</td></tr><tr><td></td><td></td><td>76.6</td><td>395 $\pm$ 7% N/mm</td></tr><tr><td></td><td></td><td>444.3</td><td>545 $\pm$ 7% N/mm</td></tr><tr><td></td><td></td><td>122.7</td><td>597 $\pm$ 7% N/mm</td></tr><tr><td></td><td></td><td>160.8</td><td>665 $\pm$ 7% N/mm</td></tr></table> <table><tr><td>iv)</td><td>160 kN capacity (for VB-1, EMU/MEMU/JUS coaches)</td><td></td><td></td></tr><tr><td></td><td></td><td>Load in kN (Static)</td><td>Vertical stiffness (Cz) With Additional Volume 50dm³</td></tr><tr><td></td><td></td><td>50</td><td>287 $\pm$ 7% N/mm</td></tr><tr><td></td><td></td><td>70</td><td>344 $\pm$ 7% N/mm</td></tr><tr><td></td><td></td><td>100</td><td>427 $\pm$ 7% N/mm</td></tr><tr><td></td><td></td><td>160</td><td>597 $\pm$ 7% N/mm</td></tr></table> <table><tr><td>v)</td><td>140 kN capacity</td><td></td><td></td></tr><tr><td></td><td></td><td>Load in kN (Static)</td><td>Vertical stiffness (Cz)</td></tr><tr><td></td><td></td><td>Additional Volume</td><td>Additional volume 40dm³</td></tr><tr><td></td><td></td><td>50</td><td>550$\pm$50 N/mm</td></tr><tr><td></td><td></td><td>115</td><td>625$\pm$75N/mm</td></tr><tr><td></td><td></td><td>140</td><td>1000$\pm$100N/mm</td></tr></table>	S. No.	Type of air spring	Vertical Stiffness under load		Load in kN (Static)	Vertical stiffness (Cz)	i)	180 kN capacity					Additional Volume 20dm ³	Additional volume 40dm ³			50	600 $\pm$ 100 N/mm			165	1200 $\pm$ 200N/mm			180	1350 $\pm$ 200N/mm	ii)	160 kN capacity					Load in kN (Static)	Vertical stiffness (Cz)			50	Informative			60	285 $\pm$ 20 N/mm			90	360 $\pm$ 25 N/mm			120	430 $\pm$ 30 N/mm			160	530 $\pm$ 40 N/mm	iii)	160.8 kN capacity (For VB-2 coaches)					Load in kN (Static)	Vertical stiffness (Cz) With Additional Volume 50dm ³			60	Informative			76.6	395 $\pm$ 7% N/mm			444.3	545 $\pm$ 7% N/mm			122.7	597 $\pm$ 7% N/mm			160.8	665 $\pm$ 7% N/mm	iv)	160 kN capacity (for VB-1, EMU/MEMU/JUS coaches)					Load in kN (Static)	Vertical stiffness (Cz) With Additional Volume 50dm ³			50	287 $\pm$ 7% N/mm			70	344 $\pm$ 7% N/mm			100	427 $\pm$ 7% N/mm			160	597 $\pm$ 7% N/mm	v)	140 kN capacity					Load in kN (Static)	Vertical stiffness (Cz)			Additional Volume	Additional volume 40dm ³			50	550 $\pm$ 50 N/mm			115	625 $\pm$ 75N/mm			140	1000 $\pm$ 100N/mm									
S. No.	Type of air spring	Vertical Stiffness under load																																																																																																																																											
		Load in kN (Static)	Vertical stiffness (Cz)																																																																																																																																										
i)	180 kN capacity																																																																																																																																												
		Additional Volume 20dm ³	Additional volume 40dm ³																																																																																																																																										
		50	600 $\pm$ 100 N/mm																																																																																																																																										
		165	1200 $\pm$ 200N/mm																																																																																																																																										
		180	1350 $\pm$ 200N/mm																																																																																																																																										
ii)	160 kN capacity																																																																																																																																												
		Load in kN (Static)	Vertical stiffness (Cz)																																																																																																																																										
		50	Informative																																																																																																																																										
		60	285 $\pm$ 20 N/mm																																																																																																																																										
		90	360 $\pm$ 25 N/mm																																																																																																																																										
		120	430 $\pm$ 30 N/mm																																																																																																																																										
		160	530 $\pm$ 40 N/mm																																																																																																																																										
iii)	160.8 kN capacity (For VB-2 coaches)																																																																																																																																												
		Load in kN (Static)	Vertical stiffness (Cz) With Additional Volume 50dm ³																																																																																																																																										
		60	Informative																																																																																																																																										
		76.6	395 $\pm$ 7% N/mm																																																																																																																																										
		444.3	545 $\pm$ 7% N/mm																																																																																																																																										
		122.7	597 $\pm$ 7% N/mm																																																																																																																																										
		160.8	665 $\pm$ 7% N/mm																																																																																																																																										
iv)	160 kN capacity (for VB-1, EMU/MEMU/JUS coaches)																																																																																																																																												
		Load in kN (Static)	Vertical stiffness (Cz) With Additional Volume 50dm ³																																																																																																																																										
		50	287 $\pm$ 7% N/mm																																																																																																																																										
		70	344 $\pm$ 7% N/mm																																																																																																																																										
		100	427 $\pm$ 7% N/mm																																																																																																																																										
		160	597 $\pm$ 7% N/mm																																																																																																																																										
v)	140 kN capacity																																																																																																																																												
		Load in kN (Static)	Vertical stiffness (Cz)																																																																																																																																										
		Additional Volume	Additional volume 40dm ³																																																																																																																																										
		50	550 $\pm$ 50 N/mm																																																																																																																																										
		115	625 $\pm$ 75N/mm																																																																																																																																										
		140	1000 $\pm$ 100N/mm																																																																																																																																										
6.5	Lateral spring stiffness of air spring assembly: At ± 20 mm (for S. No. i), ii, iv) & v) and ± 10 mm (for S. No. iii) at constant speed of 5 mm/sec, the lateral stiffness (Cy) shall be as under:	<table><tr><th rowspan="2">S. No.</th><th rowspan="2">Type of air spring</th><th colspan="2">Lateral Stiffness under load</th></tr><tr><th>Load in kN (Static)</th><th>Lateral stiffness (Cy)</th></tr><tr><td>i)</td><td>180 kN capacity</td><td></td><td></td></tr><tr><td></td><td></td><td>50</td><td>250 $\pm$ 50 N/mm</td></tr><tr><td></td><td></td><td>165</td><td>450$\pm$100 N/mm</td></tr><tr><td></td><td></td><td>180</td><td>500$\pm$100 N/mm</td></tr></table> <table><tr><td>ii)</td><td>180 kN capacity</td><td></td><td></td></tr><tr><td></td><td></td><td>Load in kN (Static)</td><td>Lateral stiffness (Cy)</td></tr><tr><td></td><td></td><td>60</td><td>130 $\pm$ 20 N/mm</td></tr><tr><td></td><td></td><td>90</td><td>165 $\pm$ 25 N/mm</td></tr><tr><td></td><td></td><td>120</td><td>200 $\pm$ 30 N/mm</td></tr><tr><td></td><td></td><td>160</td><td>250 $\pm$ 40 N/mm</td></tr></table> <table><tr><td>iii)</td><td>160.8 kN capacity (For VB-2 coaches) Note: This test also to be done at ± 10 mm at constant speed of 5 mm/sec</td><td></td><td></td></tr><tr><td></td><td></td><td>Load in kN (Static)</td><td>Lateral stiffness (Cy)</td></tr><tr><td></td><td></td><td>60</td><td>Informative</td></tr><tr><td></td><td></td><td>76.6</td><td>107 $\pm$ 15% N/mm</td></tr><tr><td></td><td></td><td>444.3</td><td>115 $\pm$ 15% N/mm</td></tr><tr><td></td><td></td><td>122.7</td><td>120 $\pm$ 15% N/mm</td></tr><tr><td></td><td></td><td>160.8</td><td>140 $\pm$ 15% N/mm</td></tr></table> <table><tr><td>iv)</td><td>160 kN capacity (for VB-1, EMU/MEMU/JUS coaches) Note: This test also to be done at ± 10 mm at constant speed of 5 mm/sec</td><td></td><td></td></tr><tr><td></td><td></td><td>Load in kN (Static)</td><td>Lateral stiffness (Cy)</td></tr><tr><td></td><td></td><td>50</td><td>111 $\pm$ 15% N/mm</td></tr><tr><td></td><td></td><td>70</td><td>110 $\pm$ 15% N/mm</td></tr><tr><td></td><td></td><td>100</td><td>129 $\pm$ 15% N/mm</td></tr><tr><td></td><td></td><td>160</td><td>164 $\pm$ 15% N/mm</td></tr></table> <table><tr><td>v)</td><td>140 kN capacity</td><td></td><td></td></tr><tr><td></td><td></td><td>Load in kN (Static)</td><td>Lateral stiffness (Cy)</td></tr><tr><td></td><td></td><td>50</td><td>150 $\pm$ 25 N/mm</td></tr><tr><td></td><td></td><td>115</td><td>175$\pm$25 N/mm</td></tr><tr><td></td><td></td><td>140</td><td>200$\pm$25 N/mm</td></tr></table> <table><tr><td>vi)</td><td>120 kN capacity</td><td></td><td></td></tr><tr><td></td><td></td><td>Load in kN (Static)</td><td>Lateral stiffness (Cy)</td></tr><tr><td></td><td></td><td>60</td><td>175$\pm$30 N/mm</td></tr><tr><td></td><td></td><td>90</td><td></td></tr><tr><td></td><td></td><td>120</td><td></td></tr></table>	S. No.	Type of air spring	Lateral Stiffness under load		Load in kN (Static)	Lateral stiffness (Cy)	i)	180 kN capacity					50	250 $\pm$ 50 N/mm			165	450 $\pm$ 100 N/mm			180	500 $\pm$ 100 N/mm	ii)	180 kN capacity					Load in kN (Static)	Lateral stiffness (Cy)			60	130 $\pm$ 20 N/mm			90	165 $\pm$ 25 N/mm			120	200 $\pm$ 30 N/mm			160	250 $\pm$ 40 N/mm	iii)	160.8 kN capacity (For VB-2 coaches) Note: This test also to be done at ± 10 mm at constant speed of 5 mm/sec					Load in kN (Static)	Lateral stiffness (Cy)			60	Informative			76.6	107 $\pm$ 15% N/mm			444.3	115 $\pm$ 15% N/mm			122.7	120 $\pm$ 15% N/mm			160.8	140 $\pm$ 15% N/mm	iv)	160 kN capacity (for VB-1, EMU/MEMU/JUS coaches) Note: This test also to be done at ± 10 mm at constant speed of 5 mm/sec					Load in kN (Static)	Lateral stiffness (Cy)			50	111 $\pm$ 15% N/mm			70	110 $\pm$ 15% N/mm			100	129 $\pm$ 15% N/mm			160	164 $\pm$ 15% N/mm	v)	140 kN capacity					Load in kN (Static)	Lateral stiffness (Cy)			50	150 $\pm$ 25 N/mm			115	175 $\pm$ 25 N/mm			140	200 $\pm$ 25 N/mm	vi)	120 kN capacity					Load in kN (Static)	Lateral stiffness (Cy)			60	175 $\pm$ 30 N/mm			90				120		
S. No.	Type of air spring	Lateral Stiffness under load																																																																																																																																											
		Load in kN (Static)	Lateral stiffness (Cy)																																																																																																																																										
i)	180 kN capacity																																																																																																																																												
		50	250 $\pm$ 50 N/mm																																																																																																																																										
		165	450 $\pm$ 100 N/mm																																																																																																																																										
		180	500 $\pm$ 100 N/mm																																																																																																																																										
ii)	180 kN capacity																																																																																																																																												
		Load in kN (Static)	Lateral stiffness (Cy)																																																																																																																																										
		60	130 $\pm$ 20 N/mm																																																																																																																																										
		90	165 $\pm$ 25 N/mm																																																																																																																																										
		120	200 $\pm$ 30 N/mm																																																																																																																																										
		160	250 $\pm$ 40 N/mm																																																																																																																																										
iii)	160.8 kN capacity (For VB-2 coaches) Note: This test also to be done at ± 10 mm at constant speed of 5 mm/sec																																																																																																																																												
		Load in kN (Static)	Lateral stiffness (Cy)																																																																																																																																										
		60	Informative																																																																																																																																										
		76.6	107 $\pm$ 15% N/mm																																																																																																																																										
		444.3	115 $\pm$ 15% N/mm																																																																																																																																										
		122.7	120 $\pm$ 15% N/mm																																																																																																																																										
		160.8	140 $\pm$ 15% N/mm																																																																																																																																										
iv)	160 kN capacity (for VB-1, EMU/MEMU/JUS coaches) Note: This test also to be done at ± 10 mm at constant speed of 5 mm/sec																																																																																																																																												
		Load in kN (Static)	Lateral stiffness (Cy)																																																																																																																																										
		50	111 $\pm$ 15% N/mm																																																																																																																																										
		70	110 $\pm$ 15% N/mm																																																																																																																																										
		100	129 $\pm$ 15% N/mm																																																																																																																																										
		160	164 $\pm$ 15% N/mm																																																																																																																																										
v)	140 kN capacity																																																																																																																																												
		Load in kN (Static)	Lateral stiffness (Cy)																																																																																																																																										
		50	150 $\pm$ 25 N/mm																																																																																																																																										
		115	175 $\pm$ 25 N/mm																																																																																																																																										
		140	200 $\pm$ 25 N/mm																																																																																																																																										
vi)	120 kN capacity																																																																																																																																												
		Load in kN (Static)	Lateral stiffness (Cy)																																																																																																																																										
		60	175 $\pm$ 30 N/mm																																																																																																																																										
		90																																																																																																																																											
		120																																																																																																																																											

6.6 Special characteristic tests & parameters for 160.8 kN & 160 kN air spring for VB-2 & VB-1, EMUMENULJUS coaches.

6.6.1 Load Pressure			
S. No.		For VB-2 Coaches	For VB-1, EMUMENULJUS
		Load in kN	Pressure (bar)
1.	76.6 kN	70	2.90 ± 5%
2.	444.8 kN	70	4.20 ± 5%
3.	122.7 kN	100	3.05 ± 5%
4.	160.8 kN	160	5.04 ± 5%

6.6.2 Variation of ±1-2% in mean values shall be permissible.

S. No.		For VB-2 Coaches	For VB-1, EMUMENULJUS
		Load in kN	Stiffness (N/mm)
1.	76.6 kN	2175± 15% N/mm	1575± 15% N/mm
2.	444.8 kN	3325± 15% N/mm	2000± 15% N/mm
3.	122.7 kN	3100± 15% N/mm	2800± 15% N/mm
4.	160.8 kN	5050± 15% N/mm	

6.6.3 Lateral Stiffness of Emergency Spring for VB-1, EMUMENULJUS coaches.

S. No.		For VB-2 Coaches	For VB-1, EMUMENULJUS
		Load in kN	Stiffness (N/mm)
1.	76.6 kN	Informative	242± 15% N/mm
2.	444.8 kN	Informative	261± 15% N/mm
3.	122.7 kN	Informative	291± 15% N/mm
4.	160.8 kN	Informative	370± 15% N/mm

6.6.4 Stability and Inflationability test of air spring for VB-2, VB-1, EMUMENULJUS coaches:

The air spring system must be inflatable without additional measures in all operational states. This should be checked by inflation at tare load in combination with maximum lateral deformation.

For stability (resistance to deflection) hysterisis must be stable in the meaning of having a positive slope in all operational states.

For stability (resistance to deflection) hysterisis must be stable in the meaning of having a positive slope in all operational states.

6.6.4.1 may be applied

For Inflationability test : Load cases LC5~ LC7s

For Stability test : Load cases LC4~LC7

6.6.4.1 Stability and Inflationability test:

Load Cases for Stability and Inflationability test of air springs for VB-2, VB-1, EMUMENULJUS coaches:

Load case	Condition	Deformation	Fz [kN]	S _z [mm]	Description
LC1	Deflated	0	160.8	0	Deflated Service
LC2	Inflated	0	160.8	0	Inflated Service
LC3	Inflated	0	160.8	0	Inflated Service
LC4	Inflated	0	160.8	0	Inflated Service
LC5	Inflated	0	160.8	0	Inflated Service
LC6	Inflated	0	160.8	0	Inflated Service
LC7	Inflated	0	160.8	0	Inflated Service
LC7s	Inflated	0	160.8	0	Inflated Service

Note: For VB-1/EMUMENULJUS coaches, deformation shall be limited to 725mm in place of 128 mm.

Load Cases for Stability and Inflationability test of air springs for VB-1/EMULJUS/EMULJUS coaches

Load case No.	Condition	Deformation	Fz [kN]	S _z [mm]	Description
LC1	Deflated	0	160.8	0	Deflated Service
LC2	Inflated	0	160.8	0	Inflated Service
LC3	Inflated	0	160.8	0	Inflated Service
LC4	Inflated	0	160.8	0	Inflated Service
LC5	Inflated	0	160.8	0	Inflated Service
LC6	Inflated	0	160.8	0	Inflated Service
LC7	Inflated	0	160.8	0	Inflated Service
LC7s	Inflated	0	160.8	0	Inflated Service

Note: For VB-1/EMUMENULJUS coaches, deformation shall be limited to 725mm in place of 128 mm.

Load Cases for Stability and Inflationability test of air springs for VB-1/EMULJUS/EMULJUS coaches

Load case No.	Condition	Deformation	Fz [kN]	S _z [mm]	Description
LC1	Deflated	0	160.8	0	Deflated Service
LC2	Inflated	0	160.8	0	Inflated Service
LC3	Inflated	0	160.8	0	Inflated Service
LC4	Inflated	0	160.8	0	Inflated Service
LC5	Inflated	0	160.8	0	Inflated Service
LC6	Inflated	0	160.8	0	Inflated Service
LC7	Inflated	0	160.8	0	Inflated Service
LC7s	Inflated	0	160.8	0	Inflated Service

6.6.5 Dynamic Stiffness for VB-2 Coaches:

S. No.	Description	Test Condition	Specified Value
1.	Dynamic Stiffness	Fz = 76.6 / 111.9 / 122.7 / 160.8 kN S _w = 0 ± 10 mm f _y = 1 Hz	Cy0 dyn (76.6 kN) = Informative Cy1 dyn (111.9 kN) = Informative Cy2 dyn (122.7 kN) = Informative Cy3 dyn (160.8 kN) = Informative
2.	Dynamic Stiffness	Fz = 76.6 / 111.9 / 122.7 / 160.8 kN S _w = 0 ± 10 mm f _y = 1 Hz Vaux = 50 km/h	Cz0 dyn (76.6 kN) = Informative Cz1 dyn (111.9 kN) = Informative Cz2 dyn (122.7 kN) = Informative Cz3 dyn (160.8 kN) = Informative

Note: For VB-1/EMUMENULJUS coaches, deformation shall be limited to 725mm in place of 128 mm.

Tolerance on load pressure is already on higher side as specified in EN 13597:2003 (E). Hence no change.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

These tests and load cases have been added for standardization of characteristics of air spring assembly for VB-2 coaches.

3490810/2025/O/o ED/CARRIAGE/RDSO																																
	ARL	RDPL	SIAS	Escort	AEL	Trelleborg	GMT	FS	Poly.	Tayal	RDSO remarks																					
6.11	Space Constraints Air spring assembly consisting of top plate with spigot (for air connection), air spring bellow, rim, external / internal emergency rubber spring, base plate etc. in initiated condition (at 6.0 kg/cm ² below pressure) shall be within the space envelope shown in RDSO Drawings. Some of the leading parameters of air spring assembly and drawing no. in initiated condition are enclosed as Annexure - VIII (enclosed). Profile & overall dimensions of initiated air spring assembly in extreme lateral, vertical & torsional load/force to be prepared during the type test as per para 6.4.3 of EN 13597:2003 and shall be submitted to RDSO.																															
6.12	Mounting arrangement The material of the base plate shall be stainless steel or corrosion resistant steel or equivalent even if this arrangement is an integral part of the emergency spring to avoid inter-metallic corrosion. The base plate shall be provided with 04 nos. mounting fasteners. Details of base plate and mounting fasteners are specified in Annexure - VIII (enclosed).																															
6.13	Pneumatic supply connection Air inlet connection point to the air spring shall be located at the centre of top plate through a spigot made air tight by using minimum two rubber O-rings. The dimension of spigot for all types of Air Springs shall be as under <table><tr><td>i)</td><td>Outer diameter of spigot</td><td>= Ø 85^{+0.09/-0.07} mm.</td></tr><tr><td>ii)</td><td>Height of spigot</td><td>= 35 ± 0.5 mm- for LHB & ICF coaches & 45 mm for VB-2/VB-1/EMU-US/ME/MLUS coaches</td></tr><tr><td>iii)</td><td>Cross section diameter of 'O' ring over spigot</td><td>= 5.7 ± 0.1 mm.</td></tr></table> Detailed dimensions of Spigot and O-ring over spigot are given in Annexure - IX (enclosed).											i)	Outer diameter of spigot	= Ø 85 ^{+0.09/-0.07} mm.	ii)	Height of spigot	= 35 ± 0.5 mm- for LHB & ICF coaches & 45 mm for VB-2/VB-1/EMU-US/ME/MLUS coaches	iii)	Cross section diameter of 'O' ring over spigot	= 5.7 ± 0.1 mm.												
i)	Outer diameter of spigot	= Ø 85 ^{+0.09/-0.07} mm.																														
ii)	Height of spigot	= 35 ± 0.5 mm- for LHB & ICF coaches & 45 mm for VB-2/VB-1/EMU-US/ME/MLUS coaches																														
iii)	Cross section diameter of 'O' ring over spigot	= 5.7 ± 0.1 mm.																														
6.14	Other Details 6.14.1 The fasteners shall be zinc 900 coated as mention in Annexure - VIII. All exposed metal parts of the air spring assembly shall be of stainless steel or corrosion resistant steel or equivalent. Salt spray test, for assessment of corrosion resistance of metal should be carried out according to ISO 9227. The specimen should not have any 'Red Rust' on the surface exposed to air. Test report of salt spray test should be as per ISO 9227 and also part of type test report. Moreover, as quality control measure, salt spray test should also be repeated by the firm at every 3 years for any one type of air spring assembly and report along with clear photographs (before and after) of the same also to be submitted to RDSO. The testing time should be minimum 720 1000 Hrs. All exposed metal parts should be painted as follows. <table><tr><th>S. No.</th><th>Type of air spring</th><th>Colour and shade</th></tr><tr><td>i)</td><td>180 KN capacity for EDU/DMLU/ME/MLUS Coaches with ICF type</td><td>Grey (RAL no. 7042)</td></tr><tr><td>ii)</td><td>160 KN capacity for LHB coaches</td><td>Sky Blue (RAL no. 5012)</td></tr><tr><td>iii)</td><td>140 KN capacity for mainline ICF & LHB coaches</td><td>Red (RAL no. 3024/3020)</td></tr><tr><td>iv)</td><td>120 KN capacity for LHB Coaches</td><td>Light Green (RAL no. 6037)</td></tr><tr><td>v)</td><td>100.8 KN capacity for VB-1/VB-2</td><td>Grey (RAL no. 3049 7012)</td></tr><tr><td>vi)</td><td>180 KN capacity for VB-1/EMU-US/ME/MLUS coaches</td><td>Red (RAL no. 3024/3020 301)</td></tr></table>											S. No.	Type of air spring	Colour and shade	i)	180 KN capacity for EDU/DMLU/ME/MLUS Coaches with ICF type	Grey (RAL no. 7042)	ii)	160 KN capacity for LHB coaches	Sky Blue (RAL no. 5012)	iii)	140 KN capacity for mainline ICF & LHB coaches	Red (RAL no. 3024/3020)	iv)	120 KN capacity for LHB Coaches	Light Green (RAL no. 6037)	v)	100.8 KN capacity for VB-1/VB-2	Grey (RAL no. 3049 7012)	vi)	180 KN capacity for VB-1/EMU-US/ME/MLUS coaches	Red (RAL no. 3024/3020 301)
S. No.	Type of air spring	Colour and shade																														
i)	180 KN capacity for EDU/DMLU/ME/MLUS Coaches with ICF type	Grey (RAL no. 7042)																														
ii)	160 KN capacity for LHB coaches	Sky Blue (RAL no. 5012)																														
iii)	140 KN capacity for mainline ICF & LHB coaches	Red (RAL no. 3024/3020)																														
iv)	120 KN capacity for LHB Coaches	Light Green (RAL no. 6037)																														
v)	100.8 KN capacity for VB-1/VB-2	Grey (RAL no. 3049 7012)																														
vi)	180 KN capacity for VB-1/EMU-US/ME/MLUS coaches	Red (RAL no. 3024/3020 301)																														
6.14.2	Any alternate material for manufacturing of emergency spring and metal parts of air spring assembly, which fulfills the functional and technical requirement of metal part/emergency spring can also be considered provided that it is proven and established globally, which is to be demonstrated by firm, subject to clearance by RDSO.																															
6.15	Physical tests of air spring bellow Physical tests of the air spring bellow as specified at para. 5 of Annexure 'A' of this specification shall form a part of the type test report.																															
6.6	The information as received above shall be used for preliminary evaluation of the firm's capability in meeting with the requirements of this Specification.																															
6.7	The firm shall be required to submit a Type Test Report of a proposed design after the preliminary evaluation carried out as per para 7.2 is found satisfactory. Type Test Report shall be complying with Annexure 'A' of this Specification.																															
6.8	The premises of the firm shall be visited by RDSO's officials for on-the-spot assessment of the firm's capability.																															
6.9	RDSO reserves complete right in granting approval or otherwise to a firm.																															

[illegible]

10.2.3 Characteristics tests

10.2.3.1 Air below spring assembly

Pressure vs load test of air spring assembly.
Air spring assembly/ at fixed installation height (para. 6.4.1/ Section - A) and with additional volume (para. 6.3 / Section - A) shall be tested at pressure starting from 1, 2, 3, 4, 5 and upto 6 kg/cm². The recordings shall be done as given below. -

S.N.	Pressure in Kg/cm ²	Specified Vertical Load in kN	Observed Vertical Load in kN
		Spg. No.	Spg. No.

The Pressure vs Load relationship of air spring assembly shall be same as given in type test report / QAP drawing approved by RDSO.

10.2.3.2 Emergency spring

Vertical load vs. deflection characteristics measured at vertical loads on Emergency spring given in type test report / QAP drawing approved by RDSO.

10.2.4 Periodical tests of Air Spring Assemblies, as a quality control measure to ensure quality of this critical suspension element:

To ensure consistency in quality of rubber components of this critical suspension component (Air Springs), following tests shall be done periodically. Tests shall be conducted by the vendors & reports along with photographs shall be submitted to RDSO. Plan & schedule of these tests shall be communicated to RDSO & RDSO might depute its personnel to witness the tests by suitable means including video call.

S. No	Description of test	Sample qty	Periodicity of tests from date of issue of this specification
1.	Salt spray test of all exposed metal parts	01 no.	Every 3 years or supply of air springs of every Coach sets, whichever is earlier.
2.	Lateral load vs deflection test of Air spring assembly upto deflection mentioned in para 6.2 of Section-A of RDSO Specification No. RDSO/CG/S/23002, Rev. 01	05 Nos.	Yearly/ After supply of 500 coach sets of particular type of air spring, whichever is later.
3.	Lateral load vs. deflection of Emergency spring as per para 4.1 of Section-B of RDSO Specification No. RDSO/CG/S/23002, Rev. 01	05 Nos.	Yearly/ After supply of 500 coach sets of particular type of air spring, whichever is later.
4.	Lateral stiffness of air spring assemblies as per para 6.5 of Section-A of RDSO Specification No. RDSO/CG/S/23002, Rev. 01	05 Nos.	Yearly/ After supply of 500 coach sets of particular type of air spring, whichever is later.
5.	Vertical stiffness of air spring assemblies as per para 6.4 of Section-A of RDSO Specification No. RDSO/CG/S/23002, Rev. 01	05 Nos.	Yearly/ After supply of 500 coach sets of particular type of air spring, whichever is later.
6.	Failure test of air spring assemblies (All the tests of para 8 & 9) of Annexure-A of RDSO Specification no. RDSO/CG/S/23002, Rev. #01 to be done.	01 no. of each type of air spring assembly approved by RDSO (i.e. 120 kN, 140 kN, 160 kN, 180 kN & 160 kN capacity).	Every 5 years

10.3 10% samples of the lot or a minimum 10 samples whichever is maximum shall be picked up randomly for dimensional test as given in clause 10.2.1/ Section-A of this Specification.

10.4 For other specified inspections as given in clause 10.2.2 / Section - A and 10.2.3 / Section - A of this Specification, samples shall be picked up randomly as under.

Lot size upto	10	25	50	75	100
No of samples	2	3	4	5	6

For lot sizes more than 100, 6% of the samples shall be picked up randomly for the above inspections.

10.5 In case any picked up sample fails, manufacturer/supplier shall re-offer, rectifying the defects. However, in such cases, double the quantity of samples shall be picked up and shall be checked for dimension and other specified tests. In case any one sample fails again, the entire lot shall be rejected.

11 MARKING.

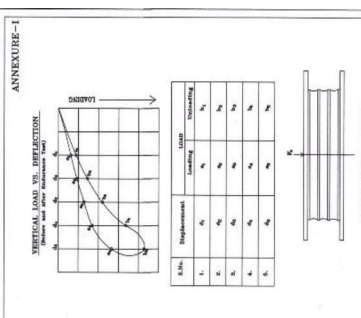
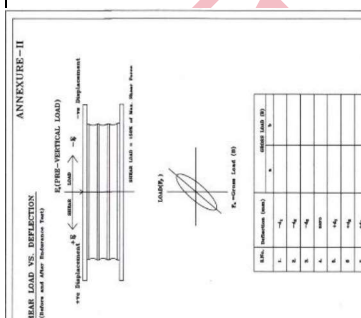
Marking on air spring assembly shall be legibly marked to indicate the following:

S. No.	Detail of item of air spring assembly	Particulars to be marked
1.	Every item of the air spring assembly (Top plate, Bottom plate, Air below & Emergency spring)	1) Manufacturer's initials (Vendor code/OEM Name). 2) Month and year of manufacture (MM/YY). 3) Identification marks, i.e. Part Number, Batch Number etc. 4) Capacity of air spring (180 kN/160.8 kN/160 kN/140 kN/120 kN)
2.	Base plate of air spring assembly	*Air Spring capacity (180 kN / 160 kN / 160.8 kN / 140 kN / 120 kN) on two adjacent edges of base plate.
3.	Identification plate of air spring assembly.	1) Type of Stock (BF Coaches/EMU Coaches/EMU type coaches) V/B-2 2) Capacity of air spring (180 kN/160 kN/160.8 kN/140 kN/120 kN) 3) Installed height (255 mm / 284 mm/300 mm) 4) Name of Vendor. 5) Month & year of manufacturer (MM/YY)

Marking on air spring assembly should be lasting. Marking on metal plates shall be done with engraved/ punched continuous letters with font height 12 mm and 0.5 mm deep.

3490810/2025/O/o ED/CARRIAGE/RDSO										
ARL	RDPL	SIAS	Escort	AEL	Trelleborg	GMT	FS	Poly.	Tayal	RDSO remarks
12 PACKING: The air spring assembly shall be suitably packed along with its loose parts and exposed threaded portion, to protect against any damage that may occur during transit and handling. The opening of the spigot of the spring shall be suitably covered with a plastic/rubber cap to prevent ingress of dust or foreign material in the air spring.										
13 MAINTENANCE MANUAL: The supplier shall provide at least one copy of maintenance manual, free of cost with each consignment, for maintenance and overhaul purpose.										
14 GENERAL: 14.1. RDSO may draw samples for quality check to test any property mentioned in this specification at it's discretion. The vendor shall arrange testing of these samples at a reputed outside laboratory as decided between RDSO and the vendor. The testing charges should be borne by the vendor. 14.2. RDSO reserve the right to modify any clause of this Specification as per requirement of Indian Railways. 14.3. Additional information if required may be obtained from the office of the Director General (Carriage), RDSO, Manak Nagar, Lucknow – 226011.										
Annexure –A REQUIREMENTS OF TYPE TEST REPORT The type test report of air spring assembly shall consist of the following, clearly represented by graphs as well as in tabulation forms, with detailed test procedures and their results - 1) Lateral characteristics measurement at speed V= 5 mm/sec. using triangular wave form of vibrations in lateral direction with following conditions: S. No. Type of air spring Conditions at which characteristics shall be measured Vertical Load Stroke (dy) Additional Volume I) 180 KN capacity 50, 115, 165 & 180 KN ±10, ±20, ±30, ±40, ±50, ±60 mm 20 lit. II) 160 KN capacity 50, 60, 90, 120 & 160 KN ±10, ±20, ±30, ±40, ±50, ±60, ±70 & ±80 mm 60 lit. III) 140 KN capacity 50, 70, 115 & 140 KN ±10, ±20, ±30, ±40, ±50, ±60 mm, ±80mm (FAT bogie) 40 lit. IV) 120 KN capacity 60, 90 & 120 KN ±10, ±20, ±30, ±40, ±50, ±60, ±70 & ±80 mm 60 lit. V) 160.8 KN capacity (VB-2) 64, 76.8, 111.8, 122.7 & 160.8 ±10, ±20, ±30, ±40, ±50, ±60, ±70, ±80 & ±90 50 lit. VI) 160 KN capacity (VB-1) 60, 70, 100 & 160 KN ±10, ±20, ±30, ±40, ±50, ±60, ±70, ±80 & ±100 mm 50 lit. 2) Vertical characteristics measurement at speed V= 5 mm/sec. using triangular wave form of vibrations in vertical direction with following conditions: S. No. Type of air spring Conditions at which characteristics shall be measured Vertical Load Stroke (dz) Additional Volume I) 180 KN capacity 50, 115, 165 & 180 KN ±10, ±20, ±30 mm 20, 30 & 40 lit. II) 160 KN capacity 50, 60, 90, 120 & 160 KN ±10, ±20, ±30 mm 40, 60 & 80 lit. III) 140 KN capacity 50, 70, 115 & 140 KN ±10, ±20, ±30 mm 20, 30, 40 & 60 lit. IV) 120 KN capacity 60, 90 & 120 KN ±10, ±20, ±30 mm 40, 60 & 80 lit. V) 160.8 KN capacity (VB-2) 64, 76.8, 111.8, 122.7 & 160.8 KN ±10, ±20, ±30 mm 20, 40, 50 & 60 lit. VI) 160 KN capacity (VB-1) 60, 70, 100 & 160 KN ±10, ±20, ±30 mm 20, 40, 50 & 60 lit. Note: 1) For VB-2 test, the conditions shall be 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530, 540, 550, 560, 570, 580, 590, 600, 610, 620, 630, 640, 650, 660, 670, 680, 690, 700, 710, 720, 730, 740, 750, 760, 770, 780, 790, 800, 810, 820, 830, 840, 850, 860, 870, 880, 890, 900, 910, 920, 930, 940, 950, 960, 970, 980, 990, 1000, 1010, 1020, 1030, 1040, 1050, 1060, 1070, 1080, 1090, 1100, 1110, 1120, 1130, 1140, 1150, 1160, 1170, 1180, 1190, 1200, 1210, 1220, 1230, 1240, 1250, 1260, 1270, 1280, 1290, 1300, 1310, 1320, 1330, 1340, 1350, 1360, 1370, 1380, 1390, 1400, 1410, 1420, 1430, 1440, 1450, 1460, 1470, 1480, 1490, 1500, 1510, 1520, 1530, 1540, 1550, 1560, 1570, 1580, 1590, 1600, 1610, 1620, 1630, 1640, 1650, 1660, 1670, 1680, 1690, 1700, 1710, 1720, 1730, 1740, 1750, 1760, 1770, 1780, 1790, 1800, 1810, 1820, 1830, 1840, 1850, 1860, 1870, 1880, 1890, 1900, 1910, 1920, 1930, 1940, 1950, 1960, 1970, 1980, 1990, 2000, 2010, 2020, 2030, 2040, 2050, 2060, 2070, 2080, 2090, 2100, 2110, 2120, 2130, 2140, 2150, 2160, 2170, 2180, 2190, 2200, 2210, 2220, 2230, 2240, 2250, 2260, 2270, 2280, 2290, 2300, 2310, 2320, 2330, 2340, 2350, 2360, 2370, 2380, 2390, 2400, 2410, 2420, 2430, 2440, 2450, 2460, 2470, 2480, 2490, 2500, 2510, 2520, 2530, 2540, 2550, 2560, 2570, 2580, 2590, 2600, 2610, 2620, 2630, 2640, 2650, 2660, 2670, 2680, 2690, 2700, 2710, 2720, 2730, 2740, 2750, 2760, 2770, 2780, 2790, 2800, 2810, 2820, 2830, 2840, 2850, 2860, 2870, 2880, 2890, 2900, 2910, 2920, 2930, 2940, 2950, 2960, 2970, 2980, 2990, 3000, 3010, 3020, 3030, 3040, 3050, 3060, 3070, 3080, 3090, 3100, 3110, 3120, 3130, 3140, 3150, 3160, 3170, 3180, 3190, 3200, 3210, 3220, 3230, 3240, 3250, 3260, 3270, 3280, 3290, 3300, 3310, 3320, 3330, 3340, 3350, 3360, 3370, 3380, 3390, 3400, 3410, 3420, 3430, 3440, 3450, 3460, 3470, 3480, 3490, 3500, 3510, 3520, 3530, 3540, 3550, 3560, 3570, 3580, 3590, 3600, 3610, 3620, 3630, 3640, 3650, 3660, 3670, 3680, 3690, 3700, 3710, 3720, 3730, 3740, 3750, 3760, 3770, 3780, 3790, 3800, 3810, 3820, 3830, 3840, 3850, 3860, 3870, 3880, 3890, 3900, 3910, 3920, 3930, 3940, 3950, 3960, 3970, 3980, 3990, 4000, 4010, 4020, 4030, 4040, 4050, 4060, 4070, 4080, 4090, 4100, 4110, 4120, 4130, 4140, 4150, 4160, 4170, 4180, 4190, 4200, 4210, 4220, 4230, 4240, 4250, 4260, 4270, 4280, 4290, 4300, 4310, 4320, 4330, 4340, 4350, 4360, 4370, 4380, 4390, 4400, 4410, 4420, 4430, 4440, 4450, 4460, 4470, 4480, 4490, 4500, 4510, 4520, 4530, 4540, 4550, 4560, 4570, 4580, 4590, 4600, 4610, 4620, 4630, 4640, 4650, 4660, 4670, 4680, 4690, 4700, 4710, 4720, 4730, 4740, 4750, 4760, 4770, 4780, 4790, 4800, 4810, 4820, 4830, 4840, 4850, 4860, 4870, 4880, 4890, 4900, 4910, 4920, 4930, 4940, 4950, 4960, 4970, 4980, 4990, 5000, 5010, 5020, 5030, 5040, 5050, 5060, 5070, 5080, 5090, 5100, 5110, 5120, 5130, 5140, 5150, 5160, 5170, 5180, 5190, 5200, 5210, 5220, 5230, 5240, 5250, 5260, 5270, 5280, 5290, 5300, 5310, 5320, 5330, 5340, 5350, 5360, 5370, 5380, 5390, 5400, 5410, 5420, 5430, 5440, 5450, 5460, 5470, 5480, 5490, 5500, 5510, 5520, 5530, 5540, 5550, 5560, 5570, 5580, 5590, 5600, 5610, 5620, 5630, 5640, 5650, 5660, 5670, 5680, 5690, 5700, 5710, 5720, 5730, 5740, 5750, 5760, 5770, 5780, 5790, 5800, 5810, 5820, 5830, 5840, 5850, 5860, 5870, 5880, 5890, 5900, 5910, 5920, 5930, 5940, 5950, 5960, 5970, 5980, 5990, 6000, 6010, 6020, 6030, 6040, 6050, 6060, 6070, 6080, 6090, 6100, 6110, 6120, 6130, 6140, 6150, 6160, 6170, 6180, 6190, 6200, 6210, 6220, 6230, 6240, 6250, 6260, 6270, 6280, 6290, 6300, 6310, 6320, 6330, 6340, 6350, 6360, 6370, 6380, 6390, 6400, 6410, 6420, 6430, 6440, 6450, 6460, 6470, 6480, 6490, 6500, 6510, 6520, 6530, 6540, 6550, 6560, 6570, 6580, 6590, 6600, 6610, 6620, 6630, 6640, 6650, 6660, 6670, 6680, 6690, 6700, 6710, 6720, 6730, 6740, 6750, 6760, 6770, 6780, 6790, 6800, 6810, 6820, 6830, 6840, 6850, 6860, 6870, 6880, 6890, 6900, 6910, 6920, 6930, 6940, 6950, 6960, 6970, 6980, 6990, 7000, 7010, 7020, 7030, 7040, 7050, 7060, 7070, 7080, 7090, 7100, 7110, 7120, 7130, 7140, 7150, 7160, 7170, 7180, 7190, 7200, 7210, 7220, 7230, 7240, 7250, 7260, 7270, 7280, 7290, 7300, 7310, 7320, 7330, 7340, 7350, 7360, 7370, 7380, 7390, 7400, 7410, 7420, 7430, 7440, 7450, 7460, 7470, 7480, 7490, 7500, 7510, 7520, 7530, 7540, 7550, 7560, 7570, 7580, 7590, 7600, 7610, 7620, 7630, 7640, 7650, 7660, 7670, 7680, 7690, 7700, 7710, 7720, 7730, 7740, 7750, 7760, 7770, 7780, 7790, 7800, 7810, 7820, 7830, 7840, 7850, 7860, 7870, 7880, 7890, 7900, 7910, 7920, 7930, 7940, 7950, 7960, 7970, 7980, 7990, 8000, 8010, 8020, 8030, 8040, 8050, 8060, 8070, 8080, 8090, 8100, 8110, 8120, 8130, 8140, 8150, 8160, 8170, 8180, 8190, 8200, 8210, 8220, 8230, 8240, 8250, 8260, 8270, 8280, 8290, 8300, 8310, 8320, 8330, 8340, 8350, 8360, 8370, 8380, 8390, 8400, 8410, 8420, 8430, 8440, 8450, 8460, 8470, 8480, 8490, 8500, 8510, 8520, 8530, 8540, 8550, 8560, 8570, 8580, 8590, 8600, 8610, 8620, 8630, 8640, 8650, 8660, 8670, 8680, 8690, 8700, 8710, 8720, 8730, 8740, 8750, 8760, 8770, 8780, 8790, 8800, 8810, 8820, 8830, 8840, 8850, 8860, 8870, 8880, 8890, 8900, 8910, 8920, 8930, 8940, 8950, 8960, 8970, 8980, 8990, 9000, 9010, 9020, 9030, 9040, 9050, 9060, 9070, 9080, 9090, 9100, 9110, 9120, 9130, 9140, 9150, 9160, 9170, 9180, 9190, 9200, 9210, 9220, 9230, 9240, 9250, 9260, 9270, 9280, 9290, 9300, 9310, 9320, 9330, 9340, 9350, 9360, 9370, 9380, 9390, 9400, 9410, 9420, 9430, 9440, 9450, 9460, 9470, 9480, 9490, 9500, 9510, 9520, 9530, 9540, 9550, 9560, 9570, 9580, 9590, 9600, 9610, 9620, 9630, 9640, 9650, 9660, 9670, 9680, 9690, 9700, 9710, 9720, 9730, 9740, 9750, 9760, 9770, 9780, 9790, 9800, 9810, 9820, 9830, 9840, 9850, 9860, 9870, 9880, 9890, 9900, 9910, 9920, 9930, 9940, 9950, 9960, 9970, 9980, 9990, 10000.										
3) Rotational stiffness of air spring assembly" A) THE ROTATIONAL STIFFNESS AT CONSTANT VELOCITY, SHALL BE TESTED AND MENTIONED IN THE TYPE TEST REPORT AS PER PARA 6.5.1.4 & 7.5.1.2.4 OF EN 13597:2003 (E), FOR TARE TO FULL LOAD CONDITIONS FOR EACH TYPE OF AIR SPRING ASSEMBLIES I.E. 120 KN, 140 KN, 160 KN, 160.8 & 180 KN CAPACITIES AT RESPECTIVE INSTALLATION HEIGHTS. B) THE ROTATIONAL STIFFNESS UNDER SINUSOIDAL MOTION, SHALL BE TESTED AND MENTIONED IN THE TYPE TEST REPORT AS PER PARA 6.5.1.7 & 7.5.1.3.4 OF EN 13597:2003 (E) FOR TARE TO FULL LOAD CONDITIONS FOR EACH TYPE OF AIR SPRING ASSEMBLIES I.E. 120 KN, 140 KN, 160 KN, 160.8 & 180 KN CAPACITIES AT RESPECTIVE INSTALLATION HEIGHTS. *SIMILAR TESTS AS PER APPLICABLE ALTERNATE STANDARDS SHALL ALSO BE ACCEPTABLE.										
4) Vertical force versus internal pressure characteristic measurements of air spring.										
5) Effective area versus deflection curve of air below.										
6) Salt spray test of metal part as per para. 6.13 6.14 / Section – A of Specification.										

3.3 Type Testing Facilities (Mandatory for OEM/Vendor)					Min. Qty	Remarks
S. No.	Name of Machine/ Equipment / Software	Capacity / Description / Specification				
1	Universal testing machine	Having suitable capacities	01	Testing of bumper, ply-adhesion, static load vs. deflection of emergency bumper, metal to rubber adhesion of emergency bumper, physical properties of cured rubber sample of unaged, heat aged, oil aged samples		
2	DN Abrader	Lab standard	01	Testing of abrasion resistance		
3	Ozone chamber	Lab standard	01	Testing of ozone resistance		
4	Dynamic testing equipment with programmable	Suitable capacity load cell actuator, with hydraulic pump and controller, cooling system, additional reservoir	01	Testing of vertical, lateral/shear and torsional stiffness, vertical and lateral endurance testing of air spring assembly, Testing of vertical stiffness, endurance of emergency bumper, vertical load vs. deflection, shear load vs. deflection etc.		
5	Burst pressure fixture	Water pump with controller	01	Testing of burst pressure (Up to 30 kg/Cm ²)		
6	Curing press	500cc Having suitable capacity	01	Curing of sample for metal to rubber adhesion test, test slab for petroleum resistance testing		
7	Ageing oven	Lab standard	01	Ageing of test samples for petroleum / oil resistance, Effective diameter measurement, pressure checking		
8	Vernier caliper, pressure gauge	1.0m length, 10bar with 0.01 bar least count	--			
Suitable testing machinery and infrastructure is required to conduct the complete type testing and Endurance tests of air spring assemblies and Emergency Spring as mentioned in this specification, Facilities available at sister allied/ principle concern may also be considered for this purpose on case basis on the basis of practicality						
3.4 Manufacturing facilities for Air Spring Below (For OEM/Vendor/Allied/ Sister Concern)						
S. No	Name of Machine/ Equipment/ Software	Capacity/ Description /Specification	Min. Required Qty			
1.	Weighting balance for Rubber, Rubber chemicals, Filler weighing	--	01 No			
2.	Twist checking, tensile testing machine, shrinkage tester, ageing oven	--	01 No			
3.	Kneader / Internmix/ Banbury mixer for mixing of rubber compound	--	01 No			
4.	Two roll mill	--	01 No			
5.	3 roll calendar for Calendaring of inner liner and outer cover	--	01 No			
6.	4 roll calendar for Rubber coating on fabric	--	01 No			
7.	Blade cutting machine	--	01 No.			
8.	Build drum	--	01 Nos.			
9.	Build machine	--	01 No.			
10.	Ton Curing press (min. 85 T)	--	01 No.			
11.	Hardness tester, Specific gravity balance, Mooney viscometer, Rheometer, Lab curing press	--	01 No			
3.5 Manufacturing facilities for Emergency Spring: - (For OEM/Vendor/allied/sister concern)						
S. No	Name of Machine/ Equipment/ Software	Capacity/Description/ Specification	Min. Required Qty			
1.	Weighting balance for Rubber, Rubber chemicals, Filler weighing	--	01 No			
2.	Twist checking, tensile testing machine, shrinkage tester, ageing oven	--	01 No			
3.	Kneader / Internmix/ Banbury mixer for mixing of rubber compound	--	01 No.			
4.	Mould	--	1 No.			
5.	Compression moulding press	--	1 No.			
6.	Curing press	--	1 No.			
7.	Carousal chemical storage tank	--	one			
8.	Scada (PLC)-chemical and carbon weighing control	--	1 No.			
9.	Kneader for mixing of final batch	--	1 No.			
10.	Bonding agent application spray unit	--	1 No.			
11.	Hardness tester	--	1 No.			
12.	Shot/Grit Blasting machine	--	01			
13.	Depressing facility	--	01			
14.	Testing facilities to test the surface of cleaned metal parts by using special ink. Testbrite 38 mN/m or 30 Accu-Dyne Test Pen etc.	--	01			
15.	Painting booth for base plate & Metal parts	--	01			
16.	Hard Grinder & Grinding Mic	--	01			
17.	Machine & facility for Swaging / Internal Stress Removal	--	01			
3.6 Manufacturing facilities for Top Plate and other metal parts (For OEM/ Vendor/ Allied/ Sister Concern)						
S. No	Name of Machine/ Equipment/ Software	Capacity/Description/ Specification	Min. Required Qty			
1.	Vertical turning Lathe	--	01			
2.	CNC Lathe	--	01			
3.	Radial Drilling machine	--	01			
4.	Jig & Fixtures	--	01			
5.	M/S Welding	--	01			
6.	Hydraulic Press	--	01			
7.	Vertical milling centre	--	01			
8.	Test bench for leakage testing of top plate	--	01			
9.	Testing facility for weft test	--	01			
10.	OMM	--	01			
11.	Shot/Grit Blasting machine	--	01			
12.	Depressing facility	--	01			
13.	Testing facilities to test the surface of cleaned metal parts by using special ink. Testbrite 38 mN/m or 30 Accu-Dyne Test Pen etc.	--	01			
14.	Painting booths & Machinery	--	01			
15.	Hard Grinder & Grinding Mic	--	01			
Note: For manufacturing of top plate through casting process, firm should additionally have adequate facility with suitable moulds & die, Injection Press, Induction Furnace, Tanks for pre coat and de-waxing tank, dehumidifier & cooling tower, costing equipments, heat treatment facility, MPI testing machine, contactless thermometer etc. to carry out the entire manufacturing process with quality control.						

5.0 Qualification of Man Power 5.1 The Quality Control Section shall be separately headed by a full time technical expert having a minimum bachelor's degree in Mechanical/ Automobile/ Mechatronics with at least 5 years of experience or diploma in Mechanical/ Automobile/ Mechatronics with at least 8 years of experience. He shall be free from day-to-day production & testing responsibilities. He shall be mainly responsible for development for product, failure analysis, planning corrective and preventive action, control over raw material, devising actions in case of difficulties in achieving the parameters etc. 5.2 Production/ inspection activities shall be headed by a graduate engineer with at least 5 years of experience or a diploma holder with at least 8 years of experience. He shall be actively involved in day-to-day activities of stage inspection / compliance of QAP etc. 4.1 Welders shall be qualified in accordance with prevalent National / International standards. 5.3 Welding in manufacturing shall be done by qualified and experienced welders. The quality of welding has to be according to EN 15085 / EN 25817/ ISO 5817 class B. Concerned vendor/Sub vendor Allied/Sister Concern must have EN 15085-2 CL-1 certification for plant/works (if welding work is required on Air spring assembly parts). At the type approval stage, the manufacturer shall hand over to RDSO necessary documentation for records. 5.4 Testing of welding seams The welding seams have to be checked by non-destructive methods via PT (Penetrant Test) or MT (Magnetic Particle Test) PT as per ISO 23277 MT as per ISO 17638 and ISO 23278 6.0 DOCUMENTATION Firm shall maintain the following documents/ records. 6.1 A well-documented Quality Plan. 6.2 Incoming raw material register with Test Certificates references of suppliers and internal test results. 6.3 Stage inspection results including finished products results. 6.4 Records of internal rejection and its analysis vis-a-vis action plan. 6.5 Records of final products inspection by external agencies (like RDSO/Railways), Non-Conformity Reports and case analysis as well as action taken thereof. 6.6 There should exist a system of documentation in respect of rejection at customer end, warranty replacement and In service FA performance. 6.7 Records of raw material received and supplies made to Railways against the raw material. Incoming raw material with TC reference of supplier as well as internal test/audit checking from outside agency. 6.8 The details regarding Stage inspection and test result.	ANNEXURE-I VERTICAL LOAD VS. DEFLECTION (Stiffness and Allowable Deflection Load)  <table><tr><th>S.No.</th><th>Deflection (mm)</th><th>Load (kN)</th></tr><tr><td>1.</td><td>0</td><td>0</td></tr><tr><td>2.</td><td>10</td><td>10</td></tr><tr><td>3.</td><td>20</td><td>20</td></tr><tr><td>4.</td><td>30</td><td>30</td></tr><tr><td>5.</td><td>40</td><td>40</td></tr></table>	S.No.	Deflection (mm)	Load (kN)	1.	0	0	2.	10	10	3.	20	20	4.	30	30	5.	40	40	ANNEXURE-II SHEAR LOAD VS. DEFLECTION (Stiffness and Allowable Deflection Load)  <table><tr><th>S.No.</th><th>Deflection (mm)</th><th>Load (kN)</th></tr><tr><td>1.</td><td>0</td><td>0</td></tr><tr><td>2.</td><td>10</td><td>10</td></tr><tr><td>3.</td><td>20</td><td>20</td></tr><tr><td>4.</td><td>30</td><td>30</td></tr><tr><td>5.</td><td>40</td><td>40</td></tr></table>	S.No.	Deflection (mm)	Load (kN)	1.	0	0	2.	10	10	3.	20	20	4.	30	30	5.	40	40	Comment (Clause Annexure-I to VII): No Change Technical Impact (Clause Annexure-I to VII): No impact changes are only related to added details for 160.8 Kn Air spring for VB-2 Coaches	Noted, No change.
S.No.	Deflection (mm)	Load (kN)																																						
1.	0	0																																						
2.	10	10																																						
3.	20	20																																						
4.	30	30																																						
5.	40	40																																						
S.No.	Deflection (mm)	Load (kN)																																						
1.	0	0																																						
2.	10	10																																						
3.	20	20																																						
4.	30	30																																						
5.	40	40																																						

ANNEXURE-III

EXTREMITY LOAD (VERTICAL ENDURANCE TEST)



50% MAXIMUM LOAD



50% MAXIMUM LOAD

Sl. No.	Parameter	Value	Remarks
1.	Temperature	25 ± 2°C	
2.	Load	1000 N	
3.	Frequency	10 Hz	
4.	Time	1000 hrs	
5.	Remarks		

Sl. No.	Parameter	Value	Remarks
1.	Temperature	25 ± 2°C	
2.	Load	1000 N	
3.	Frequency	10 Hz	
4.	Time	1000 hrs	
5.	Remarks		

ANNEXURE-IV

EXTREMITY LOAD (SHEAR ENDURANCE TEST)



50% MAXIMUM LOAD



50% MAXIMUM LOAD

Sl. No.	Parameter	Value	Remarks
1.	Temperature	25 ± 2°C	
2.	Load	1000 N	
3.	Frequency	10 Hz	
4.	Time	1000 hrs	
5.	Remarks		

Sl. No.	Parameter	Value	Remarks
1.	Temperature	25 ± 2°C	
2.	Load	1000 N	
3.	Frequency	10 Hz	
4.	Time	1000 hrs	
5.	Remarks		

ANNEXURE-V

VERTICAL LOAD IN IMPERFECT TEST

Sl. No.	Parameter	Value	Remarks
1.	Temperature	25 ± 2°C	
2.	Load	1000 N	
3.	Frequency	10 Hz	
4.	Time	1000 hrs	
5.	Remarks		



50% MAXIMUM LOAD

ANNEXURE-VI

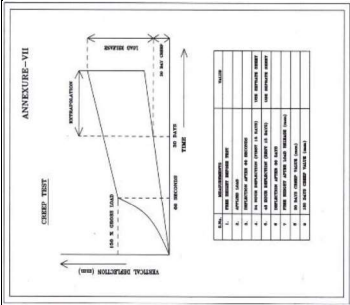
SHEAR LOAD IN IMPERFECT TEST

Sl. No.	Parameter	Value	Remarks
1.	Temperature	25 ± 2°C	
2.	Load	1000 N	
3.	Frequency	10 Hz	
4.	Time	1000 hrs	
5.	Remarks		



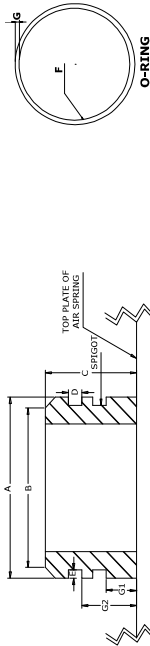
50% MAXIMUM LOAD

ARL	RDPL	SIAS	Escort	AEL	Trelleborg	GMT	FS	Poly.	Tayal	RDSO remarks
-----	------	------	--------	-----	------------	-----	----	-------	-------	--------------



Details of dimensions of Spigot and O-ring

Annexure – IX

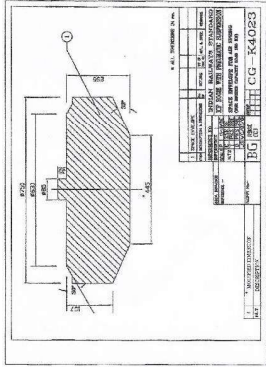


Spigot for Air Spring assemblies for LHB/ICF VB-2/ VB-1/ EMU-USMEMU-US type bogies

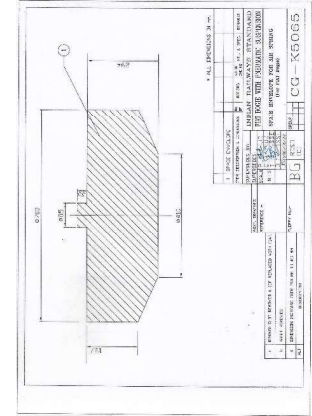
Annexure – IX	
O-Ring for Air Spring assemblies for LHB, ICF VB-2/ VB-1/ EMU-USMEMU-US type bogies	
Dimension in "mm"	
Dimension in "mm" for VB-2/ VB-1/ EMU-USMEMU-US Coaches	
External diameter of spigot (A)	Ø 85 ^{+0.08/-0.07}
Diameter of spigot without grooves (B)	75.0 ± 0.5
Height of spigot (C)	35.0 ± 0.5
Height of Groove (D)	45.0 ± 0.5
Depth of Groove (E)	6.7 ± 0.5
Internal diameter of O- ring (F)	4.7 ± 0.5
Internal diameter of O- ring (G)	74.1 ± 0.6
Cross section diameter of O- ring (H)	5.7 ± 0.1
Radius of Groove (I)	15.0 ± 0.1
Radius of Groove (J)	27.0 ± 0.1

Note - The mating bolster hole diameter where spigot shall be fitted is Ø 85 HB mm (Bore)

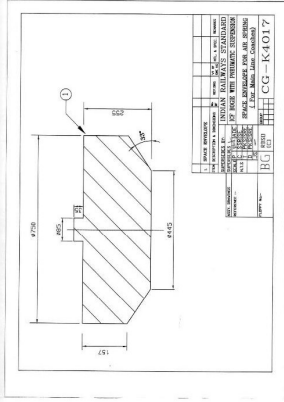
Annexure – X



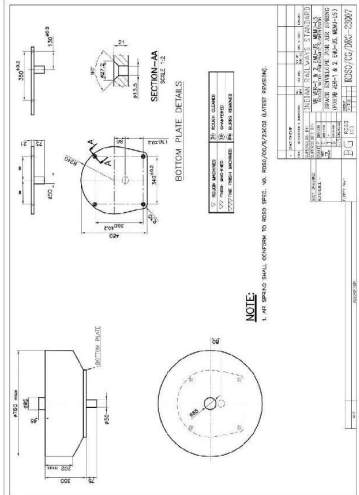
Annexure – XI



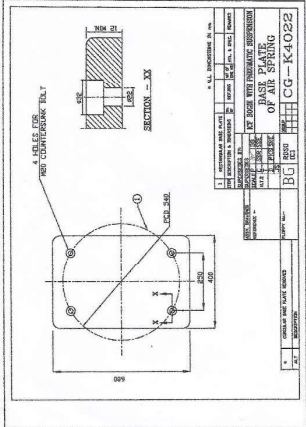
Annexure -XII



Annexure -XIII



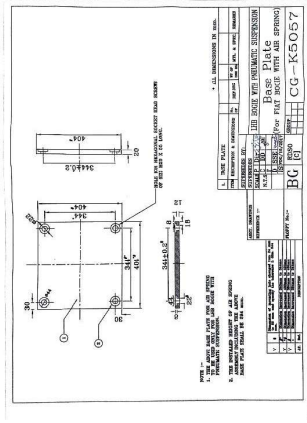
Annexure -XIV



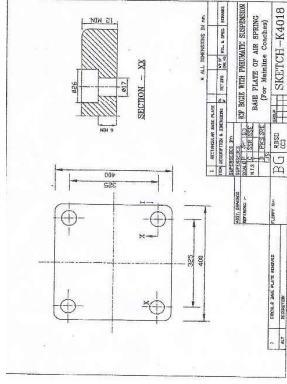
VB2 GMT uses aluminum top plate.

NOTE - Bottom plate thickness for VB-1 & VB-2 are different between Annexure-VIII, No.9 & Annexure-X, III & Annexure-XVIII, we think Annexure-VIII is correct, please confirm.

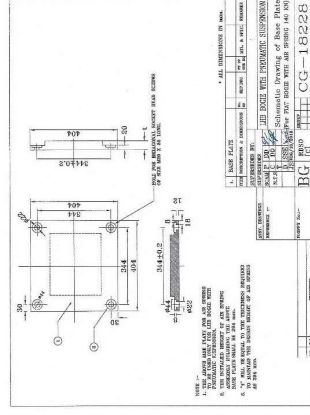
Annexure - XV



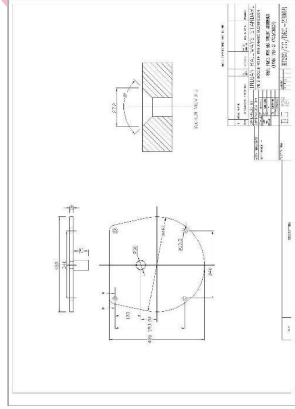
Annexure - XVI



Annexure - XVII



Annexure - XVIII



GMT comment through mail dated 06.10.2023

Please find enclosed my summary of the comparison between the 17308901 air spring system and the new spec. I mainly had a look on the added characteristics for the Vande Bharat VB2 air spring system and not at the complete spec, which do not refer only to VB2.

The added values for the VB2 air spring system correspond mostly to the type test of the air spring system 17308901. So I think that the specification corresponds to 17308901 but there are mostly minor differences or uncertainties which should be discussed with the customer.

- 6.1.1: Tare load is specified to 50 kN, the air spring system 17308901 is designed for a tare load of 76.6 kN with an air gap of 25 mm. It should be discussed under which tare load the height of 300 mm is specified. A lower tare load will of course result in a reduction of the air gap.
- 6.2: Max. deformation is specified to 128 mm with no comment if it is only under tare load or over the complete load range. I assume that the horizontal deformation of 128 mm in depository load and 92 mm in service are still valid but this should also be clarified. I have seen the air spring system on the test bench during development max. deformed and a horizontal deformation of 128 mm at higher loads seems critical.
- 6.4.2: Tolerance according spec. ±7% is quite small, usually we agree to min. 10%.
- 6.7: Max. dynamic load changed from 160.6 kN to 184 kN. For the critical metal part / rim still feasible as it was calculated in FKM to 180 kN (air spring system 17305201 / Train 18).
- 6.8: Burst pressure is specified to min. 30 bar. The below has reached in the type test a burst pressure of 16.9 bar. The below will not fulfill this requirement. We should refer to the standard EN13597 with 3 x max. static pressure & min. 16 bar as min. burst pressure à Requirement Min. 16 bar.
- 6.4.1: Color is specified to RAL 7042, the air spring system 17308901 is colored in RAL7012. Only a minor deviation but still would result in a new part no.
- Annex A1.2): The specified tests are partly not feasible due to resulting internal collision of the top plate with the sliding plate as a result of a smaller air gap at lower load of 60 kN, see also my comment in 6.1.1.
- Dimensions / drawings:
 - The drawings of the spec. correspond overall to 17308901 except the O-Ring grooves on the top plate and O-Ring diameter which do not correspond to our internal standard. I heard there were some doubts in this project about our O-rings claiming that they were a bit loose on our air inlets but did not hear of any problems in the vehicle. Can you confirm?
 - Therefore, we should use our standard.
 - The specification still mentions a steel top plate. 17308901 has an aluminum top plate to save weight.

For a full check of the specification I would have to do a CBC, if required I can create it.

SVR's Comments

- With reference to the above cited letter, comments have been sought on final draft STR No. RDSO/COS/23002, Rev.01, for air spring assemblies prepared by RDSO. The draft STR has been down loaded from RDSO website and found that the specifications of air springs used in Vande Bharat train is added to the new spec as Rev.01, As on date, spare workshop is not overhauling/maintaining Vande Bharat train, but overhauling spare parts inlets and outlets for air spring maintenance on Vande Bharat have been noted for future reference please.
- Following comments are submitted to RDSO for their consideration and implementation to the specification of Air Springs.
 - 1. Interchangeability of air bellows of different make is not possible due to different design and the vendors are not replacing the defective air bellows in time which are under warranty. Due to this, it is difficult to turn out coaches as per the schedule. Hence, RDSO may incorporate standard common design of air bellows in draft specifications, which can be interchangeable during the maintenance of air springs.
 - 2. Budgetary Quotation for spare parts of air springs is not offered on request by the vendor however, the complete air spring quotation is provided. Maintenance/repair of Air springs after the guaranteed/warranty period is not possible if unable to procure spare parts. Mandatory supply of spares by suppliers to Railways to be incorporated in draft specifications.
 - 3. More than 90% of air spring failure is due to air bellows defect. The rubber material used in air bellows to be standardized and to be incorporated in draft specifications. The air spring assembly drawing approved by RDSO may be enclosed in the RDSO STR for better appreciation.

WR's Comments

- With reference to the above following comments are suggested on Final Draft for Air Spring for coaches.
 - 1. The comments are not applicable to the current draft STR as it is a preliminary draft STR on post completion of warranty period.
 - 2. To identify the life of air spring they should have unified details like month, year and make to be punched on spool or other suitable location on top plate and base plate and similarly embossed on air bellows, because after six year of life the tag plate is corroded or found missing.
 - 3. The details punched or embossed on the Air Spring components should clearly indicate the Date of Manufacturing and other related parameters instead of being in some manufacturer provided Code.

ICF Comments

ITEM: Mounting Fasteners details		160.8 kN capacity (for VB-2 coaches)	160 kN capacity (for VB-1, EMU/LJUS, MEMU/LJUS, Vande Metro coaches)
Type, size & grade of screw	Existing	Proposed	Proposed
	Bolt ISO 10642-M12x100* 8.8-A3-1, Length of bolt have to be relevant due to length of shank and thickness of all clamped parts or nonstandard, fully threaded one needs to be used.	Carbody side- Hexagon head bolt - ISO 4014-M16 x 70-A3-8 Bogie side- Hexagon socket countersunk head Screw (Full thread) IS 6761 M12X80-8.8	Carbody side- Hexagon head bolt-IS 13 64(PART-1) ISO 4014-M16 x70-10.9 Bogie side- Hexagon socket countersunk head screw IS 6761-1994 - M12X90-A3-8
Type, size & grade of washer	Nord lock washer - NL12 - min. 400HV	Carbody side- Washer to ISO 7089-16-200HV- (2Nos. per screw) Bogie side- Washer to ISO 7089-12-200HV	Carbody side- Washer to ISO 7089-16-300HV- (2 Nos. per screw) Bogie side- Washer to ISO 7089-12-300HV
Type, size & grade of nut	Nut ISO 4032 * M12 -J5- electro galvanized (ISO4042)	1. FS all steel Locknut M-16, Property class - 8 2. FS all steel Locknut M-12, Property class - 8	FS all steel lock nut M-16 Property class-10 FS all steel locknut M-12, Property class-10
Surface finish of fasteners	All fasteners (screws, washers & nuts) shall be "Zinc electroplated to A31, finish of IS1367 (Part-111)"	All fasteners (screws, washers & nuts) shall be "Zinc electroplated to A31, finish of IS1367 (Part, 111)"	No changes needed

Incorporated the ICF above suggestions.