Documents regarding Approval of

CNG Check valve of class 0

Of BMT Co. Ltd. Make

Approval number: **E4-110R-000309-00**

Report No: **IN110-A0-120036** Dated **16-July-2012**

Name of technical service

TÜV NORD Mobilität GmbH & Co. KG
Institut für Fahrzeugtechnik und Mobilität
Adlerstr. 7
D-45307 Essen

CONTENTS

RDW

Vehicle Technology Division

THE NETHERLANDS
(N E D E R L A N D)

E4

COMMUNICATION

Concerning [1]:

- approval granted
~~- approval extended~~
~~- approval refused~~
~~- approval withdrawn~~
~~- production definitely discontinued~~

of a type of CNG component pursuant to Regulation number 110.

Approval number: E4-110R-000309 **Extension number: 00**

1. CNG component considered:

- ~~Container(s) or cylinder(s)~~ [1]
- ~~Pressure indicator~~
- ~~Pressure relief valve~~
- ~~Automatic valve(s)~~
- ~~Excess flow valve~~
- ~~Gas-tight housing~~
- ~~Pressure regulator(s)~~
- Non-return valve(s)
- ~~Pressure relief device~~
- ~~Manual valve~~
- ~~Flexible fuel lines~~
- ~~Filling unit or receptacle~~
- ~~Gas injector(s)~~
- ~~Gas flow adjuster~~
- ~~Gas/air mixer~~
- ~~Electronic control unit~~
- ~~Pressure and temperature sensor(s)~~
- ~~CNG filter(s)~~

2. Trade name or mark : SUPERLOK T&S VALVES
High-Pressure Check Valve
(SHCV1, SHCV2, SHCV3Series)

Manufacturer's name and address : BMT CO., LTD
21-1, Bukjeong-dong, Yangsan-si,
Gyeongsangnam-do,
626-110 S.Korea

RDW

P.O. Box 777
2700 AT Zoetermeer
The Netherlands

Tel. + 31 (0)79 345 81 43
Fax + 31 (0)79 345 80 43
www.rdw.nl

Vehicle Approval and Information

Approval number: E4-110R-000309 **Extension number: 00**

4.	If applicable, name and address of manufacturer's representative	:	NA
5.	Submitted for approval on	:	December'2011
6.	Technical service responsible for conducting approval tests	:	**TÜV NORD Mobilität GmbH & Co. KG** Institut für Fahrzeugtechnik und Mobilität Adlerstr. 7 D-45307 Essen
7.	Date of report issued by that service	:	17-July-2012
8.	Number of report issued by that service	:	IN110-A0-120036
9.	Approval	:	granted/~~refused/extended/withdrawn~~ (1)
10.	Reason(s) of extension (if applicable)	:	NA
11.	Place	:	ZOETERMEER
12.	Date	:	06-NOV-2012
13.	Signature	:	

RDW

R. Kauerz

14. The documents filed with the application or extension of approval can be obtained upon request.

(1) Strike out what does not apply.

Approval number: E4-110R-000309 **Extension number: 00**

ADDENDUM

1. Additional information concerning the type-approval of a type of CNG components pursuant to Regulation number 110.

1.1.	Container(s) or cylinder(s)	
1.1.1.	Dimensions	: Not Applicable
1.1.2.	Material	: Not Applicable
1.2.	Pressure indicator	
1.2.1.	Working pressure(s) (2)	: Not Applicable
1.2.2.	Material	: Not Applicable
1.3.	Pressure relief valve (discharge valve)	
1.3.1.	Working pressure(s) (2)	: Not Applicable
1.3.2.	Material	: Not Applicable
1.4.	Automatic valve(s)	
1.4.1.	Working pressure(s) (2)	: Not Applicable
1.4.2.	Material	: Not Applicable
1.5.	Excess flow valve	
1.5.1.	Working pressure(s) (2)	: Not Applicable
1.5.2.	Material	: Not Applicable
1.6.	Gas-tight housing	
1.6.1.	Working pressure(s) (2)	: Not Applicable
1.6.2.	Material	: Not Applicable
1.7.	Pressure regulator(s)	
1.7.1.	Working pressure(s) (2)	: Not Applicable
1.7.2.	Material	: Not Applicable
1.8.	Check valve(s) or non-return valve(s)	
1.8.1.	Working pressure(s) (2)	: 260 bar for consideration of R110
1.8.2.	Material	: 316 Stainless steel
1.9.	Pressure relief device (temperature triggered)	
1.9.1.	Working pressure(s) (2)	: Not Applicable
1.9.2.	Material	: Not Applicable
1.10.	Manual valve	
1.10.1.	Working pressure(s) (2)	: Not Applicable
1.10.2.	Material	: Not Applicable
1.11.	Flexible fuel lines	
1.11.1.	Working pressure(s) (2)	: Not Applicable
1.11.2.	Material	: Not Applicable
1.12.	Filling unit or receptacle	
1.12.1.	Working pressure(s) (2)	: Not Applicable
1.12.2.	Material	: Not Applicable

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Approval number: E4-110R-000309 **Extension number: 00**

1.13.	Gas injector(s)	
1.13.1.	Working pressure(s) [(2)]	: Not Applicable
1.13.2.	Material	: Not Applicable
1.14.	Gas flow adjuster	
1.14.1.	Working pressure(s) [(2)]	: Not Applicable
1.14.2.	Material	: Not Applicable
1.15.	Gas/air mixer	
1.15.1.	Working pressure(s) [(2)]	: Not Applicable
1.15.2.	Material	: Not Applicable
1.16.	Electronic control unit (CNG-fuelling)	
1.16.1.	Basic software principles	: Not Applicable
1.17.	Pressure and temperature sensor(s)	
1.17.1.	Working pressure(s) [(2)]	: Not Applicable
1.17.2.	Material	: Not Applicable
1.18.	CNG filter(s)	
1.18.1.	Working pressure(s) [(2)]	: Not Applicable
1.18.2.	Material	: Not Applicable

[(2)] Specify the tolerance

BMT CO., LTD
21-1, Bukjeong-dong, Yangsan-si, Gyeongsangnam-do, 626-110 S.Korea
Tel: 82-55-783-1000 Fax: 82-55-783-1110
http://www.superlok.com

This is for Type Approval of ECE Regulation 110 (CNG) for Specific Components of Vehicles

INFORMATION DOCUMENT No : BMT-CNG-120717-03

Essential Characteristics of the CNG Component

1.1 Trade Name or Mark : SUPERLOK T&S VALVES

1.2 Maker name and Address: BMT CO., LTD
21-1, Bukjeong-dong, Yangsan-si, Gyeongsangnam-do, 626-110 South Korea

1.3 Type/General commercial description:
SHCV SERIES / HIGH-PRESSURE CHECK VALVE

1.4 Working Pressure(s) :

VALVE NAME	Working Pressure for ECE R110 TYPE
High-pressure Check valve	260 bar

1.5 Description and Drawing : See attached document

1.6 Material **:** 316 Stainless steel

1.7 Operating temperatures :

VALVE NAME	Temperature rating
High-pressure Check valve	-40℃ to 120℃

1.8 Remarks: Non-return valve(s)

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BMT CO., LTD
21-1, Bukjeong-dong, Yangsan-si, Gyeongsangnam-do, 626-110 S.Korea
Tel: 82-55-783-1000 Fax: 82-55-783-1110
http://www.superlok.com

2. Features of High Pressure Check valves

SHCV High-pressure Check Valve

- Cracking pressure fixed from 1/3 to 28psi(0.02 to 1.7bar)
- Variety of end connections
- 316 stainless steel body material as standard

3. Description

	SHCV1	SHCV2	SHCV3
Working Pressure for ECE R110 TYPE	260 bar	260 bar	260 bar
Temperature rating	-40 to 120℃	-40 to 120℃	-40 to 120℃
Body material	316 Stainless Steel	316 Stainless Steel	316 Stainless Steel
Port Connection	1/8″ to 1/4″, 6mm	3/8″ to 1/2″ and 8mm to 12mm	3/4″ to 1″ and 22mm to 25mm
Orifice	4.8mm	7.8mm	15mm
Cracking Pressure	1/3 to 25psi (0.02 to 1.7bar)	1/3 to 25psi (0.02 to 1.7bar)	1/3 to 25psi (0.02 to 1.7bar)
Cv Max	0.67	1.8	4.7

4. Working Pressure and MAWP

Valve Name	Working Pressure for ECE R110 TYPE
High-pressure Check Valve	260 bar

5. Material Standard

Material Grade	Bar Stock	Forgings
316 Stainless Steel	ASTM A276, A479 ASME SA479	ASTM A182 ASME SA182

BMT CO., LTD
21-1, Bukjeong-dong, Yangsan-si, Gyeongsangnam-do, 626-110 S.Korea
Tel: 82-55-783-1000 Fax: 82-55-783-1110
http://www.superlok.com

6. Non-Metallic Materials

6.1 O-ring

Elastomer base	EPDM
Hardness Shore A Durometer	70 +/-5
Tensile Strength	7.5 MPa

6.2 Seat & Packing

Chemical Designation	Tensile Strength
Polyterafluoroethylene (PTFE)	20MPa
Poly ether ether ketone (PEEK)	80MPa

7. Manufacturer's Statement

The samples, which have been presented for evaluation, are made during mass production according to the presented documents.
We, as the producer of SUPERLOK T&S VALVE, carry on our own responsibility - the production process guarantees the parameter stability & unchanging and outlet inspection guarantee. SUPELOK T&S VALVE will accomplish permanently the requirements which are specified by our instruction.

8. Pictures of High-pressure Check Valve

Picture 1. High-pressure Check Valve

BMT CO., LTD
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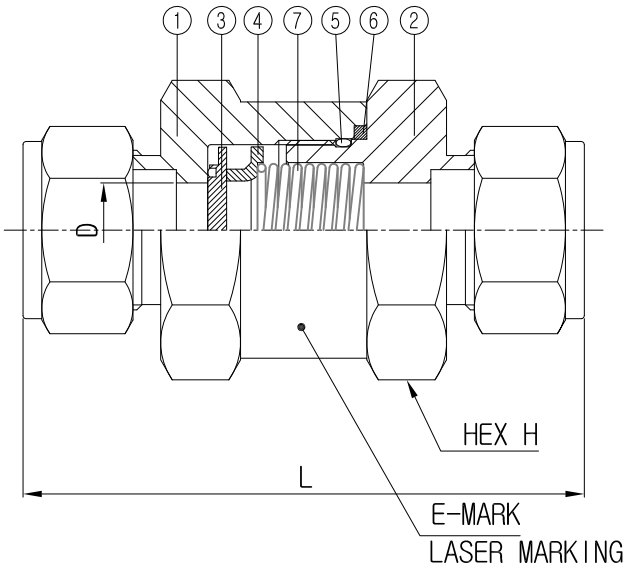
9. Drawings

NO	TITLE	DWG No.
1	High-pressure Check Valve	111124-01-114-04 (Rev.A)
2	Type Approval Mark	111124-01-114-07 (Rev.A)

NO.	DESCRIPTION	MATERIAL	Q'TY	REMARK
1	INNET BODY	SS 316	1	
2	OUTLET BODY	SS 316	1	
3	POPPET	SS 316+ EPDM	1	
4	POPPET STOPPER	SS 316	1	
5	O-RING	EPDM	1	
6	PACKING	PTFE	1	
7	SPRING	SS 304	1	



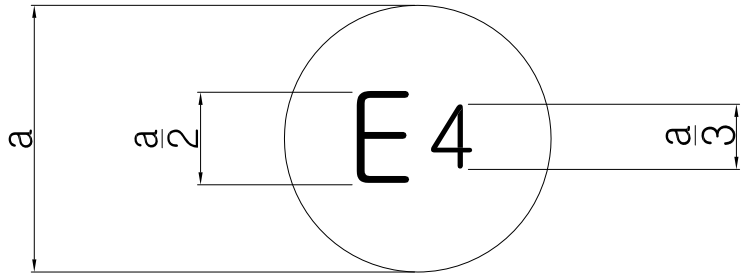
Unit : mm

PART NO.	END CONNECTION	L	H (HEX)	D	Q'TY	WORKING PRESSURE for ECE R110 TYPE	MAX WORKING PRESSURE
SHCV1-M4N-10P-N	1/4" MALE NPT	55.1	17.5	4.8	6 EA	260 bar	414 bar
SHCV2-M8N-10P-N	1/2" MALE NPT	69.3	26.9	7.8	6 EA	260 bar	414 bar
SHCV3-S12-10P-N	3/4" SUPERLOK	89.4	41.3	15	6 EA	260 bar	344 bar

Rev.	Issue Data	Description	Originator	Checked	Approved
A	24.NOV.11	Issued for Approval	C.S.RA	S.M.LEE	J.H.LIM

PURCHASER	
CLIENT	
PROJECT NAME	-
PROJECT NO.	-
PO. NO.	-
MFR. MODEL/TYPE VALVE NAME	SHCV SERIES HIGH PRESSURE CHECK VALVE
TAG NO.	-
DRAWING NO.	111124-01-114-04
GENERAL ARRANGEMENT DRAWING for VALVE	BMT Co., Ltd.

NO.	DESCRIPTION	MATERIAL	Q'TY	REMARK



Approval mark Drawing

110 R-XXXXXX

a ≥ 8mm

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Rev.	Issue Data	Description	Originator	Checked	Approved
A	24.NOV.11	Issued for Approval	C.S.RA	S.M.LEE	J.H.LIM

PURCHASER	
CLIENT	
PROJECT NAME	-
PROJECT NO.	-
PO. NO.	-
MFR. MODEL/TYPE	-
VALVE NAME	-
TAG NO.	-
DRAWING NO.	111124-01-114-07
GENERAL ARRANGEMENT DRAWING for VALVE	BMT Co., Ltd.

Test Report
No.: IN110-A0-120036
Dated: 16/07/2012
ECE Regulation No.110

Type : High-Pressure Check valve (SHCV Series)

Manufacturer : BMT CO., LTD

Test Report

AGREEMENT CONCERNING THE ADOPTION OF UNIFORM TECHNICAL PRESCRIPTIONS FOR WHEELED VEHICLES, EQUIPMENT AND PARTS WHICH CAN BE FITTED AND/OR BE USED ON WHEELED VEHICLES AND THE CONDITIONS FOR RECIPROCAL RECOGNITIONOF APPROVALS GRANTED ON THE BASIS OF THESE PRESCRIPTIONS

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF:
SPECIFIC COMPONENTS OF MOTOR VEHICLES USING COMPRESSED NATURAL GAS (CNG) IN THEIR PROPULSION SYSTEM;

ECE-R 110
as last amended

Revision 1 – Amendment 1 - Amendment 2
Including Supplement 9 to Regulation No. 110 – Date of entry into force: 19 August 2010

Approval status	
	Number of approval
ECE	Previous Approval: Nil
	Current Approval No. E4-110R-000309

Test Report
No.: IN110-A0-120036
Dated: 16/07/2012
ECE Regulation No.110

Type : High-Pressure Check valve (SHCV Series)

Manufacturer : BMT CO., LTD

0.0	General		
0.1	Make	:	SUPERLOK T&S VALVES
0.2	Manufacturer's name and address	:	BMT CO., LTD 21-1, Bukjeong-dong, Yangsan-si, Gyeongsangnam-do, 626-110 S.Korea
0.3	Type and Commercial Description	:	High-Pressure Check valve (SHCV Series) (SHCV1, SHCV2, SHCV3 Series)
0.4	Working Pressure	:	260 bar Class 0
1.0	Test information		
1.1	Test Objects	:	High Pressure Check valve
1.2	Test dates	:	May'2012-June2012
1.3	Equipment /facilities used	:	The test equipment and facilities used were in compliance with the requirements of the Standards

2.0 **Equipment used**

	Equipment	**Make/Model**	**Calibration Validity**
2.1	Salt Chamber	CM Enviro	Jan'13
2.2	Over Pressure Test	Praj	Dec'12
2.3	Hot Chamber	S A Electrical	Feb'13
2.4	Cold Chamber	Praj	Dec'12
2.5	Ammonia Chamber	Praj	Dec'12
2.6	Temperature cyclic test setup	ARAI	Dec'12

Test Report
No.: IN110-A0-120036
Dated: 16/07/2012
ECE Regulation No.110

Type : High-Pressure Check valve (SHCV Series)

Manufacturer : BMT CO., LTD

High-Pressure Check Valve

PART NO.	END CONNECTION	L	H (HEX)	D	Q'TY	WORKING PRESSURE for ECE R110 TYPE	MAX WORKING PRESSURE
SHCV1-M4N-10P-N	1/4" MALE NPT	55.1	17.5	4.8	6 EA	260 bar	414 bar
SHCV2-M8N-10P-N	1/2" MALE NPT	69.3	26.9	7.8	6 EA	260 bar	414 bar
SHCV3-S12-10P-N	3/4" SUPERLOK	89.4	41.3	15	6 EA	260 bar	344 bar

Conclusion of matrix:
BMT produces check Valves as provided in the matrix. Based on the above information and analyzing, a WCC is obtained and valve SHCV1-M4N-10P-N (Low fitting and orifice size) and SHCV3-S12-25P (High fitting and orifice size) are taken for testing, hence all other valves which fall within the matrix need not be tested.

List of Enclosures:
Enclosure 1: Information Document and Drawings
Enclosure 2: Results of Test

Test Report
No.: IN110-A0-120036
Dated: 16/07/2012
ECE Regulation No.110

Type : High-Pressure Check valve (SHCV Series)

Manufacturer : BMT CO., LTD

3.0 **Statement of conformity:**

The type described in this test report and the appendices attached are in compliance with the Test Specification mentioned above.
The Test Report comprises pages 1 to 7.
The Test Report shall be reproduced and published in full only and by the client only. It shall be reproduced partially with the written permission of the Test Laboratory only.

TEST LABORATORY

TÜV NORD Mobilität GmbH & Co. KG
IFM - Institut für Fahrzeugtechnik und Mobilität,
Adlerstr. 7, 45307 Essen

Designated Technical Service
RDW No. 99050016

Pune, India. 17.07.2012

Yeshwant Ambure
Project Leader

M. S. Ogale
Head Homologation

Test Report
No.: IN110-A0-120036
Dated: 16/07/2012
ECE Regulation No.110

Type : High-Pressure Check valve (SHCV Series)

Manufacturer : BMT CO., LTD

List of modifications

Appendix 1

More details for application of : **Date** :

Correction of : -

Modification of : -

Addition of : -

Deletion of : -

BMT CO., LTD
21-1, Bukjeong-dong, Yangsan-si, Gyeongsangnam-do, 626-110 S.Korea
Tel: 82-55-783-1000 Fax: 82-55-783-1110
http://www.superlok.com

This is for Type Approval of ECE Regulation 110 (CNG) for Specific Components of Vehicles

INFORMATION DOCUMENT No : BMT-CNG-120717-03

Essential Characteristics of the CNG Component

1.1 Trade Name or Mark : SUPERLOK T&S VALVES

1.2 Maker name and Address: BMT CO., LTD
21-1, Bukjeong-dong, Yangsan-si, Gyeongsangnam-do, 626-110 South Korea

1.3 Type/General commercial description:
SHCV SERIES / HIGH-PRESSURE CHECK VALVE

1.4 Working Pressure(s) :

VALVE NAME	Working Pressure for ECE R110 TYPE
High-pressure Check valve	260 bar

1.5 Description and Drawing : See attached document

1.6 Material **:** 316 Stainless steel

1.7 Operating temperatures :

VALVE NAME	Temperature rating
High-pressure Check valve	-40℃ to 120℃

1.8 Remarks: Non-return valve(s)

BMT CO., LTD
21-1, Bukjeong-dong, Yangsan-si, Gyeongsangnam-do, 626-110 S.Korea
Tel: 82-55-783-1000 Fax: 82-55-783-1110
http://www.superlok.com

2. Features of High Pressure Check valves

SHCV High-pressure Check Valve

- Cracking pressure fixed from 1/3 to 28psi(0.02 to 1.7bar)
- Variety of end connections
- 316 stainless steel body material as standard

3. Description

	SHCV1	SHCV2	SHCV3
Working Pressure for ECE R110 TYPE	260 bar	260 bar	260 bar
Temperature rating	-40 to 120℃	-40 to 120℃	-40 to 120℃
Body material	316 Stainless Steel	316 Stainless Steel	316 Stainless Steel
Port Connection	1/8″ to 1/4″, 6mm	3/8″ to 1/2″ and 8mm to 12mm	3/4″ to 1″ and 22mm to 25mm
Orifice	4.8mm	7.8mm	15mm
Cracking Pressure	1/3 to 25psi (0.02 to 1.7bar)	1/3 to 25psi (0.02 to 1.7bar)	1/3 to 25psi (0.02 to 1.7bar)
Cv Max	0.67	1.8	4.7

4. Working Pressure and MAWP

Valve Name	Working Pressure for ECE R110 TYPE
High-pressure Check Valve	260 bar

5. Material Standard

Material Grade	Bar Stock	Forgings
316 Stainless Steel	ASTM A276, A479 ASME SA479	ASTM A182 ASME SA182

BMT CO., LTD
21-1, Bukjeong-dong, Yangsan-si, Gyeongsangnam-do, 626-110 S.Korea
Tel: 82-55-783-1000 Fax: 82-55-783-1110
http://www.superlok.com

6. Non-Metallic Materials

6.1 O-ring

Elastomer base	EPDM
Hardness Shore A Durometer	70 +/-5
Tensile Strength	7.5 MPa

6.2 Seat & Packing

Chemical Designation	Tensile Strength
Polyterafluoroethylene (PTFE)	20MPa
Poly ether ether ketone (PEEK)	80MPa

7. Manufacturer's Statement

The samples, which have been presented for evaluation, are made during mass production according to the presented documents.
We, as the producer of SUPERLOK T&S VALVE, carry on our own responsibility - the production process guarantees the parameter stability & unchanging and outlet inspection guarantee. SUPELOK T&S VALVE will accomplish permanently the requirements which are specified by our instruction.

8. Pictures of High-pressure Check Valve

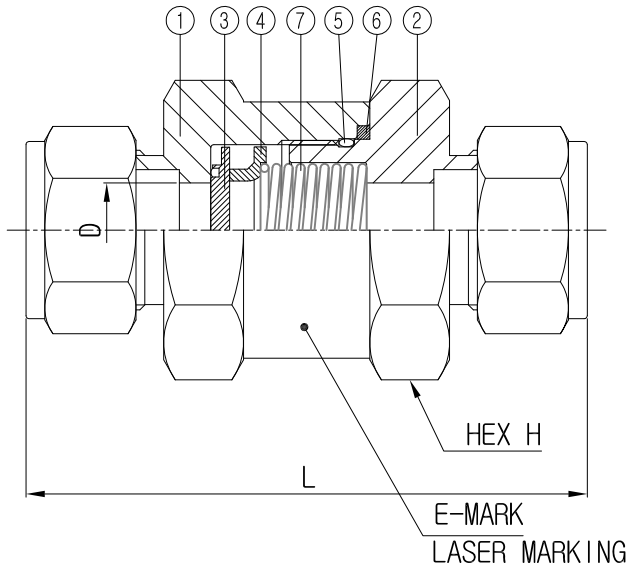
Picture 1. High-pressure Check Valve

BMT CO., LTD
21-1, Bukjeong-dong, Yangsan-si, Gyeongsangnam-do, 626-110 S.Korea
Tel: 82-55-783-1000 Fax: 82-55-783-1110
http://www.superlok.com

9. Drawings

NO	TITLE	DWG No.
1	High-pressure Check Valve	111124-01-114-04 (Rev.A)
2	Type Approval Mark	111124-01-114-07 (Rev.A)

NO.	DESCRIPTION	MATERIAL	Q'TY	REMARK
1	INNET BODY	SS 316	1	
2	OUTLET BODY	SS 316	1	
3	POPPET	SS 316+ EPDM	1	
4	POPPET STOPPER	SS 316	1	
5	O-RING	EPDM	1	
6	PACKING	PTFE	1	
7	SPRING	SS 304	1	



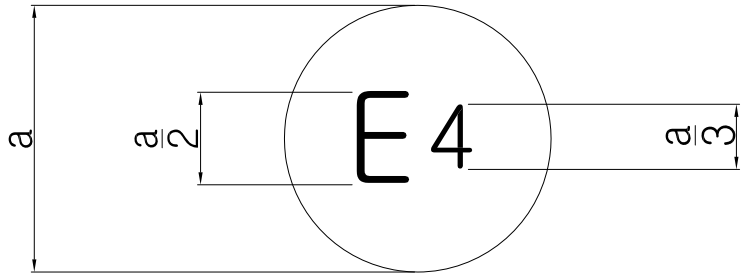
Unit : mm

PART NO.	END CONNECTION	L	H (HEX)	D	Q'TY	WORKING PRESSURE for ECE R110 TYPE	MAX WORKING PRESSURE
SHCV1-M4N-10P-N	1/4" MALE NPT	55.1	17.5	4.8	6 EA	260 bar	414 bar
SHCV2-M8N-10P-N	1/2" MALE NPT	69.3	26.9	7.8	6 EA	260 bar	414 bar
SHCV3-S12-10P-N	3/4" SUPERLOK	89.4	41.3	15	6 EA	260 bar	344 bar

Rev.	Issue Data	Description	Originator	Checked	Approved
A	24.NOV.11	Issued for Approval	C.S.RA	S.M.LEE	J.H.LIM

PURCHASER	
CLIENT	
PROJECT NAME	-
PROJECT NO.	-
PO. NO.	-
MFR. MODEL/TYPE VALVE NAME	SHCV SERIES HIGH PRESSURE CHECK VALVE
TAG NO.	-
DRAWING NO.	111124-01-114-04
GENERAL ARRANGEMENT DRAWING for VALVE	BMT Co., Ltd.

NO.	DESCRIPTION	MATERIAL	Q'TY	REMARK



Approval mark Drawing

110 R-XXXXXX

a ≥ 8mm

Rev.	Issue Data	Description	Originator	Checked	Approved
A	24.NOV.11	Issued for Approval	C.S.RA	S.M.LEE	J.H.LIM

PURCHASER	
CLIENT	
PROJECT NAME	-
PROJECT NO.	-
PO. NO.	-
MFR. MODEL/TYPE	-
VALVE NAME	-
TAG NO.	-
DRAWING NO.	111124-01-114-07

GENERAL ARRANGEMENT DRAWING for VALVE

BMT Co., Ltd.

Manufacturer: BMT CO., LTD

Component type: High-Pressure Check Valve SHCV Series

Test Report No IN110-A0-120036
Technical Report
Enclosure 2
Page 1 of 8

TÜV NORD Mobilität

RECORD OF TEST ON
CNG Check valve as regards to
Test and performance requirements, as per standard ECE R 110

0.1	Observer: Mr. M.S. Ogale Mr. Yeshwant Ambure	Place : ARAI, Pune and Praj Lab
0.2	Operator :- Mr. Dekate, ARAI Ashok Bhagat, Praj Lab	Test date:- May'2012-June'2012
0.3	Customer	BMT CO., LTD 21-1, Bukjeong-dong, Yangsan-si, Gyeongsangnam-do, 626-110 S.Korea
1.0	Component under test	High-pressure Check Valve SHCV1-M4N-10P-N and SHCV3-S12-25P-N
2.0	**Manufacturer's Specification**	
2.1	Trademark or Trade name	SUPERLOK T&S VALVES
2.2	Model name and number	High-pressure Check valve (SHCV Series) (SHCV1, SHCV2, SHCV3)
2.3	Manufacturers Specification	As attached at Enclosure 1
3.0	**Results of Tests**	
	General Requirements of standard	**Observations**
3.1	The materials constituting the non-return valve which are in contact with the CNG when operating, shall be compatible with the test CNG. In order to verify this compatibility the procedure described in Annex 5D shall be used.	Meets the Requirement Satisfactory
3.2	The non-return valve shall be so designed as to withstand a pressure of 1.5 times the working pressure (MPa) without leakage and deformation.	Meets the Requirement Satisfactory
3.3	The non-return valve shall be so designed as to be leak-proof (external) at a pressure of 1.5 times the working pressure (MPa) (see Annex 5B).	Meets the Requirement Satisfactory

3.4	The non-return valve, being in the normal position of use specified by the manufacturer, is submitted to 20,000 operations; then it is deactivated. The non-return valve shall remain leak-proof (external) at a pressure of 1.5 times the working pressure (MPa) (see Annex 5B).	Meets the Requirement Satisfactory
3.5	The non-return valve shall be so designed to operate at temperatures as specified in Annex 5O.	Meets the Requirement Satisfactory
3.6	The non-return valve has to comply with the test procedures for the Class component determined according to the scheme in Figure 1-1 of paragraph 2 of this Regulation.	Meets the Requirement Satisfactory

4.0	**Specific test requirements**	
4.1	**Overpressure Test:**	
	A CNG containing component shall withstand without any visible evidence of rupture or permanent distortion a hydraulic pressure of 1.5 times the working pressure (MPa) during minimal 3 minutes at room temperature with the outlet of the high-pressure part plugged. Water or any other suitable hydraulic fluid may be used as a test medium.	**Observations:** Water used as test medium. No leakage observed at 1.5 times working pressure of 390 bar Meets the Requirement Satisfactory

Class	Working pressure	Test pressure
Class 0	3000<P<2 6000	1.5times working pressure

1. Working pressure: 260 bar
2. Test Pressure: 390 bar

4.2	**EXTERNAL LEAKAGE TEST**
	A component shall be free from leakage through stem or body seals or other joints, and shall not show evidence of porosity in casting when tested as described in the tests below.
	The test shall be performed at the following conditions: (a) at room temperature at pressure of 390 bar (b) at the minimum operating temperature: -40°C at pressure of 390 bar (c) at the maximum operating temperature: +120°C at pressure of 390 bar

	Equipment under test will be connected to a source of aerostatic pressure. An automatic valve and a pressure gauge having a pressure range of not less than 1.5 times nor more than 2 times the test pressure is to be installed in the pressure supply piping. The sample is subjected to the gas pressure equal to working pressure. The sample should be submerged in water to detect leakage or any other equivalent test method Test carried out under following conditions	
	Requirements: The external leakage must be lower than the requirements stated in the annexes or if no requirements are mentioned the external leakage shall be lower than 15 cm3 /hour.	
4.2.1	**Room temperature test**	
	Requirements: A CNG containing component shall not leak more than 15 cm3/hour with the outlet plugged when submitted to a gas pressure, at room temperature	**Observations:** No Leakage Observed. Meets the Requirement Satisfactory
4.2.2	**Maximum operating temperature test**	
	Requirements: A CNG containing component shall not leak more than 15 cm3/hour with the outlet plugged when submitted to a gas pressure at the maximum operating temp of 120°C, after conditioning the component for 8 hours at 120°C	**Observations:** No Leakage Observed. Meets the Requirement Satisfactory
4.2.3	**Minimum operating temperature test**	
	Requirements: A CNG containing component shall not leak more than 15 cm3/hour with the outlet plugged when submitted to a gas pressure, at the minimum operating temp of -40°C , after conditioning the component for 8 hours at -40°C	**Observations:** No Leakage Observed. Meets the Requirement Satisfactory

4.3	**Internal Leakage test**
	The seat of the valves, when in the closed position, shall be free from leakage at any aerostatic pressure between 0 to 1.5 times the working pressure (kPa). The internal leakage tests are conducted with the inlet of the sample valve connected to a source of aerostatic pressure, the valve in the closed position, and with the outlet open. An automatic valve and a pressure gauge having a pressure range of not less than 1.5 times nor more than 2 times the test pressure is to be installed in the pressure supply piping. The pressure gauge is to be installed between the automatic valve and the sample under test. While under the applied test pressure, observations for leakage are to be made with the open outlet submerged in water unless otherwise indicated.

	Test Condition: Test Pressure: 390 bar	**Observations:** No Leakage observed. Meets the Requirement Satisfactory

4.4	**Durability Test**	
	The component shall be connected to a source of pressurized dry air or nitrogen by means of a suitable fitting and subjected to the number of cycles specified for that specific component. A cycle shall consist of one opening and one closing of the component within a period of not less than 10±2 seconds.	
4.4.1	**Room temperature cycling:**	
	Requirements: The component shall be operated through 96 percent of the total cycles at room temperature and at rated service pressure. During the off cycle the downstream pressure of the test fixture should be allowed to decay to 50 per cent of the test pressure. After that, the components shall comply with the leakage test of Annex 5B at room temperature. It is allowed to interrupt this part of the test at 20 per cent intervals for leakage testing.	**Observations:** No leakage Observed Meets the requirement Satisfactory
4.4.2	**High temperature cycling:**	
	Requirements: The component shall be operated through 2 percent of the total cycles at the appropriate maximum temperature specified at rated service pressure. The component shall comply with the leakage test of Annex 5B at the appropriate maximum temperature at the completion of the high temperature cycles.	**Observations:** No leakage Observed Meets the requirement Satisfactory
4.4.3	**Low temperature cycling:**	
	Requirements: The component shall be operated through 2 per cent of the total cycles at the appropriate minimum temperature specified at rated service pressure. The component shall comply with the leakage test of Annex 5B at the appropriate minimum temperature specified at the completion of the low temperature cycles.	**Observations:** No leakage Observed Meets the requirement Satisfactory

4.5 CNG Compatibility Test

A synthetic part in contact with CNG shall not show excessive volume change or loss of weight. Resistance to n-pentane according to ISO 1817 with the following conditions:
(a) medium: n-pentane
(b) temperature: 23 °C (tolerance acc. to ISO 1817)
(c) immersion period: 72 hours

Requirements:
maximum change in volume 20 percent After storage in air with a temperature of 40 °C for a period of 48 hours the mass compared to the original value may not decrease more than 5 percent.

Observations:

Sr. No.	Sample Identification Mark	Change in Volume in %		Change in Mass in %		Remark
		Specified Value	Observed Value	Specified Value	Observed Value	
1	PTFE	20 Max.	0.06	- 5 % Max	-0.2	OK
2	PEEK	20 Max	0.07	- 5 % Max	-0.01	OK
3	'O' ring	20 Max	2.5	- 5 % Max	- 3.48	OK

Meets the requirements
Satisfactory

4.6 CORROSION RESISTANCE TEST

4.6.1 **Requirements:**
A metal CNG containing component shall comply with the leakage tests, after submitting it to 144 hours salt spray test with all connections closed. Solution: 5% NaCl in 95% distilled water by weight. External leakage test carried out at room temp/ at 120°C / at -40°C and internal leakage test carried out at room temperature

Observation: No corrosion observed
Meets the Requirement
Satisfactory

4.6.2 **External leakage test after corrosion resistance test**

Test Conditions	Room Temp	Low Temp	High Temp
	30° C at 390 bar	-40° C at 390 bar	+120°C at 390 bar
Observations	**No Leakage Observed**	**No Leakage Observed**	**No Leakage Observed**
	Meets the Requirement Satisfactory		

4.6.2 **Internal Leakage Test after corrosion resistance test**

Internal Leak test at room temperature as per Annex 5C

Observations: No leakage observed.
Meets the requirements
Satisfactory.

4.7 Resistance to dry heat

1. The test has to be done in compliance with ISO 188. The test piece has to be exposed to air at a temperature equal to the maximum operating temperature for 168 hours.
2. The allowable change in tensile strength should not exceed 25 per cent. The allowable change in ultimate elongation shall not exceed the following values:
-Maximum increase 10 per cent
-Maximum decrease 30 per cent

Observations:

Sr. No.	Sample	Change in Tensile strength in %		Change in elongation %		Remark
		Specified Value	Observed Value	Specified Value	Observed Value	
1	PTFE	+25 Max	9.20	+10 -30	-0.64	OK
2	PEEK		2.61		- 27.3	OK
3	O-Ring EPDM		12.37		-17.50	OK

Meets the requirements satisfactory

4.8 Temperature cyclic test

A non metallic part containing CNG shall comply with the leakage tests mentioned in Annexes 5B and 5C after having been submitted to 96 hours temperature cycle from the minimum operating temperature up to the maximum operating temperature with a cycle time of 120 minutes, under maximum working pressure

Observations:

4.8.1 External leakage test after temperature cyclic test

Test Conditions	Room Temp	Low Temp	High Temp
	30°C at 390 bar	-40° C at 390 bar	+120°C at 390 bar
Observations	**No Leakage observed**	**No Leakage Observed**	**No Leakage Observed**
	Meets the Requirement Satisfactory		

4.8.2 Internal Leakage Test after temperature cyclic test

Internal Leak test at room temperature as per Annex 5C	**Observations**: No leakage observed. Meets the requirements Satisfactory.

4.9	**Vibration Resistance:**			
	All components with moving parts shall remain undamaged, continue to operate, and comply with the component's leakage tests after 6 hours of vibration in accordance with the following test method. **Test method** The component shall be secured in an apparatus and vibrated for 2 hours at 17 Hz with an amplitude of 1.5 mm (0,06 in.) in each of three orientation axes. On completion of 6 hours of vibration the component shall comply with Annex 5C.		**Observations:** No Leakage observed. Meets the requirements. Satisfactory.	
4.9.1	**External leakage test**			
	Test Conditions	Room Temp	Low Temp	High Temp
		30° C at 390 bar	-40° C at 390 bar	+120°C at 390 bar
	Observations	**No Leakage Observed**	**No Leakage Observed**	**No Leakage Observed**
		Meets the Requirement Satisfactory		
4.9.2	**Internal Leakage Test**			
	Internal Leak test at room temperature as per Annex 5C		**Observations**: No leakage observed. Meets the requirements Satisfactory.	

5.8	**OZONE TEST**		
	Medium : Ozone	Duration: 72 Hours	Ref Standard: ISO 1431-1
	Test Temp: 40°C		
	Requirement of Standard		
	The test piece, which has to be stressed to 20 per cent elongation, shall be exposed to air at 40C with an ozone concentration of 50 parts per hundred million during 72 hours. No cracking of the test piece is allowed.		**Observation:** **No cracks observed at 10X Magnification.** **Satisfactory.**

4.10	**The operating temperatures of the Check Valve shall be classified as per the table given below**

ANNEX 5O – OPERATING TEMPERATURES

	Engine compartment	Assembled on the engine	On board
Moderate	- 20 ° C + 105 ° C	- 20 ° C + 120 ° C	- 20 ° C + 85 ° C
Cold	- 40 ° C + 105 ° C	- 40 ° C + 120 ° C	- 40 ° C + 85 ° C

Requirement:	**Observation:**
The Check Valve should meet operating temperature require as given in the table annex 5O	The High Pressure Check Valve Type: SHCV1-M4N-10P-N and SHCV3-S12-25P-N has the temperature range of -40°C to +120°C. The Check Valve meets the test requirements when subjected to all relevant tests with this temperature.

5.0	**Conclusion:** High-Pressure Check Valve SHCV Series as described in the information document as above meets the requirement of Regulation ECE R110.

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