

**Application Documents
for the Transport Licensing
of the Type B(U)F Package
Transport Cask GNS 16**

– Safety Analysis Report –

Part III

– Operation / Maintenance –



G N B

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List of Documents
Part III
- Operation/Maintenance -

for the Type B(U)F Package
Transport Cask

- GNS 16 -

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Amendments are marked by a vertical black line at the left margin.

U III - 1 GNB B 049/97 E, Rev. 3

- Operation and Maintenance Instructions for the Transport Cask GNS 16
in order to Satisfy the Transport Requirements

U III - 2 MV 32 E, Rev. 02

- Assembly Regulation for the Transport Cask - GNS 16 -

Test Procedure**U III - 3 PV 361/1 E, Rev. 3**

- Leak Test –Pressure-Change Measurement - GNS 16 -
Transport Requirements
together with
- **PV 361 E, Rev. 02**
Basic test procedure, Leak-Test, Pressure-Change procedure

U III - 4 PV 430/2 E, Rev. 00

- Dose-Rate Measurement, Transport Requirements - GNS 16 -
together with

- **PV 430, Rev. 00**
Basic test procedure, Dose-Rate-Measurment

U III - 5 PV 530/2 E, Rev. 00

- Contamination Measurement - GNS 16 -
together with

- **PV 530, Rev. 04**
Basic test procedure, Contamination Measurement

U III - 6 PV 730/2 E, Rev. 00

- Temperature Measurement, Transport Requirements - GNS 16 -
together with

- **PV 730, Rev.00**
Basic test procedure, Temperature Measurement, Transport
Requirements

U III - 7 PV 120, Index: b

- Periodic Inspections on Transport Casks
and Transport and Storage Casks for Radioactive
Materials which require a transport license

U III - 8 PV 25, Rev. 00

- Dye Penetration Test Procedure of Transport and Storage Casks
Annex II: Trunnions

U III - 9 PV 24, Rev. 02

- Test Procedure for Surface Tests

U III - 10 PV 111, Rev. 08

- Overload Test, Transport and Storage Cask, Trunnions and
Trunnion Bolt Joint

U III - 11 PV 112, Rev. 04

- OVERLOAD TEST, Cask Lids, Threaded Boreholes in Order to
Secure the Lid-Suspension Adapter

U III - 12 PV 117, Rev. 01

- Leak Test, Bubble Test

U III - 13 PV 19, Rev. 01

- Test Procedure for the Visual Inspection
of Transport and Storage Systems,
Appendix I, Rev. 0: "CASTOR Cask Body";
Appendix III, Rev. 0: "Sealing Barriers";
Appendix IV, Rev. 0: "Trunnions";
Appendix VI, Rev. 2: "Screws, screwbolts, nuts and other connecting
elements"

U III - 14 vacant

Work Regulations (AV)**U III - 15 AV 25, Rev.03**

- WORK REGULATIONS for the Verification of the Shielding Effect of Transport and Storage Casks for High-Level Radioactive Inventories

U III - 16 AV 28, Rev. "01"

- WORK REGULATIONS for the Verification of the Heat-Dissipation Capacity of Transport and Storage Casks for High-Level Radioactive Inventories

U III - 17 WKP No.: 510.060 - 01 E, Index: 02

- Plan for Periodic Inspections on a GNS 16 Transport Cask after 15 Transport Runs or, at the Latest, after 3 Years

U III - 18 WKP No.: 510.060 - 02 E, Index: 04

- Plan for Periodic Inspections on a GNS 16 Transport Cask after 60 Transport Runs or, at the Latest, after 6 Years

U III - 19 WKP No.:510.060 - 04 E, Index: 01

- Plan for Periodic Inspections on Shock Absorbers of a GNS 16 Transport Cask after 15 Transport Runs or, at the Latest, after 3 Years - at the Earliest, prior to the Next Transport Run

U III - 20 AV 45, Rev . 00

- Visual Inspection and Treatment of Seal Surfaces for Elastomer-/Metal Sealings

U III - 21 AV 56, Rev. "1"

- WORK REGULATIONS
Treatment of Metal Sealings and Seal Surfaces of Transport and Storage Casks prior to Loading

○ Document is enclosed

■ Document is not specific to the model
and has already been submitted

U III - 22 AA 28, Rev. 4

■ WORK REGULATIONS Decontamination of Transport and Storage Casks
for Spent Fuel Elements

☐ Document is enclosed

☒ Document is not specific to the model
and has already been submitted

**Operation and Maintenance Instructions
for the Transport Cask
- GNS 16 -
in Order to Satisfy the
Transport Requirements**

Report No.: GNB B 049/97 E

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This report is a translation of the German report GNB B 049/97. The information in the original German version applies in cases of doubt.

Document Revisions

<u>Revision No.</u>	<u>Date</u>	<u>Author</u>	<u>Explanation of the Amendment</u>
0	17.06.1997	Crefeld	First issue
01	23.03.1998	Crefeld	Consideration of BAM remarks
2	19.02.1999	Crefeld	Change titel PV 361/1 Page 10: D 3 "Dismantle sealing bolts" removed Assembling and disassembly of the threaded rods (Item 86) escape general "Dry-Loading" work steps B 5 – D 13 complete revised

Amendments are indicated by a vertical line at the left margin.

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1 Purpose and Area of Application

These instructions include the work steps which must be taken in a nuclear facility on the basis of the requirements of the protection objectives with regard to the transport requirement during the checking of the transport cask - GNS 16 - for a transport run on public transport routes.

2 Terms and Abbreviations

Approval holder:	Organisation which is registered at the Federal Office for Radiation Protection (BfS) as the holder of the transport approval for the transport cask which is subject to approval (see approval certificate).
BWA:	Operation and maintenance instructions
FR:	Research reactor
MV:	Assembly Regulation
PV:	Test procedure
Tr.:	Carrier
AA:	Work instructions

3 General Requirements and Remarks

- (1) Prior to transport on public transport routes, the cask must be put into the condition on which the approval is based.
The holder of the transport approval must take appropriate measures to ensure that the preparation of the cask for transportation is performed in accordance with these operation and maintenance instructions (see also § 9 of GGVS).
- (2) The item numbers specified in the text for the individual components relate to the GNB drawing no.:

510.060-01
Transport Cask - GNS 16 -

and to the GNB parts list no.:

510.060-01/1
Transport Cask - GNS 16 -

- (3) All the drawings, PV, MV and AA quoted in the BWA must correspond to the revision status on which the applicable package-design approval is based. The revision status of the drawings is shown in the parts list (see type list in the approval certificate) and the revision status of the PV, MV and AA is shown in the list of documents in Part III (Operation/Maintenance) according to the applicable approval certificate.

Documents other than those listed in the list of documents in Part III Operation/Maintenance (quoted in the approval certificate) may also be used instead in so far as they fulfil the following prerequisites:

- All the documents must guarantee that the criteria of the transport requirements can be checked. The criteria to be complied with must be specified.
 - Documents specific to the facility may be used in so far as GNS has given its written agreement to their application.
 - The documents drafted by GNS and/or GNB must have been approved by BAM.
- (4) The work steps in these BWA must be incorporated, without any contradictions, into the specific step-sequence plans of the nuclear facilities where the cask is checked for transport.
- (5) All the tools must be in such a condition that the cask can be checked and maintained in accordance with the specifications. Those tools and measuring equipment which are subject to calibration must have a valid calibration certificate. The identification numbers of the tools and of the calibrated measuring equipment must be entered in the record.
- (6) Prior to use, all the components must be subjected to at least one visual inspection. Those components which exhibit damage must be replaced with intact components with identical specifications or, while complying with approved regulations, must be put into the condition stipulated in the specifications. After the replacement of components, acceptance tests (e.g. overload test and leak test) must be repeated if necessary. In principle, any replaced components, together with their identification numbers, must be recorded in the cask-accompanying book. (log-book)

- (7) It is recommended to use special equipment, such as an anti-contamination shirt and sealing bolts for threaded blind holes in the cask body, during the handling process (wet loading). The use of this auxiliary equipment must be checked in connection with the specific outline conditions of the nuclear facility.
- (8) Depending on the application, the cask may be subject to more stringent requirements than those defined in order to satisfy transport requirements, e.g. with regard to shielding and leak tightness. If necessary, such requirements must be incorporated into the step-sequence plans specific to the facility.
- (9) Both "wet loading" and "dry loading" are planned for the GNS 16. The dry loading is carried out using a mobile loading aid.

The work steps for the two loading variations are basically the same. However, in order to improve clarity, separate descriptions have been drawn up for the work steps required in each case.

All the works steps for operation and maintenance prior to a transport run on public roads in the case of wet loading in a dispatching nuclear facility are described in Section 5.

In the reverse order, these instructions are also applicable to the unloading of a cask under water.

In the case of wet unloading, recooling must if applicable be carried out before unloading. Should recooling become necessary, corresponding equipment and the accompanying documents must be made available at an early stage. Before a possible recooling, the pressure of the inner cask area can be compensated by means of the quick closure coupling (SVK) and a gas sample taken as the case may be.

All the works steps for operation and maintenance prior to a transport run on public roads in the case of dry loading using a mobile loading aid in a dispatching nuclear facility are described in Section 6.

In the reverse order, these instructions are also applicable to the unloading of a cask using this mobile loading aid.

These operation and maintenance instructions must be applied analogously to the transport of the cask on public transport routes after unloading.

- (10) After 162 transports the trunnions and the trunnion bolts are to be exchanged. For this, it is assumed that per transport 40 crane handlings take place. For this purpose, a record is to be maintained concerning each crane handling. The handlings performed within the scope of periodic inspections are to be considered as one transport and are to be documented. The documentation of the crane handlings as well as the trunnion exchange is to be enclosed in the Cask log book.

4 Fundamental Documents

Assembly drawing, transport cask – GNS 16 –

- GNB drawing no. 510.060 – 01
- GNB parts list no. 510.060 – 01/1

Cask-accompanying book (log book)

Transport papers

Test Procedures

GNB PV 430/2 E	Dose-Rate Measurement,
	Transport Requirements - GNS 16 -
GNB PV 730/2 E	Temperature Measurement,
	Transport Requirements - GNS 16 -
GNB PV 530/2 E	Contamination Measurement - GNS 16 -
GNS PV 361/1 E	Leak Test, - Pressure change procedure
	- GNS 16 – Transport requirements

Assembly Regulation

GNB MV 32 E	Assembly Regulation for the Transport
	Cask - GNS 16 -

5 Description of the Work Steps for "Wet-Loading" Handling Prior to a Transport Run on Public Roads (x = Responsible for Execution)

No.	Description	Specification	Record	Tr.	FR
A	Acceptance of the unloaded cask				
A 1	Transfer of the transport unit with the unloaded cask and of the accompanying papers			x	x ¹
A 2 ¹	Visual inspection of the transport unit and of the cask for damage and soiling				x ¹
A 3	Removal of the hexagon nuts (Item 82) and of the attachment stops (Item 96) from the load bearers of the impact limiter lid side, taking off of the impact limiter lid side (Item 90), taking out of the GNS 16				x ¹
A 4 ^{2,3}	Take dose-rate measurements on the cask	PV 430/2 E			x ¹
A 5 ^{2,3}	Take contamination measurements on the cask	PV 530/2 E			x ¹
A 6	Visual inspection of the cask surface as well as of the trunnions and of the trunnion-bolt seal for damage				x ¹

B	Preparation of the cask for loading				
B 1	Dismounting of the protective plate (Item 80)				x
B 1.1	Visual inspection of the threaded bore holes on the top side of the protective plate in order to secure the load attachment tackle prior to dismounting the protective plate				x
B 1.2	Prior to lifting off the protective plate, screw in three M12 eye bolts and take off the protective plate				x
B 1.3	Visual inspection of the dismantled protective plate for soiling, damage and general condition				x
B 1.4	Check the threaded blind holes for the cap screws (Item 84) in the protective plate for soiling and if necessary clean them by means of wet and/or dry vacuum cleaners				x
B 2	Removal of the primary lid (Item 20)				x
B 2.1	Visual inspection of the threaded blind holes on the top side of the primary lid in order to secure the load attachment tackle prior to removal of the protective plate				x
B 2.2	Before taking off the primary lid, screw in three guide bolts and remove primary lid				x

¹ Applicable to acceptance in a nuclear facility² Data for information, not relevant to transport requirement³ Not applicable to brand-new, unloaded casks

No.	Description	Specification	Record	Tr.	FR
B 2.3	Check sealing surface of the primary lid in the cask body for soiling and clean if necessary Check the threaded blind holes for the cap screws/plumbing screws (Items 32/34) in the cask body for soiling and if necessary clean them by means of wet and/or dry vacuum cleaners				x
B 2.4	Put on sealing surface protection for the primary lid seat and mount cords				x
B 2.5	Visual inspection for soiling, damage and overall condition - of the removed primary lid (Item 20) - of the removed cap screws/plumbing screws (Item 32/34) - of the threaded grooves for the O-rings (Item 42) in the primary lid				x
B 2.6	Visual inspection of the O-rings (Item 42), replace if necessary				x
B. 2.7	Remove screw plugs (Item 26) at test connections "A1" and "A2", inspect the O-rings (Item 74) visually for damage and replace if necessary				x
B 3	Removal of the closure lid (Item 28) from the primary lid (Item 20)				x
B 3.1	Visual inspection for soiling, damage and overall condition - of the removed closure lid (Item 28) - of the removed cap screws (Item 37) - of the threaded blind holes for cap screws in the primary lid (Item 20)				x
B 3.2	Visual inspection of the sealing grooves for the O-rings (Items 46/48) in the closure lid and of the relevant sealing surface on the primary lid for soiling and damage				x
B 3.3	Visual inspection of the O-rings (Items 46/48). Replace seals if necessary				x
B 4	Removal of the blind plug (Item 24) from the primary lid (Item 20)				x
B 4.1	Visual inspection of the O-ring (Item 40) in the removed blind plug. Replace seal if necessary				x
B 5	Basket (Item 15 or 16)				
B 5.1	Visual inspection of the basket and of the loading positions for soiling and damage				x

No.	Description	Specification	Record	Tr.	FR
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C	Loading				
C 1	Load the cask according to the loading plan. Comparison of the permissible contents according to the approval with the data of the elements provided for transport and confirmation of the contents according to the transport approval. In the loading plan, document the fuel-element numbers and the loading position in the basket	Approval certificate	Transport papers	x	x
C 2	Remove the sealing surface protection for the primary lid seat				x
C 3	Mount the primary lid (Item 20) under water while paying attention to the position of the orientation point (Item 108). Visual inspection of correct installation				x
C 4	Partially drain the cavity using the partial-drainage lance				x
C 5	Removal of the water from the threaded blind holes of the primary lid and of the cask body by suction				x

D	Mounting and leak test of the primary lid				
D 1	Prepare the cap screws/plumbing screws (Items 32/34) and the screw plugs (Item 26) for installation				x
D 2	Remove 3 guide bolts				x
D 3	Screw in the cap screws/plumbing screws (Items 32/34) and tighten with nominal starting torque (lid on block). The blocking dimension is shown in the manufacturing documentation of the cask	MV 32 E			x
D 4	Drain the sealing space via the testing connections "A1" and "A2"				x
D 5	Empty the inner cavity of the cask using the drainage lance				x
D 6	Installation of the blind plug (Item 24) in the primary lid				x
D 7	Carry out the leak test on the O-rings (Item 42) in the primary lid	MV 32 E PV 361/1 E	Transport papers		x
D 8	Insert the screw plugs (Item 26) with the O-rings (Item 74) at the testing connections "A1" and "A2"	MV 32 E			x
D 9	Check the sealing surface of the closure lid (Item 28) in the primary lid for soiling clean if necessary.				x
D 10	Prepare the cap screws (Item 37) for installation.				x

No.	Description	Specification	Record	Tr.	FR
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D 11	Insert the closure lid (Item 28) into the primary lid while paying attention to the position according to the marks	MV 32PV 361/1 E			x
D 12	Tighten the cap screws (Item 37) of the closure lid (Item 28) to the nominal starting torque	MV 32 E			x
D 13	Carry out the leak test on the O-rings (Items 46/48) in the closure lid (Item 28)	PV 361/1 E	Transport papers		x

E	Putting on of the protective plate (Item 80)				
E 1	Inspect the sealing surface of the protective plate for soiling and clean if necessary				x
E 2	Visual inspection of the sealing ring (Item 85). Replace seal if necessary				x
E 3	After putting on the protective plate, remove three M12 eye bolts				x
E 4	Screw in cap screws (Item 84) and tighten with nominal starting torque	MV 32 E			x

F	Preparation of the Cask for Transport				
F 1	Take contamination measurements on the cask	PV 530/2 E	Transport- papers	x	x
F 2	Take dose-rate measurements on the cask	PV 430/2 E	Transport- papers	x	x
F 3	Insertion of the GNS 16 into the impact limiter bottom side (Item 95), mounting of the impact limiter lid side (Item 90), tightening of the hexagon nuts (Item 82), mounting of the attachment stops (Item 96) onto the load bearers of the impact limiter on the cover side	MV 32 E		x	x
F 4	Closing of the 20' transport container; if necessary, checking of the functional capacity of the vents			x	x
F 5	Take temperature measurements on the outer surfaces of the 20' transport container	PV 730/2 E	Transport- papers	x	x
F 6	Take dose-rate measurements on the outer surfaces of the 20' transport container	PV 430/2 E	Transport- papers	x	x
F 7	Carry out the labelling of the transport unit taking account of the dose rate measured		Transport- papers	x	x
F 8	Draft the transport papers and issue the release for departure		Transport- papers	x	x

6 Description of the Work Steps for "Dry-Loading" Handling Prior to a Transport Run on Public Roads (x = Responsible for Execution)

No.	Description	Specification	Record	Tr.	FR
A	Acceptance of the unloaded cask				
A 1	Transfer of the transport unit with the unloaded cask and of the accompanying papers			x	x ¹
A 2 ¹	Visual inspection of the transport unit and of the cask for damage and soiling				x ¹
A 3	Removal of the hexagon nuts (Item 82) and of the attachment stops (Item 96) from the load bearers of the impact limiter lid side, taking off of the impact limiter lid side (Item 90), taking out of the GNS 16				x ¹
A 4 ^{2,3}	Take dose-rate measurements on the cask	PV 430/2 E			x ¹
A 5 ^{2,3}	Take contamination measurements on the cask	PV 530/2 E			x ¹
A 6	Visual inspection of the cask surface as well as of the trunnions and of the trunnion-bolt seal for damage				x ¹

B	Preparation of the cask for loading				
B 1	Dismounting of the protective plate (Item 80)				x
B 1.1	Visual inspection of the threaded bore holes on the top side of the protective plate in order to secure the load attachment tackle prior to dismounting the protective plate				x
B 1.2	Prior to lifting off the protective plate, screw in three M12 eye bolts and take off the protective plate				x
B 1.3	Visual inspection of the dismounted protective plate for soiling, damage and general condition				x
B 1.4	Check the threaded blind holes for the cap screws (Item 84) in the protective plate for soiling and if necessary clean them by means of wet and/or dry vacuum cleaners				x
B 2	Removal of the primary lid (Pos. 20)				x
B 2.1	Visual inspection of the threaded blind holes on the top side of the primary lid in order to secure the load attachment tackle prior to removal of the protective plate				x
B 2.2	Before taking off the primary lid, screw in three guide bolts and remove primary lid				x

¹ Applicable to acceptance in a nuclear facility.

² Data for information, not relevant to transport requirements

³ Not applicable to brand-new, unloaded casks.

No.	Description	Specification	Record	Tr.	FR
B 2.3	Check sealing surface of the primary lid in the cask body for soiling and clean if necessary Check the threaded blind holes for the cap screws/plumbing screws (Items 32/34) in the cask body for soiling and if necessary clean them by means of wet and/or dry vacuum cleaners				x
B 2.4	Put on sealing surface protection for the primary lid seat				x
B 2.5	Visual inspection for soiling, damage and overall condition - of the removed closure plate (Item 28) - of the removed cap screws (Item 37) - of the threaded blind holes for cap screws in the primary lid (Item 20)				x
B 2.6	Visual inspection of the O-rings, replace if necessary				x
B 2.7	Remove screw plugs (Item 26) at test connections "A1" and "A2", inspect the O-rings (Item 74) visually for damage and replace if necessary				x
B 3	Removal of the closure lid (Item 28) from the primary lid (Item 20)				x
B 3.1	Visual inspection for soiling, damage and overall condition - of the removed closure lid (Item 28) - of the removed cap screws (Item 37) - of the threaded blind holes for cap screws in the primary lid (Item 20)				x
B 3.2	Visual inspection of the sealing grooves for the O-rings (Items 46/48) in the closure lid and of the relevant sealing surface on the primary lid for soiling and damage				x
B 3.3	Visual inspection of the O-rings (Items 46/48). Replace seals if necessary				x
B 4	Removal of the blind plug (Item 24) from the primary lid (Item 20)				x
B 4.1	Visual examination of the O-ring (Item 40) in the removed blind plug. Replace seal if necessary				x
B5	Basket (Item 15 or 16)				
B 5.1	Visual inspection of the basket and of the loading positions for soiling and damage				x
B6	Sealing surface protection remove				x
B7	Mobile loading aid assemble				x

No.	Description	Specification	Report	Tr.	FR
C	Loading by means of a mobile loading aid ✓				
C 1	Load the cask according to the loading plan. Comparison of the permissible contents according to the approval with the data of the elements provided for transport and confirmation of the contents according to the transport approval. In the loading plan, document the fuel-element numbers and the loading position in the basket ✓	Approval certificate	Transport papers	x	x
C 2	Mobile watertank assemble ✓				x
C 3	Mobile loading aid disassemble ✓				x
C 4	Mount the primary lid (Item 20) under water while paying attention to the position of the orientation point (Item 108). Visual inspection of correct installation ✓				x
C 5	Mobile watertank disassemble ✓				x
C 6	Partially drain the cavity using the partial-drainage lance				x
C 7	Removal of the water from the threaded blind holes of the primary lid and of the cask body by suction				x

D	Mounting and leak test of the primary lid				
D 1	Prepare the cap screws/plumbing screws (Items 32/34) and the screw plugs (Item 26) for installation				x
D 2	Remove 3 guide bolts				x
D 3	Screw in the cap screws/plumbing screws (Items 32/34) and tighten with nominal starting torque (lid on block). The blocking dimension is shown in the manufacturing documentation of the cask				x
D 4	Drain the sealing space via the testing connections "A1" and "A2"				x
D 5	Empty the inner cavity of the cask using the drainage lance				x
D 6	Installation of the blind plug (Item 24) in the primary lid				x
D 7	Carry out the leak test on the O-rings (Item 42) in the primary lid	MV 32 E PV 361/1 E	Transport papers		x
D 8	Insert the screw plugs (Item 26) with the O-rings (Item 74) at the testing connections "A1" and "A2"	MV 32 E			x
D 9	Check the sealing surface of the closure lid (Item 28) in the primary lid for soiling clean if necessary.				x
D 10	Prepare the cap screws (Item 37) for installation.				x
D 11	Insert the closure lid (Item 28) into the primary lid while paying attention to the position according to the marks	MV 32PV 361/1 E			x
D 12	Tighten the cap screws (Item 37) of the closure lid (Item 28) to the nominal starting torque	MV 32 E			x
D 13	Carry out the leak test on the O-rings (Items 46/48) in the closure lid (Item 28)	PV 361/1 E	Transport papers		x

No.	Description	Specification	Record	Tr.	FR
E	Putting on of the protective plate (Item 80)				
E 1	Inspect the sealing surface of the protective plate for soiling and clean if necessary				x
E 2	Visual inspection of the sealing ring (Item 85). Replace seal if necessary				x
E 3	After putting on the protective plate, remove three M12 eye bolts				x
E 4	Screw in cap screws (Item 84) and tighten with nominal starting torque	MV 32 E			x

F	Preparation of the Cask for Transport				
F 1	Take contamination measurements on the cask	PV 530/2 E	Transport-papers	x	x
F 2	Take dose-rate measurements on the cask	PV 430/2 E	Transport-papers	x	x
F 3	Insertion of the GNS 16 into the impact limiter bottom side (Item 95), insertion of the threaded rods (Item 86), mounting of the impact limiter lid side (Item 90), tightening of the hexagon nuts (Item 82), mounting of the attachment stops (Item 96) onto the load bearers of the impact limiter cover side	MV 32 E		x	x
F 4	Closing of the 20' transport container; if necessary, checking of the functional capacity of the vents			x	x
F 5	Take temperature measurements on the surface of the 20' transport container	PV 730/2 E	Transport-papers	x	x
F 6	Take dose-rate measurements on the surface of the 20' transport container	PV 430/2 E	Transport-papers	x	x
F 7	Carry out the labelling of the transport unit taking account of the dose rate measured		Transport-papers	x	x
F 8	Draft the transport papers and issue the release for departure		Transport-papers	x	x

ASSEMBLY REGULATION

MV 32 E


for the transport cask

GNS 16

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Date of issue : 22.02.01

	Name	Date	Signature
Author :	Niehaus	22.02.01	
Check by techn. dept. :	Weiß	01.03.01	
Check by TZQ :	Kupferschmidt	05.03.01	
Released by GNB :	Diersch	12.03.01	
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(if required)			

Translation approved : Weiß, GNB-EBA 18.04.01 
Bau

This report is a translation of the German Assembly Regulations MV 32 "02".
The information in the original German version applies in cases of doubt.

REVISION STATUS

Revision	Date	Author	Explanation of change
00	22.08.97	M. Weiß	First edition
01	24.04.98	M. Weiß	Annex 1 Tightening torque Pos. 37 changed
02	22.02.01	C. Niehaus	Editorial changes Supplement concerning the reduction of the tightening torques at assembled casks Annex 1: modification of the tightening torques

Alterations to the previous version of this report are marked by a vertical black line at the left margin of the text.

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1 Purpose

These assembly regulation describes the cask-specific features of the transport cask GNS 16, which are to be observed for the assembly and dismantling of cask components as part of the commissioning inspection, handling during loading and unloading and the periodic inspections (WKPs). Moreover, these assembly regulations provide an overview of the cask-specific features to be allowed for if this is not specially regulated in other approved documents. The assembly regulation is intended to ensure the proper assembly and dismantling of the components of the cask closure system and the trunnions so that the cask is in an operable condition defined in accordance with its licence.

2 Scope of application

This assembly regulation applies to the transport cask GNS 16.

The item numbers of the individual components mentioned in these regulations relate to the drawing No.:

510 . 060 - 01

and to the parts list:

510 . 060 - 01 / 1 / 7/

This assembly regulation does not replace the provisions in the test regulations to be applied, WKP plans and operating and maintenance instructions but is an aid in the implementation of these instructions. In this context this assembly regulation is to be used for commissioning inspections, during loading and unloading and for the periodic inspections (WKPs) of the transport cask GNS 16. Furthermore, the provisions in the master documents (test regulations, operating and maintenance instructions, FPPs and WKP plans) apply.

These assembly regulation is to be applied when using the following regulations and instructions:

Test regulation PV 120 /4/ Periodic inspections on transport casks and transport and storage casks for radioactive materials which are subject to approval.

GNB B 049/97 /8/ Operating and maintenance instruction for the transport cask GNS 16 to satisfy the requirements under traffic law

3 Terms and symbols

FPP	:	Fabrication and test plan
KS	:	Classification level as per TRV006
KTA	:	Nuclear Technology Committee
MV	:	Assembly regulation
Item	:	Item No.
PV	:	Test regulation
QR	:	Quality guideline
SVK	:	Quick connection plug
SW	:	Wrench size
WKP	:	Periodic inspections

4 Areas of responsibility

Unless other statements have been made in master documents (inspection regulations, operating and maintenance instruction, FPPs, WKP plans and plant-specific approval documents), these assembly regulation is binding on all people and departments charged with the production, handling and maintenance of the casks of the type GNS 16.

5 Cask features

5.1 Designations of the cask components

The PV 120 /4/ to be used for the WKP's describes the inspections, irrespective of the cask type, of the major cask components. The following definitions show the assignment of the general component designations used in the PV to the applicable item designations and item numbers according to the parts list 510.060-01/1 for the transport cask GNS 16.

Component designation in the PV 120	Item	Item designation as per parts list
Cask body	2	Cask body
Cask lid	20	Primary lid (for item 2)
Closure of the cask openings	28	Closure lid (for item 20)
Cask lid bolt	32	Cap screw (for item 20)
Cask lid bolt	34	Plumbing screw (for item 20)
Cask lid bolt	37	Cap screw (for item 28)
Trunnion	12	Trunnion (for item 2)
Trunnion bolt	13	Cap screw (for item 12)
Elastomer seal	42	O-ring (for item 20)
Elastomer seal	46	O-ring (for item 28)

Component designation in the PV 120	Item	Item designation as per parts list
Elastomer seal	48	O-ring (for item 28)
Shock absorber	90	Impact limiter lid side (for item 2)
Shock absorber	95	Impact limiter bottom side (for item 2)
Bolt elements of the shock absorbers	82	Hexagon nut with collar (for item 86)
Bolt elements of the shock absorbers	86	Threaded rod (for items 90, 95)

5.2 Tightening torques and screw sizes

The dimensions indicated in the following table are to be observed for inspecting the cask lid and trunnion screws:

Item	Item designation	Thread size	Wrench size
13	Cap screw (for item 12)	M20	17
32	Cap screw (for item 20)	M30	22
34	Plumbing screw (for item 20)	M30	22
37	Cap screw (for item 28)	M16	14

In the periodic inspections (WKPs) the relevant tapped bores in the cask body and the cask lids are also to be inspected in addition to the above components.

The necessary screw pre-load force is generally applied by manual assembly using torque wrenches. The required screw pre-load is generated by a defined and measurable torque.

The screw tightening torques to be used for the assembly of the cask components of the GNS 16 are defined in Annex 1. They apply exclusively for the lubricants MOLYKOTE D21 and MOLYKOTE 321R.

The torque wrenches must permit reliable reading of the necessary tightening torques or be released at a tightening torque which can be set with adequate accuracy. If no lower values are set for the torque wrench type used (e.g. for manual torque tools according to DIN ISO 6789 /12/) the error limit for setting or reading must not exceed 4% of the torque to be applied. The torque wrenches used must be calibrated with the last calibration to be performed not longer than two years before. Furthermore, they have to be checked before use with a calibrated torquemeter with the last check to be performed not longer than 6 months before.

For all test and measuring devices the provisions of DIN EN ISO 9001 /11/, item 4.11 concerning the "Monitoring of Test Devices" have to be respected.

Several screws of the same type distributed on a pitch circle are to be tightened in at least four passes and the tightening torque applied in each case is to be graduated (reference values: 50%, 75% and twice 100%) and increased up to the value to be used in accordance with Annex 1. At 100% of the tightening torque as many passes are needed until no screw can be turned any more. In order to prevent canting of the lid or uneven tightening, the screws are to be tightened crosswise.

The screw elements are to be prepared for their use as follows:

- (1) Clean screw with cleaning agents and solvents approved for the nuclear sector.

- (2) Coat or spray thread and the underside of the heads with a lubricant approved by GNB.
- (3) If washers are used, they are also to be coated on both sides with lubricant using a brush.

For all screws lubricants confirmed by GNB have to be used which meet the following criteria:

- a) free of sulphur and halogen
- b) compatible with the leak tests (pressure modification method)
- c) compatible with the material pairings of the cask components
- d) The coefficients of friction for the existing material pairings must be known with their range of variation

The lubricants MOLYKOTE D21 and MOLYKOTE 321R comply with these conditions. The use of other lubricants requires the release in writing by GNB. The lubricants used have to be documented in the cask test book.

5.3 Check of the leak-tightness function

The elastomer seals items 42 and 46 are integral parts of the leak-tight containment. During the commissioning inspection, after a loading and at the periodic inspections (WKP) observance of the specified leak-tightness is to be verified. The vacuum-holding test required for this purpose, the test connections and the tightness requirements are described in the test regulation PV 361/1 /5/.

As part of the leak-tightness tests the sealing surfaces on the cask body, the cask lid and the closures of the cask openings are to be inspected visually for damage and contamination.

5.4 Load slinging points and overload test

As part of the mechanical design of the transport cask GNS 16 the load slinging points of the cask body and lid were designed in accordance with the KTA 3905 /1/. The following load slinging points are to be considered:

Load slinging point of	Item	Item designation as per parts list	Requirement as per KTA 3905
Cask body	12	Trunnion (for item 2)	increased (4.3)
Cask body	13	Cap screw (for item 12)	increased(4.3)
Primary lid	20	1 tapped bore M24 in the centre of the lid upper side	increased(4.3)

In the case of load slinging points with increased requirements (4.3) overload tests have to be conducted as part of the periodic inspections (WKPs) in accordance with KTA 3905.

The cask-specific details of the overload tests of the load slinging points of the GNS 16 are summarized in Annex 2. The performance of the overload tests is regulated in the text regulations PV 111 /2/ and PV 112 /3/.

5.5 Assembly of the trunnions

- Identification control and visual check according to PV 19, annex IV /9/ of the trunnions for damages
- Visual check of the tapped holes of the trunnion seat according to PV 19, annex IV /9/ and, if required, cleaning with thread brush and/or blow-off with compressed air.
- Visual check of the trunnion screws according to PV 19, annex VI /9/ and, if required, cleaning with brush and compressed air.
- Cleaning of the underside of the trunnion and of the cask-side contact surface of the trunnion according to AA-A-014 /10/ (surfaces must be free of grease).

- Positioning and assembly of the trunnions (see fig. 1)
- If not done already, identification of the trunnion positions, starting from the zero point of the cask body (see fig. 1)
- Lubrication of the screws and tapped holes according to paragr. 5.2
- If not done already, identification of the screws of the trunnion no. 1 with serial numbers (1 – 12). In analogy, the screws of the second trunnion have to be identified with the serial numbers (13 – 24).
- Tightening of the trunnion screws according to paragr. 5.2 to the desired tightening torque according to annex 1.

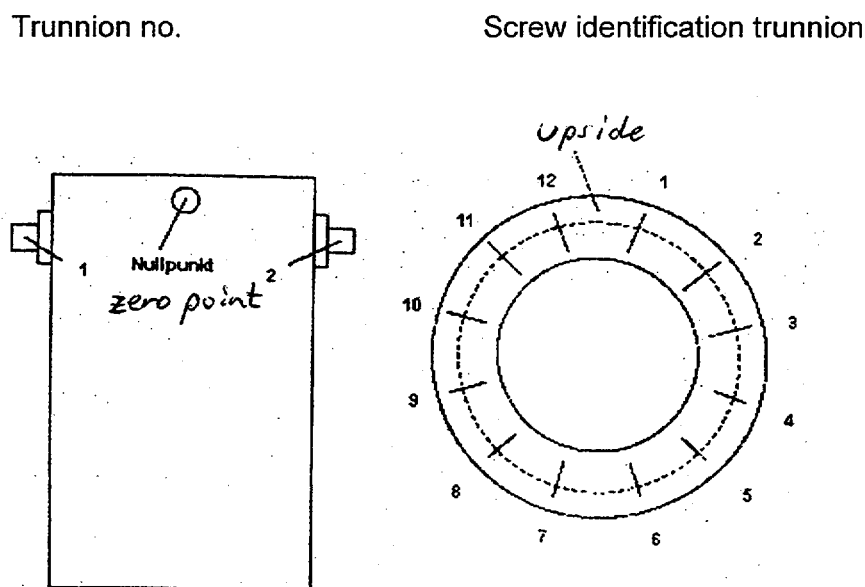


Fig. 1: Identification of the trunnions and of the trunnion screws

5.6 Reduction of the tightening torque at already assembled casks

For casks where the trunnion screws originally had been assembled and dismantled with a tightening torque of 250 Nm, the tightening torques have to be reduced to 150 Nm according to annex 1 at the latest before the next handling.

Here the following points have to be observed:

- To avoid a repetition of the overload test no more than 3 screws per trunnion regularly distributed over the perimeter may be untightened at the same time when the tightening torque is reduced.
- The untightening torques have to be checked. In the test book shall be documented that they are between 0.7 and 1.25 times of the original tightening torque.
- If the criterium is not fulfilled the following tests at the screw are required:
 - (i) visual check for damages according to PV 19 annex VI /9/
 - (ii) OR test (magnaflux test) according to PV 24 /6/
 - (iii) Gauge test for dimensional accuracy of the threadIf these tests are negative the screws can be used again.
- If more than 5 screws per trunnion are exchanged a repetition of the overload test is necessary.
- The working has to be executed by consulting the BAM or an expert appointed by them.
- A certificate about the successful completion of the working has to be taken into the the cask test book.

6 Revision service

The revision service for these assembly regulation is to be provided by the development department involved in consultation with the quality department in accordance with the procedures laid down in the QR-Q-001 - GNS documentation system.

The validity date indicated on the cover page "QR-Q001 F 02" when the last index was issued indicates when the changes of this assembly regulation (MV) came into force.

7 Distribution list

Direct distribution to the departments or subcontractors affected can be carried out on a case-to-case basis in consultation with the quality department.

9 Documents cited

- /1/ KTA 3905 Load slinging points on loads in nuclear power stations

- /2/ PV 111 Overload test transport and storage casks,
trunnions and trunnion screws

- /3/ PV 112 Overload test, cask lid,
tapped bores for attaching the lid tackle adapter

- /4/ PV120 Periodic inspections (WKP) on transport casks and transport
and storage casks for radioactive materials subject to approval

- /5/ PV 361/1 Test regulations for the performance of leak-tightness tests
Pressure rise measurements - GNS 16
Transport law

- /6/ PV 24 rev. 2 Test regulation for surface tests

- /7/ 510.060-01/1 Parts list transport cask GNS 16

- /8/ GNB B 049/97 Operating and maintenance instruction for the transport cask
GNS 16 in order to satisfy the requirements of traffic law

- /9/ PV 19 Test regulation for visual check of transport and storage sys-
tems
Annex IV Trunnions
Annex VI Screws, screw bolts, nuts and other connection ele-
ments

/10/ AA-A-014 Finish-cleaning of components

/11/ DIN ISO 9001 Quality management systems
Model for quality assurance (QM presentation in design, development, production, assembly and maintenance) August 1994

/12/ DIN ISO 6789 Screw tools, manual torque tools December 1993

* The valid revision status of the regulations to be applied (PV and AA) – if not indicated here – can be found in the reference list of part II, design or part III, operation/maintenance according to the valid approval certificate. Other regulations can be applied if the respective regulations of the operation and maintenance instructions (see valid approval certificate) are observed. The valid revision status of the parts lists can be found in the type list (annex to the valid approval certificate).

Annex 1 to the MV 32 - Assembly Regulation GNS 16

Tightening torques for assembly

Item	Designation	AS	Thread	Wrench size mm	Tightening torque Nm
-	-	-	mm	mm	
13	Cap screw (for item 12)	1	20	17	150*
14	Headless screw (for item 12)	3	8	4	15
26	Screw plug (for items 20, 28, 90, 95)	3	10	10	30
32	Cap screw (for item 20)	1	30	22	500*
34	Plumbing screw (for item 20)	1	30	22	500*
35	Guide bolt (for item 2)	3	24 , 20	24	50
37	Cap screw (for item 28)	1	16	14	60*
60	Quick connection plug (for item 20)	3	1/2"	27	60
82	Hexagonal nut with collar (for item 86)	2	48	75	100
84	Cap screw (for item 80)	3	16	14	100
86	Threaded rod (for items 90, 95)	2	G 1 1/2, 48	46	200

* in acc. with GNB B 091/2000 or GNB B 087/2000

The indicated torques apply exclusively with the use of Molykote D21 and Molykote 321R.

Annex 2 to the MV 32 - Assembly Regulation GNS 16

Masses and tightening torques for the overload test at load slinging points

(1) Trunnion (item 12), trunnion screws (item 13) and relevant screw-in threads

Max. handling mass G_H (on 2 trunnions):

$$G_H = 13\,080 \text{ kg}$$

Test mass G_p for trunnion screws and screw-in threads at static load:

$$G_p = 1.5 \times G_H = 19\,620 \text{ kg} \quad \text{chosen: } 20\,000 \text{ kg}$$

Torques trunnion screws item 13

Tightening torque : 150 Nm

Release torque 1 : $= 0.70 \times \text{tightening torque} = 105 \text{ Nm}$

Release torque 2 : $= 1.25 \times \text{tightening torque} = 187,5 \text{ Nm}$

(2) Primary lid

Mass $G_D = 1\,310 \text{ kg}$

Test mass G_p for static overload test

$$G_p = 1.5 \times G_D = 1\,965 \text{ kg} \quad \text{chosen: } 2\,000 \text{ kg}$$

Test mass for dynamic overload test

$$G_p = 1.25 \times G_D = 1\,638 \text{ kg} \quad \text{chosen: } 1\,700 \text{ kg}$$

Tightening torque for attachment bolt M24: 150 Nm

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PV 361/1 E

Leak Test

Pressure-Change Measurement

- GNS 16 -

Transport Requirements

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Name
Author : Stamprath
Approved GNS : Ilmer
Approved GNB : Weiß
Approval by TZQ :
Released by GNB :
Check mark external :

Translation approved : Dr. Holst GNS-BEP

This report is a translation of the German Leak Test Specification PV 361/1. The information in the original German version applies in cases of doubt.

**GNB**

Gesellschaft für Nuklear-Behälter mbH

REVISION STATUS

Revision	Date	Author	Explanation of the Amendment - if necessary, Indication of Pages
00	26.05.1997	Heumos	First issue
01	13.01.1998	Crefeld	Complete revision
02	27.11.1998	Greven	Changes in Sec. 2 Tests carried out as pressure drop measurement as well as pressure increase measurement in case of unloaded casks (see Sec. 3 and Sec. 6). Description of the condition of the cask (see Sec. 4) Definition of test gas (see Sec. 5). Definition of allowable standard leak rate as function of cask inventory (see Sec. 7). Changes in report form sheets Additions in Sec. 2 and 8. Text corrections.
03	04.03.1999	Stamprath	Description the steps for drying the space between seals, see Page 4.

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2	Responsibility	4
3	Type of Tests	4
4	Condition of the Cask	4
5	Test gas	5
6	Testing Sequence	5
7	Permissible Standard Leak Rates	5
8	Applicable documents	6

Annexes

Annex 1: Testing connections

PV 361/1 F01 "2": Test report pressure change test

PV 361/1 F02 "2": Measuring report pressure change test

PV 361/1 E "02" 03

Page 3 of 6

Approval by TZQ for the PV		Approval - External for the PV	
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1 Validity

This test procedure in accordance to the basic test procedure PV 361, is valid for transport cask GNS 16.

2 Responsibility

For execution and documentation of a leak test at the transport cask GNS 16 according to this test procedure only the authorized test person is responsible.

3 Type of Tests

The tests are based on pressure drop measuring. For unloaded dry casks (for checks during assembling or cask maintenance) it is possible to use pressure increase measurements instead of pressure drop measuring.

4 Condition of the Cask

Primary lid is bolted and peaced in lid housing.

Prior to leak testing of the primary lid seals (O-ring, Pos. 42 inner side and outer side) the cask cavity is partially dewatered and the space between seals (Proofconnections A1 and A2) are completely dewatered.

For leak testing of the primary lid seals of an unloaded cask (O-ring, Pos. 42 inner side and outer side) by means of pressure increase method, the cask cavity must be dry.

After loading under water the space between seals (Proofconnections A1 und A2) is of a pressure < 10 hPa to evacuated and sequentially for at least one hour further to evacuated. Trough this is the space between seals enough dry for the leak test.

During the leak test of the primary lid seals the cask cavity is in pressure equilibrium with the outer atmosphere.

The leak test of the primary lid seals is successfully finished before leak test of the closure lid seals (O-ring, Pos. 46 and 48) starts. The closure lid is mounted and placed in the lid housing.

Approval by TZQ for the PV		Approval - External for the PV	
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5 Test gas

For performance of pressure drop measurement Nitrogen or dry air can be used as test gas. Pressure increase measurement is compared to atmospheric pressure.

6 Testing Sequence

The increase in pressure or pressure drop must be measured at the testing connections A1 or A2 and C (see Table 1 and Annex 1) in accordance with chapter 7.1 and chapter 7.2 of the basic test procedure PV 361.

7 Permissible Standard Leak Rates

The permissible standard leak rates $Q_{ST,ZUL}$ are shown in Table 1.

Table 1: Data and Remarks about the Tests

Cask/ Inventory	Testing Connection	Seal(s) ¹⁾	$Q_{ST,ZUL}$ hPa · l · s ⁻¹	Testing Adapter ²⁾
Testing during cask assembling or maintenance (unloaded)	A1 or A2 Primary lid	O-ring (Pos. 42, inner and outer side)	$\leq 2,0 \text{ E-05}$	Adapter type SA
	C Closure lid	O-ring (Pos. 46 and 48)	$\leq 2,0 \text{ E-05}$	Adapter type SA
Cask loaded with intact fuel	A1 or A2 Primary lid	O-ring (Pos. 42, inner and outer side)	$\leq 1,0 \text{ E-04}$	Adapter type SA
	C Closure lid	O-ring (Pos. 46 and 48)	$\leq 1,0 \text{ E-04}$	Adapter type SA
Cask loaded with defective fuel	A1 or A2 Primary lid	O-ring (Pos. 42, inner and outer side)	$\leq 2,0 \text{ E-05}$	Adapter type SA
	C Closure lid	O-ring (Pos. 46 and 48)	$\leq 2,0 \text{ E-05}$	Adapter type SA

¹⁾ Assembly drawing, GNS 16 (GNB 510.060-01)

²⁾ See illustration in PV 361, Annex 4



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8 Applicable documents

PV 361 Basic test specification for leak tests according to pressure change method

PV 361/1 E "02" 03

Page 6 of 6

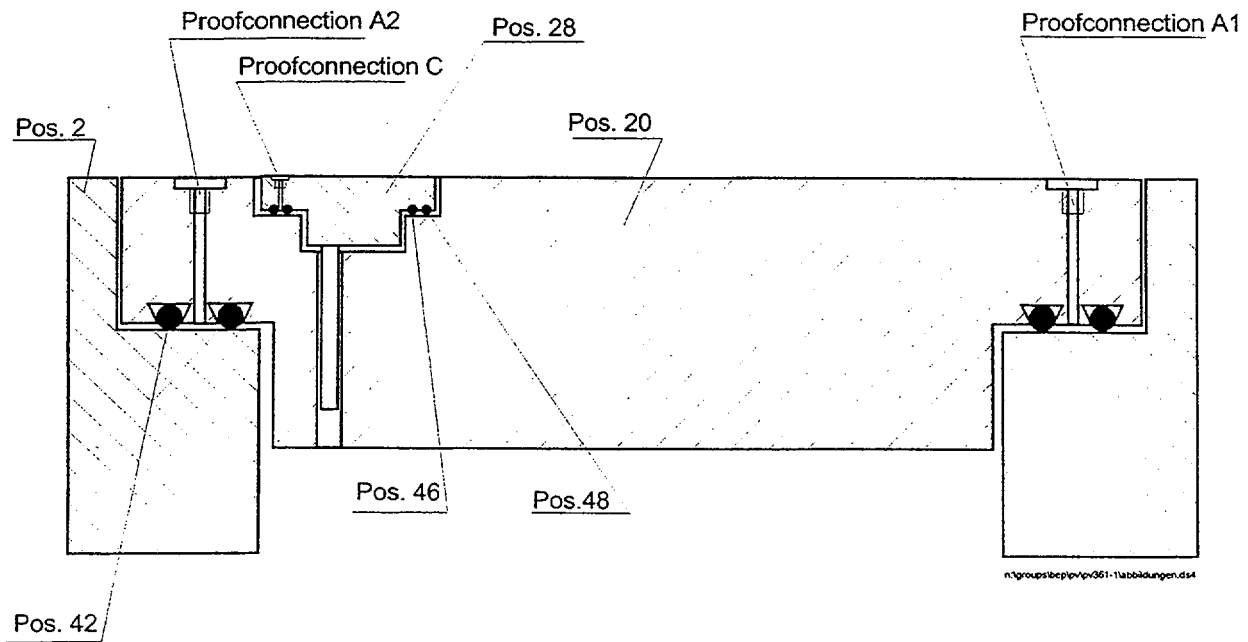
Approval by TZQ for the PV		Approval - External for the PV	
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Testing Connections for PV 361/1 E



Annex 1 to PV 361/1 E "02" 03

Page 1 of 1

Approval by TZQ
for the PV

Approval - External
for the PV

Report No.: _____



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Test Report, Pressure-Change Test for PV 361/1

Cask type: GNS 16

Ident-No.: _____

Sealing barrier:	<i>Primary lid</i>
Permissible Standard Leak Rate:	
<p>Cask loaded with intact fuel only</p> <p style="text-align: center;"><input type="checkbox"/> $Q_{ST, ZUL} \leq 1,0 \text{ E-04 hPa} \cdot \text{l} \cdot \text{s}^{-1}$</p> <p><u>Remark:</u> The indicated value applies for the testing of the respective sealing pair. The max. standard leak rate for the whole sealing barrier amounts to $2.0 \text{ E-04 hPa} \cdot \text{l} \cdot \text{s}^{-1}$.</p>	
<p>Cask loaded with defective fuel as well as unloaded casks for checks during assembling or cask maintenance</p> <p style="text-align: center;"><input type="checkbox"/> $Q_{ST, ZUL} \leq 2,0 \text{ E-05 hPa} \cdot \text{l} \cdot \text{s}^{-1}$</p> <p><u>Remark:</u> The indicated value applies for the testing of the respective sealing pair. The max. standard leak rate for the whole sealing barriers amounts to $4.0 \text{ E-05 hPa} \cdot \text{l} \cdot \text{s}^{-1}$.</p>	
Determined Standard Leak Rates:	
Test number 1	$Q_{ST} = \text{hPa} \cdot \text{l} \cdot \text{s}^{-1}$
Test number 2	$Q_{ST} = \text{hPa} \cdot \text{l} \cdot \text{s}^{-1}$
<p>Remarks:</p>	

Place of Testing/ Facility/ Institution: _____ **Measuring Date** _____

Assessment: ☐ acceptable ☐ not acceptable

	Name	Signature	Date
Tester			
Test supervisor			
Independent expert			

Approval by TZQ for the PV		Approval - External for the PV	
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Report No.: _____



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Measuring Report, Pressure-Change Test for PV 361/1 E

Type of cask: GNS 16

Ident No.: _____

Test number		1	2	
Sealing face	Item:	20	28	
Seal	Item:	42/42	46/48	
Sealing face	Item:	2	20	
Test borehole		A1 or A2	C	
Data about the Devices and the Test Set-Up				
Pressure gauge	type/no.			
Error limit Δp_{UN}	hPa			
Temperature gauge	type/no.			
Testing volume $V_{PRÜF}$	l			
Data about Execution of the Test				
Method (pressure increase / pressure drop)				
Test duration t_s	s			
Initial Measurements				
p_1	hPa			
ϑ_1	°C			
Final Measurements				
p_2	hPa			
ϑ_2	°C			

Place of Testing/ Facility/ Institution: _____ Date: _____

	Name	Signature	Date
Tester			
Test supervisor			
Independent expert			

Approval by TZQ for the PV		Approval - External for the PV	
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**GNB**

Gesellschaft für Nuklear-Behälter mbH

Measuring Report, Pressure-Change Test for PV 361/1 E

Type of cask: GNS 16

Ident No.: _____

Test number	1	2	3
Determination of the Measured Results			
$T_1 = (\vartheta_1/^{\circ}\text{C} + 273.2) \text{ K}$ K			
$T_2 = (\vartheta_2/^{\circ}\text{C} + 273.2) \text{ K}$ K			
$p_{1,ST} = p_1 \cdot \frac{T_{ST}}{T_1}$ hPa			
$p_{2,ST} = p_2 \cdot \frac{T_{ST}}{T_2}$ hPa			
$\Delta p_{ST} = p_{1,ST} - p_{2,ST}$ hPa			
$p_{M,ST} = \frac{p_{1,ST} + p_{2,ST}}{2}$ hPa			
$Q = \frac{\Delta p_{ST} \cdot V_{PRÜF}}{t_S}$ hPa · l · s ⁻¹			
$Q_{ST} = Q \cdot \frac{p_{ST}^2}{p_{M,ST}^2 - p_{ST}^2}$ hPa · l · s ⁻¹			

Place of Testing/ Facility/ Institution: _____ Date : _____

	Name	Signature	Date
Tester			
Test supervisor			
Independent expert			

Approval by- TZQ for the PV		Approval - External for the PV	
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Gesellschaft für Nuklear-Behälter mbH

PV 361 E

Basic Test Procedure


Leak Tests

Pressure-Change Procedures

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 19.06.98

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REVISION STATUS

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00	20.05.1997	Heumos	First issue
01	07.01.1998	Greven	Complete revision
02	30.01.1998	Greven	Concideration of the BAM remarks dated 29.01.1998 (Pages 9, 10, 12 and 13 and Annex 3)

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1 Validity

This basic test procedure is applicable in conjunction with the respective cask-specific test procedure for those leak tests carried out using a pressure-change procedure. In cases of deviations from the cask-specific test procedure, the specifications in the cask-specific test procedure are decisive.

2 Purpose of the Tests

The measurements serve to check whether the permissible leak rates of the components are complied with.

3 Qualifications of the Personnel

The testers deployed must possess sufficient knowledge in the field of leak tests, in particular of the pressure-change procedures and of vacuum technology, and must be acquainted with the function of the devices and accessories used. The qualifications of the testers must be proven to the responsible authority upon demand.

The leak tests must be carried out by personnel who are qualified according to the guidelines stipulated in EN 473 (e.g. LT1 course of the Deutsche Gesellschaft für Zerstörungsfreie Prüfung e. V. - "German Society for Non-Destructive Testing" - in conjunction with in-plant training) or can prove that they have comparable qualifications.

The people deployed as test supervisors must be qualified according to the guidelines stipulated in EN 473 (e.g. LT2 course of the Deutsche Gesellschaft für Zerstörungsfreie Prüfung e. V. in conjunction with in-plant training) or must be able to prove that they have comparable qualifications.

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4 Type of Tests

The tests are carried out as pressure-drop or pressure-increase measurements.

5 Condition of the Components to be tested

The components to be tested must be dry and free from oils, dust and contaminations in so far as these may have an influence on the quality of the test results.

If any liquid residues remain in the testing volume as a result of the working process, it must be ensured during the testing-volume evacuation necessary for the pressure-increase test that the pressure does not fall below the saturation vapour pressure of water (see Chapter 7.1). As an alternative in such cases, a pressure-drop test may be carried out if necessary or a refrigeration trap (see Annex 3) may be integrated if the cask-specific test procedure provide for this.

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6 Requirements on the Testing Devices

The requirements set below must be regarded as minimum demands.

6.1 General Requirements

- Temperature gauge
 - Measuring range : 0 - 100 °C
 - Error limit : 0.2 K
 - Resolution of the display : 0.1 K
 - If necessary, analog output (see Annex 3) : e.g. 0 - 10 V or 4 - 20 mA
- Recording unit
 - y/t recorder:
 - Input ports * : 2
 - Feed : 1 mm/min
 - Recorder width in y-direction : 200 mm
 - PC (alternative):
 - Input ports * : 2
 - Recording rate : 2/s

* Adapted to the analog output of the connected pressure gauge or temperature gauge

Valid calibration certificates must be available for the pressure gauge and temperature gauge. The calibration certificate in each case must not be more than 2 years old.

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6.2 Pressure-Increase Measurement

Remark:

The following testing devices are also required in order to determine the testing volume according to the method described in Chapter 7.3.

- Pressure gauge for the pressure in the testing volume

Measuring range	: 0 - 200 hPa abs.
Error limit	: 0.2 % (in relation to full-scale deflection)
Resolution of the display	: 0.1 hPa
Analog output	: e.g. 0 - 10 V or 4 - 20 mA

The pressure gauge should be independent of the gas type.

- Vacuum pump

Final total pressure with gas ballast	: ≤ 1 hPa abs.
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Remark:

When the pressure gauge is selected and the error limit is thus stipulated, it must be ensured that this results in a test duration appropriate for the testing task (see Chapter 7.4).

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6.3 Pressure-Drop Measurement

- Pressure gauge for the pressure in the testing volume

Measuring range	: 1000 - 2000 hPa abs.
Error limit	: 0.2 % (in relation to full-scale deflection)
Resolution	: 1 hPa
Analog output	: e.g. 0 - 10 V or 4 - 20 mA

The pressure gauge should be independent of the gas type.

- Test set-up

Pressure-proof up to	: 3000 hPa abs.
Testing medium	: e.g. N ₂ , Ar, He or dry air
Gas-cylinder fitting with pressure-reducing valve	

Caution: Comply with the Pressure-Vessel Ordinance and accident-prevention regulations!
--

Remark:

When the pressure gauge is selected and the error limit is thus stipulated, it must be ensured that this results in a test duration appropriate for the testing task (see Chapter 7.4).

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7 Testing Sequence

7.1 Performance of the Pressure Increase Measurement

- Prepare the pressure gauge and the temperature gauge according to the specifications in the instructions for the respective devices
- Assemble the test set-up in accordance with Annex 3, close all the valves
- Determine and record the testing volume $V_{PRÜF}$ according to Chapter 7.3
- Determine and record the test period t_S according to Chapter 7.4
- Open V_P
- If any humidity is present in the testing volume: read off the temperature ϑ_0
- Evacuate the testing volume (final pressure 10 ± 5 hPa above the saturation vapour pressure of water relevant for the read-off temperature ϑ_0 if any humidity is present in the testing chamber, otherwise 10 ± 5 hPa abs.) ¹⁾
- Close V_P and begin recording using the recorder
- After a waiting period of at least 10 min:
Read off and record the initial pressure p_1 . If the signal is not stable or it is foreseeable that the permissible standard leak rate will be exceeded, inform the test supervisor. (There may be a leak in the test set-up, permeation, outgassing, an apparent leak ...)
- Read off and record the initial temperature ϑ_1
- After the test period t_S :
Read off and record the final pressure p_2
- Read off and record the final temperature ϑ_2
- Label the recordings of the recorder.
- Carry out the calculation according to the measuring report.
Complete the measuring report as far as possible
- Dismantle the test set-up

¹⁾ If the determined final pressure is outside the measuring range of the pressure gauge used, the testing volume must be dried.

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Table 1: Saturation Vapour Pressure of Water

Temperature	°C	20	25	30	35	40	45	50
Saturation Vapour Pressure	hPa	23.4	31.7	42.4	56.2	73.8	95.9	123.4
Temperature	°C	55	60	65	70	75	80	85
Saturation Vapour Pressure	hPa	157.5	199.2	250.1	311.6	385.5	473.6	578.0

7.2 Performance of the Pressure Drop Measurement

- Prepare the pressure gauge and the temperature gauge according to the specifications in the instructions for the respective devices
- Assemble the test set-up in accordance with Annex 3, close all the valves
- Determine and record the testing volume $V_{PRÜF}$ according to Chapter 7.3, in so far as this is not yet known
- Determine and record the test period t_S according to Chapter 7.4
- Open V_P
- **Slowly** apply pressure to the testing volume (final pressure 1950 ± 25 hPa abs.)
- Close V_P and begin recording using the recorder
- After a waiting period of approximately 10 min:
Read off and record the initial pressure p_1 . If the signal is not stable or it is foreseeable that the permissible standard leak rate will be exceeded, inform the test supervisor. (There may be a leak in the test set-up, permeation, an apparent leak ...)
- Read off and record the initial temperature ϑ_1
- After the test period t_S :
Read off and record the final pressure p_2
- Read off and record the final temperature ϑ_2
- Label the recordings of the recorder
- Carry out the calculations according to the measuring report.
Complete the measuring report as far as possible
- Relieve the pressure from the testing volume
- Dismantle the test set-up

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7.3 Determination of the Testing Volume

Remarks:

In so far as this has not yet been carried out, the testing volume must be determined (e.g. according to the following method) by means of calculation or gauging of the capacity by litres.

The prerequisite for the following method is a known reference volume for which $V_{PRÜF} \approx V_{REF}$ (see Annex 3) is applicable.

- Open V_O , open V_P
- Carry out evacuation to the final pressure $180 \text{ hPa} < p < 200 \text{ hPa}$
- Record the pressure p_1
- Close V_O
- Carry out evacuation to the final pressure $p \leq 1 \text{ hPa}$
- Close V_P , open V_O , wait for pressure compensation
- Record the pressure p_2
- Calculate: $V_{PRÜF} = V_{REF} \cdot (p_1/p_2 - 1)$
- Record the testing volume $V_{PRÜF}$ in the measuring report
- Close V_O

7.4 Determination of the Test Period t_S

- Take the error limit Δp_{UN} of the pressure gauge from the manufacturer's documents or from the calibration report and record it
- Calculate the minimum measuring period: $\Delta t_{MIN} = V_{PRÜF} \cdot \Delta p_{UN} / Q_{ST,ZUL}$
- Calculate the test period: $t_S = 3 \cdot \Delta t_{MIN} + 30 \text{ min}$
- Record the test period t_S in the measuring report

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8 Recording

The measured values must be recorded and the measured results determined according to the data and formulae in the measuring report of the cask-specific test procedure (for specimen report, see Annex 2)

It is permissible to use computer printouts for the measuring reports if the content-related specifications and the responsibilities correspond to the stipulations in the copies provided with a test mark.

9 Evaluation

The measured results must be evaluated according to the data in the test report of the cask-specific test procedure (for specimen report, see Annex 1).

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10 List of the Symbols Used

p_1	: hPa	: Initial pressure
p_2	: hPa	: Final pressure
$p_{1,ST}$: hPa	: Initial pressure, converted to the standard temperature
$p_{2,ST}$: hPa	: Final pressure, converted to the standard temperature
$p_{M,ST}$: hPa	: Average test pressure
p_{ST}	: hPa	: Standard pressure 1013 hPa
Q	: hPa·l·s ⁻¹	: Leak rate
Q_{ST}	: hPa·l·s ⁻¹	: Standard leak rate
$Q_{ST,ZUL}$: hPa·l·s ⁻¹	: Permissible standard leak rate
T_1	: K	: Initial temperature
T_2	: K	: Final temperature
T_{ST}	: K	: Standard temperature 293 K
t_s	: s	: Test duration
$V_{PRÜF}$: l	: Testing volume
V_{REF}	: l	: Reference volume
Δp_{ST}	: hPa	: Standard pressure difference
Δp_{UN}	: hPa	: Error limit of the pressure gauge
Δt_{MIN}	: s	: Minimum measuring duration
ϑ_0	: °C	: Temperature in order to determine the necessary final pressure
ϑ_1	: °C	: Initial temperature
ϑ_2	: °C	: Final temperature

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11 List of the Abbreviations Used

PV : Test Procedure (" Prüfvorschrift ")

DGZfP : German Society for Non-Destructive Testing

(" Deutsche Gesellschaft für zerstörungsfreie Prüfung, e. V. ")

Table 2: Conversion Table, Units

1 hPa	=	1 mbar
1 Pa	=	1 E -02 mbar
1 l	=	1 E -03 m ³
1 hPa l / s	=	1 mbar l / s
1 hPa l / s	=	0.1 Pa m ³ / s
1 hPa l / s	=	0.1 W

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Report No.: _____



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Test Report, Pressure-Change Test for PV 361

Cask Type: _____

Ident No.: _____

Sealing Barrier:			
Permissible Standard Leak Rate:			
$Q_{ST, ZUL}$	$<$		$hPa \cdot l \cdot s^{-1}$
Determined Standard Leak Rates:			
Test number 1	Q_{ST}	$=$	$hPa \cdot l \cdot s^{-1}$
Test number 2	Q_{ST}	$=$	$hPa \cdot l \cdot s^{-1}$
Test number 3	Q_{ST}	$=$	$hPa \cdot l \cdot s^{-1}$
Remarks:			

Place of Testing / Facility / Institution: _____ Date: _____

Assessment:



acceptable



not acceptable

	Name	Signature	Date
Tester			
Test supervisor			
Independent expert *			

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Report No.: _____



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Measuring Report, Pressure-Change Test for PV 361

Cask Type: _____

Ident No.: _____

Test number	1	2	3
Sealing face Item:			
Seal Item:			
Sealing face Item:			
Test borehole			
Data about the Devices and the Test Set-Up			
Pressure gauge type/no.			
Error limit Δp_{UN} hPa			
Temperature gauge type/no.			
Testing volume $V_{PRÜF}$ l			
Data about Execution of the Test			
Method (pressure increase / pressure drop)			
Test period: ts			
Initial Measurements			
p_1 hPa			
ϑ_1 °C			
Final Measurements			
p_2 hPa			
ϑ_2 °C			

Place of Measuring / Facility / Institution: _____ Date: _____

	Name	Signature	Date
Tester			
Test supervisor			
Independent expert *			

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Report No.: _____



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Measuring Report, Pressure-Change Test for PV 361

Cask Type: _____

Ident No.: _____

Test number	1	2	3
Determination of the Measured Results			
$T_1 = (\vartheta_1 / ^\circ\text{C} + 273.2) \text{ K}$ K			
$T_2 = (\vartheta_2 / ^\circ\text{C} + 273.2) \text{ K}$ K			
$p_{1,ST} = p_1 \cdot \frac{T_{ST}}{T_1}$ hPa			
$p_{2,ST} = p_2 \cdot \frac{T_{ST}}{T_2}$ hPa			
$\Delta p_{ST} = p_{1,ST} - p_{2,ST}$ hPa			
$p_{M,ST} = \frac{p_{1,ST} + p_{2,ST}}{2}$ hPa			
$Q = \frac{\Delta p_{ST} \cdot V_{PRÜF}}{t_S}$ hPa · l · s ⁻¹			
$Q_{ST} = Q \cdot \frac{p_{ST}^2}{p_{M,ST}^2 - p_{ST}^2}$ hPa · l · s ⁻¹			

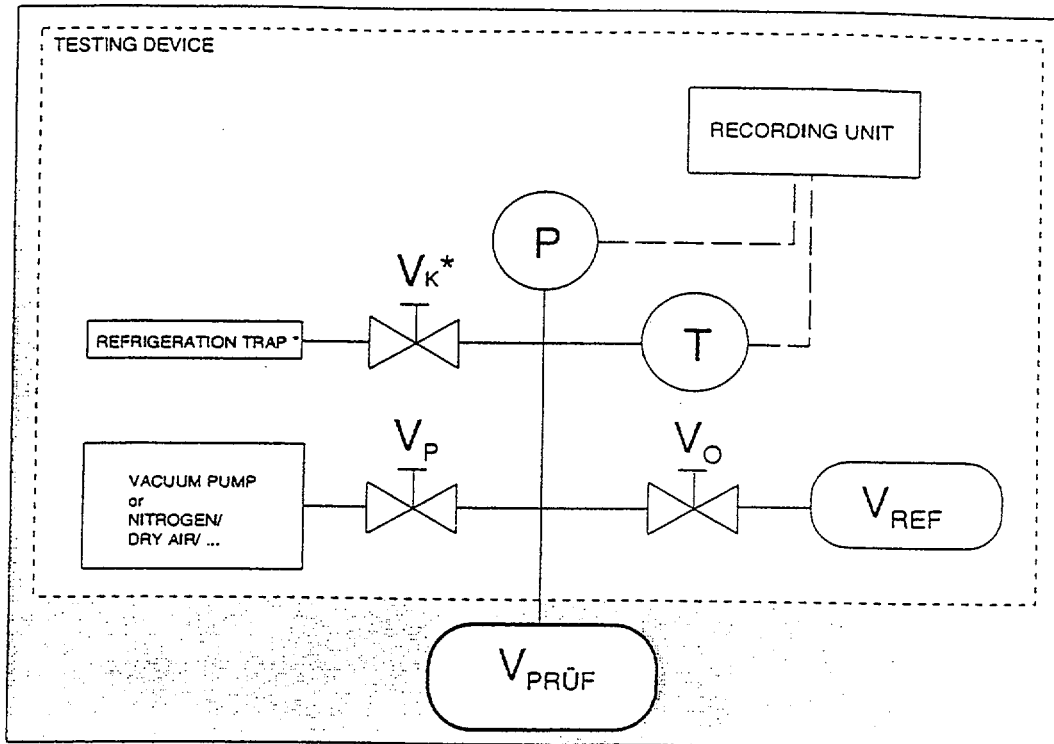
Place of Measuring / Facility / Institution: _____ Date: _____

	Name	Signature	Date
Tester			
Test supervisor			
Independent expert *			

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Test Set-Up for PV 361 - diagrammatic -

**Remarks:***** Alternative Components (see Chapter 5)**

The reference volume also includes the volume of the connecting lines as far as the valve V_O .

The reference volume must only be assembled whenever it is required in order to determine the testing volume.

The following must be applicable: $V_{PRÜF} \approx V_{REF}$.

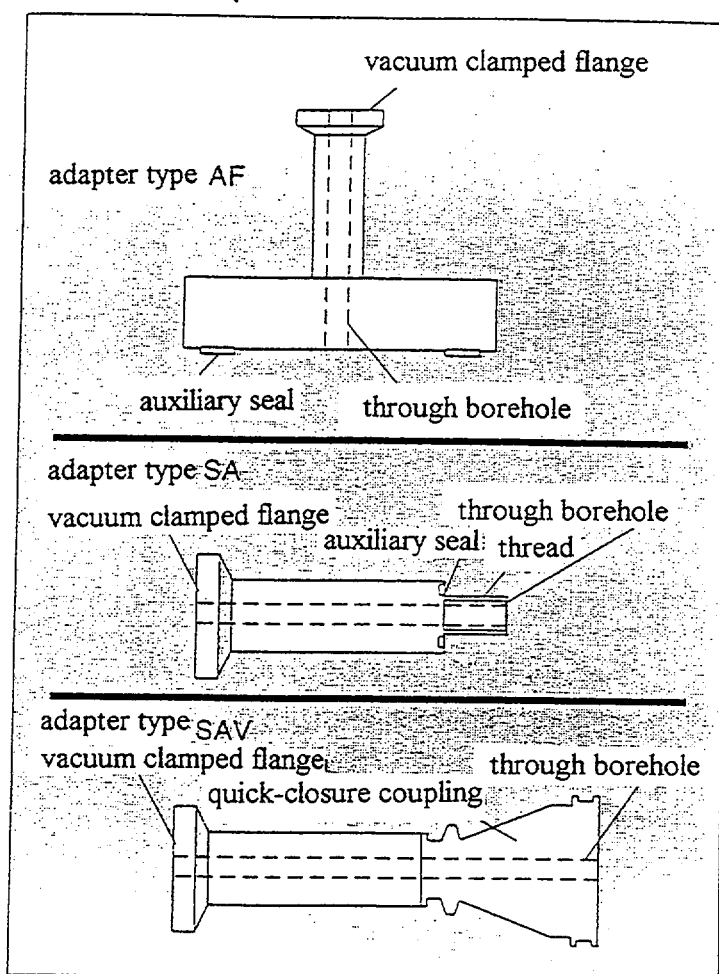
It must be ensured that there is a pressure of 1000 ± 50 hPa in the chamber which is delimited from the testing volume by the seal to be tested. If it is not possible to exclude any pressure increase in this chamber in the course of the test, it is imperative that a pressure-increase test is carried out. In any case, Q_{ST} can then be determined using p_{ST} .

In the case of pressure-increase measurements, it is permissible to use a temperature gauge without an analog output and thus to measure the necessary temperatures intermittently.

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Testing Adapter for PV 361

- diagrammatic -



Remark:

In the specific-cask test procedure, it is specified which testing adapter is used for which testing volume.

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PV 430/2 E

Dose Rate Measurement

Transport Requirements

- GNS 16 -

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Revision : 00

Date of issue : 10.06.1997

Name

Author : Crefeld, GNS-TIG 2


Approved by
Special Department : Götze, GNS-BEP

Approved by TZQ 2 : E.Seligmann

Released by GNS/GNB : Laug, GNB/PB

Check mark external :

Translation approved : Crefeld, GNS-TIG2

 26.05.98

This report is a translation of the German report PV 430/2. The information in the original German version applies in cases of doubt.

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1 Validity

This test procedure in accordance to the basic test procedure PV 430, is valid for transport cask GNS 16.

2 Measurement and evaluation

Measurement and evaluation of the results measured is to be made by means of form sheets and in accordance with the measuring point plans (Annex 1 and 2).

Should the **maximal values** occur at points other than those stipulated in the measuring points plan (measurements are to be made at at least these points), the additional measuring points are to be entered in the measuring points plan and indicated in the additional sheet (Annex 2, Page 5 of 5).

3 Type of transport

The GNS 16 transport cask is transported in a 20' transport container under exclusive use.

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**Test Report, Dose Rate Measurement
for PV 430/2 E**

Type of cask: GNS 16

Ident.No: _____

Position	Maximal dose rate in mSv/h			
	Gamma	Neutron	Total ($\gamma+n$)	Limit
External surfaces of the package				10
1 m from the external surfaces of the package				---
External surfaces of the vehicle				2
2 m from the external surfaces of the vehicle				0.1
Points of the vehicle normally occupied by persons, if personal dose rate metres are not employed				0.02

Place of Testing/ Facility/ Institution: _____

Date: _____

Assessment

☐ acceptable

☐ not acceptable

	Name	Signature	Date
Staff of health physics			

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Report No. _____



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Measuring Report, Dose Rate Measurement, Package for PV 430/2 E

Type of cask: GNS 16

Ident. No.: _____

Measuring devices for	Type	Manufacturer	Device no.	Calibration certificate	Date of calibration
Gamma dose rate					
Neutron dose rate				---	

Numerical quantity for neutron dose rate: _____

Measuring point		Dose Rate in mSv/h	
No.		γ value measured	n value measured
1 T	Lifting lug area		
2 S	Shock absorber bottom side, centre		
3 S	Shock absorber cover side, centre		
1 B	Cask, centre		
Background rate \dot{D}_0			

Place of testing/ Facility/ Institution: _____

Date: _____

Assessment

☐ acceptable

☐ not acceptable

	Name	Signature	Date
Staff of health physics			

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Report No. _____



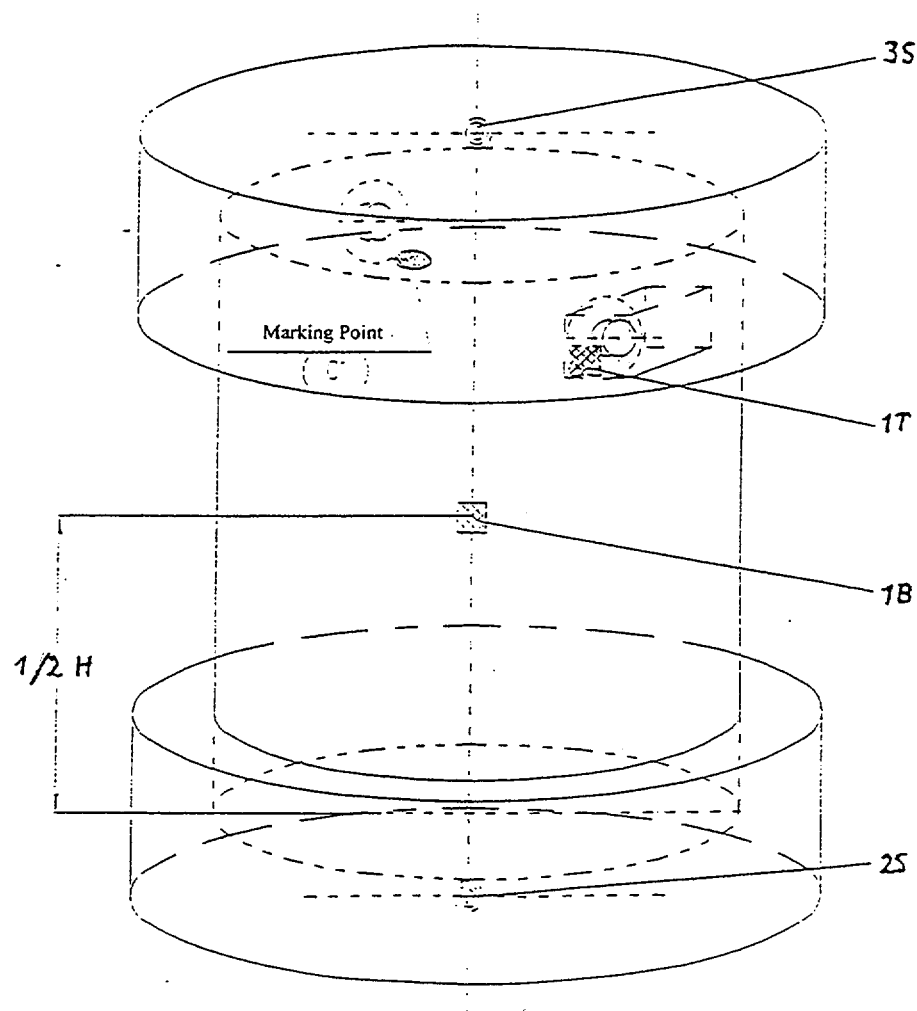
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Measuring Points Plan, Package for PV 430/2 E

Type of cask: GNS 16

Ident No: _____



T = trunnion surface
S = shock absorber surface
B = cask surface
H = cask height

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Report No. _____



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Measuring Report, Dose Rate Measurement, 20' Transport Container for PV 430/2 E

Type of cask: GNS 16

Ident. No.: _____

Measuring devices for	Type	Manufacturer	Device no.	Calibration certificate	Date of calibration
Gamma dose rate					
Neutron dose rate				---	

Numerical quantity for neutron dose rate: _____

Measuring point		Dose Rate in mSv/h	
No.		γ-value measured	n-value measured
1	External surface container - side wall centre right		
2	External surface container - side wall centre left		
3	External surface container - side wall upper right		
4	External surface container - side wall upper left		
5	2 m from the external surface of the container, centre right		
6	2 m from the external surface of the container, centre left		
7	2 m from the external surface of the container, upper right		
8	2 m from the external surface of the container, upper left		
Background rate \dot{D}_0			

Place of testing/ Facility/ Institution: _____

Date: _____

	Name	Signature	Date
Staff of health physics			

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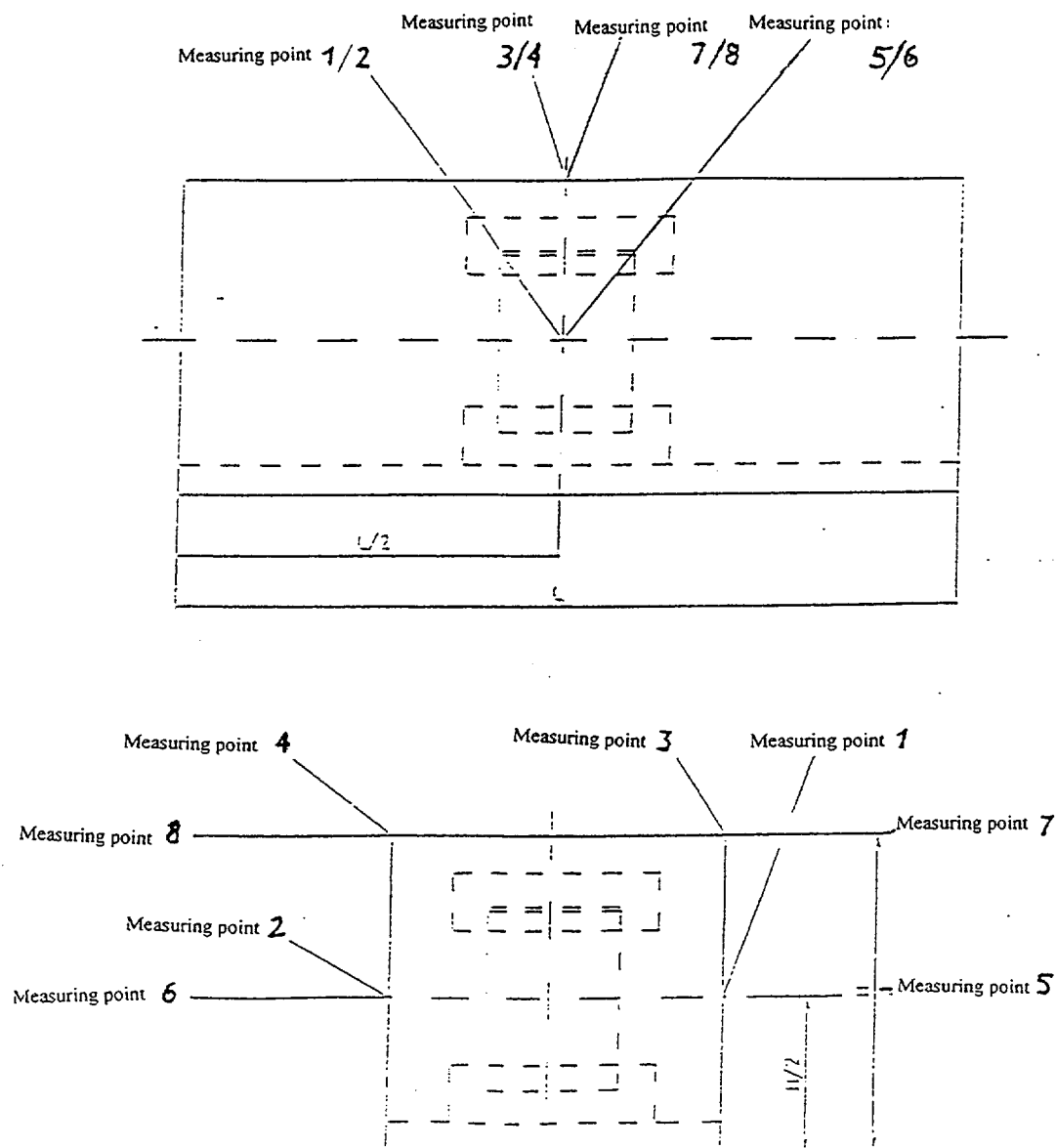
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Measuring Points Plan, 20' Transport Container for PV 430/2 E

Type of cask: GNS 16

Ident. No.: _____



L = Length of the 20' Transport Container

H = Height from the lower surface to the roof of the 20' Transport Container

Report No. _____



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Measuring Report, Dose Rate Measurement (additional form sheet) for PV 430/2 E

Type of cask: GNS 16

Ident. No.: _____

Measuring devices for	Type	Manufacturer	Device no.	Calibration certificate	Date of calibration
Gamma dose rate					
Neutron dose rate				---	

Numerical quantity for neutron dose rate: _____

Measuring point		Dose Rate in mSv/h	
No.		γ value measured	n value measured
Background rate \dot{D}_0			

Place of testing/ Facility/ Institution: _____

Date: _____

	Name	Signature	Date
Staff of health physics			

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PV 530/2 E

Contamination Measurement

- GNS 16 -

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Revision : 00
Date of issue : 10.06.1997
Author : **Name**
Crefeld, GNS-TIG 2

Approved by
Special Department : Götze, GNS-BEP
Approved by TZQ : E.Seligmann
Released by GNS/GNB : R. Laug

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Translation approved : Crefeld, GNS-TIG2

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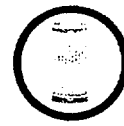
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Annex 2	Measuring Report, Contamination Measurement	Page 1 of 3
	Measuring Report, Contamination Measurement (additional form sheet)	Page 2 of 3
	Plan of Measuring Points, Contamination Measurement	Page 3 of 3

**GNB**

Gesellschaft für Nuklear-Behälter mbH

1 Validity

This test procedure in accordance to the basic test procedure PV 530, is valid for the transport cask GNS 16.

2 Measurement and evaluation

Measurement and evaluation of the results is to be made by means of form sheets and in accordance to the plan of measuring points (Annex 1 and 2).

Any additional points are to be noted in the plan of measuring points and indicated in the additional form sheet (Annex 2, Page 2 of 3).

3 Transport

The GNS 16 transport cask is transported in a 20' transport container under exclusive use.

Approved by TZQ * for the PV		Check mark external for the PV	
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**GNB**

Gesellschaft für Nuklear-Behälter mbH

Test Report, Contamination Measurement for PV 530/2 E

Type of cask: GNS 16 Ident No. _____Beta-Contamination < 4 Bq/cm² ☐ acceptable ☐ not acceptable α/β - γ ratio:Alpha Contamination < 0,4 Bq/cm² ☐ acceptable ☐ not acceptable

Remarks / Notices:

Place of Testing/ Facility/ Institution: _____ Date: _____

	Name	Signature	Date
Staff of health physics			

Approved by TZQ * for the PV		Check mark external * for the PV	
---------------------------------	--	-------------------------------------	--

**GNB**

Gesellschaft für Nuklear-Be

Measuring Report, Contamination Measurement

for PV 530/2 E

Type of cask: GNS 16

Ident No.: _____

Measuring device _____

Device No.: _____

Measuring time: _____

	α	β
Background n_B		
Calibration source		
ε_i		

Measuring point	Background n_B [s^{-1}]		Total counting rate n [s^{-1}]		$n - n_B$ [s^{-1}]		$0.33/\varepsilon_i$ [cm^2]		$0.67/\varepsilon_i$ [cm^2]		$A^{(1,2)}$ [Bq/cm^2]	
	α	β	α	β	α	β	α	β	α	β	α	β
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												

$$^1) A = (n - n_B) \frac{0.133}{\varepsilon_i} \text{ for } \alpha \text{ radiation, } A = (n - n_B) \frac{0.067}{\varepsilon_i} \text{ for } \beta \text{ radiation}$$

²⁾ When an other qualified procedure is employed, only this column is to be filled in and ¹⁾ no longer applies

Place of Testing/ Facility/ Institution: _____

Date: _____

	Name	Signature	Date
Staff of health physics			

Approved by TZQ *
for the PV

GNB 7

Check mark external
for the PV

* if required

**GNB**

Gesellschaft für Nuklear-Behälter mbH

Measuring Report, Contamination Measurement (additional form sheet) for PV 530/2 E

Type of cask: GNS 16

Ident No.: _____

Measuring device: _____

Device No.: _____

Measuring time: _____

	α	β
Background n_B		
Calibration source		
ε_i		

Measuring point		Background n_B [s^{-1}]		Total counting rate n [s^{-1}]		$n - n_B$ [s^{-1}]		0.133/ ε_i [cm^2]	0.067/ ε_i [cm^2]	$A^{(1,2)}$ [Bq/ cm^2]	
		α	β	α	β	α	β	α	β	α	β
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

¹⁾ $A = (n - n_B) \frac{0.133}{\varepsilon_i}$ for α radiation, $A = (n - n_B) \frac{0.067}{\varepsilon_i}$ for β radiation

²⁾ When an other qualified procedure is employed, only this column is to be filled in and ¹⁾ no longer applies

Place of Testing/ Facility/ Institution: _____

Date: _____

	Name	Signature	Date
Staff of health physics			

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for the PV

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* if required



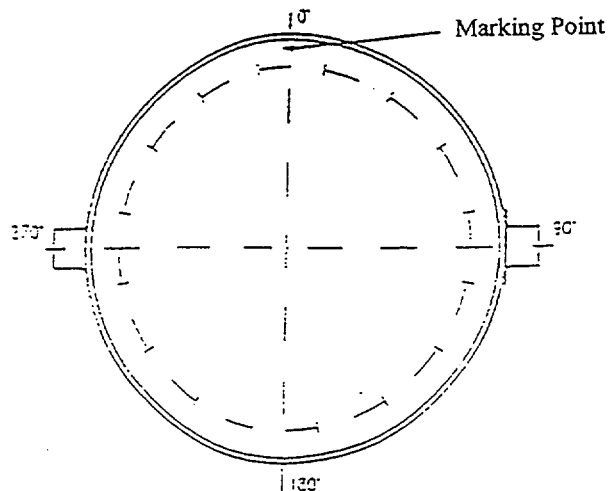
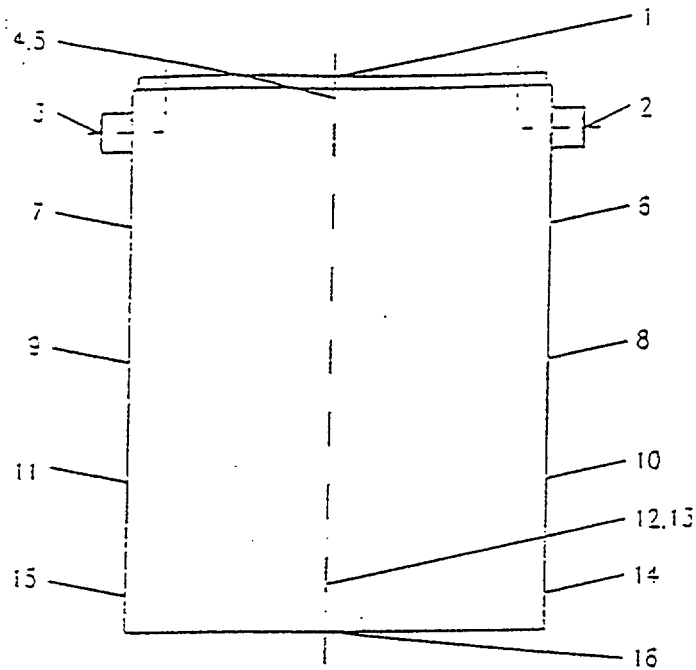
GNB

Gesellschaft für Nuklear-Behälter mbH

Plan of Measuring Points, Contamination Measurement for PV 530/2 E

Type of cask: GNS 16

Ident No. : _____



**GNB**

Gesellschaft für Nuklear-Behälter mbH

PV 730/2 E

Temperature Measurement


Transport Requirements

- GNS 16 -

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Revision : 00
Date of issue : 12.06.1997
Name
Author : Crefeld, GNS-TIG 2
Approved by
Special Department : Götze, GNS-BEP
Approved by TZQ : E.Seligmann
Released by GNS/GNB : Laug, GNB/PB
Check mark external :
Translation approved : Crefeld, GNS-TIG2

 27.05.98

This report is a translation of the German report PV 730/2. The information in the original German version applies in cases of doubt.

**GNB**

Gesellschaft für Nuklear-Behälter mbH

DOCUMENT REVISIONS

Revision	Date	Author	Explanation of the Amendments, if nessessary Indication of Pages
00	12.06.97	Crefeld	First issue

Approved by TZQ * for the PV		Check mark external * for the PV	
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**GNB**

Gesellschaft für Nuklear-Behälter mbH

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2	Measurement and evaluation	4
3	Type of transport	4

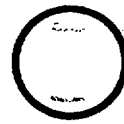
Annex 1 Test Report, Temperature Measurement Page 1 of 1

Annex 2 Measuring Report, Temperature Measurement Page 1 of 3

Measuring Report, Temperature Measurement
(additional form sheet) Page 2 of 3

Plan of Measuring Points, Temperature Measurement Page 3 of 3

Approved by TZQ * for the PV		Check mark external * for the PV	
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**GNB**

Gesellschaft für Nuklear-Behälter mbH

1 Validity

This test procedure in accordance to the basic test procedure PV 730, is valid for the transport cask GNS 16.

2 Measurement and evaluation

Measurement and evaluation of the results is to be made by means of the form sheets and in accordance with the plan of measuring points (Annex 1 and 2). Any additional measuring points are noted in the plan of measuring points and indicated in the additional form sheet (Annex 2, Page 2 of 3).

3 Type of transport

The GNS 16 transport cask is transported in a 20' transport container under exclusive use.

Approved by TZQ * for the PV		Check mark external * for the PV	
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Report No.



GNB

Gesellschaft für Nuklear-Behälter mbH

**Test Report, Temperature Measurement
for PV 730/2 E**

Type of cask: GNS 16

Ident. No.: _____

Measuring point	Surface temperature $\vartheta_{3max} [^{\circ}\text{C}]$	Maximum admissible temperature (transport under exclusive use [$^{\circ}\text{C}$]) ($\vartheta_{max} = \vartheta_{u3} + 47\text{K}$)

Assessment:

Maximum admissible temperature \geq surface temperature ϑ_{3max}

☐ acceptable

☐ not acceptable

Place of Testing/ Facility/ Institution: _____ **Date:** _____

	Name	Signature	Date
Executive staff			

Annex 1 of PV 730/2 E "00"

Page 1 of 1

Approved by TZQ * for the PV		Check mark external for the PV	
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* if required

Report No.



GNB

Gesellschaft für Nuklear-Behälter mbH

Measuring Report, Temperature Measurement for PV 730/2 E

Type of cask: GNS 16

Ident No: _____

Measuring device	Type	Manufacturer	Device No.:

Surface temperatures [°C]				Corrected surface temperatures ϑ_{oi} [°C]		
Time of the last three measurements		t	t + 1h	t + 2h		
Measuring points / temperature (ϑ_i)		ϑ_1	ϑ_2	ϑ_3	$\vartheta_{o1} = \vartheta_1$	$\vartheta_{o2} = \vartheta_2 - (\vartheta_{U2} - \vartheta_{U1})$ $\vartheta_{o3} = \vartheta_3 - (\vartheta_{U3} - \vartheta_{U1})$
1	Right side, centre					
2	Left side, centre					
3	Right side, at the top					
4	Left side, at the top					
ϑ_{3max} (maximum value of the temperatures ϑ_{3i})						
Ambient temperatures (ϑ_{Uj})		ϑ_{U1}	ϑ_{U2}	ϑ_{U3}	Place of measurement for ϑ_{Uj} :	

Stationary state			
		$\Delta\vartheta = \vartheta_{o1} - \vartheta_{o2} $ [K]	$\Delta\vartheta = \vartheta_{o1} - \vartheta_{o3} $ [K]
		$\Delta\vartheta$ [K] admissible	
1	Right side, centre		1
2	Left side, centre		1
3	Right side, at the top		1
4	Left side, at the top		1
			1

Place of Testing/ Facility/ Institution: _____

Date: _____

	Name	Signature	Date
Executive staff			

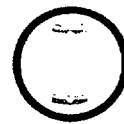
Annex 2 of PV 730/2 E "00"

Page 1 of 3

Approved by TZQ * for the PV		Check mark external * for the PV	
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* if required

Report No.



GNB

Gesellschaft für Nuklear-Behälter mbH

Measuring Report, Temperature Measurement (additional form sheet) for PV 730/2 E

Type of task: GNS 16

Ident No.: _____

Measuring device	Type	Manufacturer	Device No.

Surface temperatures [°C]				Corrected surface temperatures ϑ_{oi} [°C]		
Time of the last three measurements	t	t+1 h	t+2 h			
Measuring points / temperature (ϑ_i)	ϑ_1	ϑ_2	ϑ_3	$\vartheta_{o1} = \vartheta_1$	$\vartheta_{o2} = \vartheta_2 - (\vartheta_{u2} - \vartheta_{u1})$	$\vartheta_{o3} = \vartheta_3 - (\vartheta_{u3} - \vartheta_{u1})$
$\vartheta_{3 \text{ max.}}$ (maximum value of the temperatures ϑ_3)	ϑ_{u1}	ϑ_{u2}	ϑ_{u3}	Place of measurement for ϑ_u :		
Ambient temperatures (ϑ_{ui})						

Stationary state			
	$\Delta\vartheta = \vartheta_{o1} - \vartheta_{o2} $ [K]	$\Delta\vartheta = \vartheta_{o1} - \vartheta_{o3} $ [K]	$\Delta\vartheta$ [K] admissible
			1
			1
			1
			1
			1

Place of Testing/ Facility/ Institution: _____

Date: _____

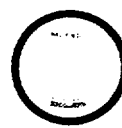
	Name	Signature	Date
Executive staff			

Annex 2 of PV 730/2 E "00"

Page 2 of 3

Approved by TZQ * for the PV	GNB 7	Check mark external for the PV	
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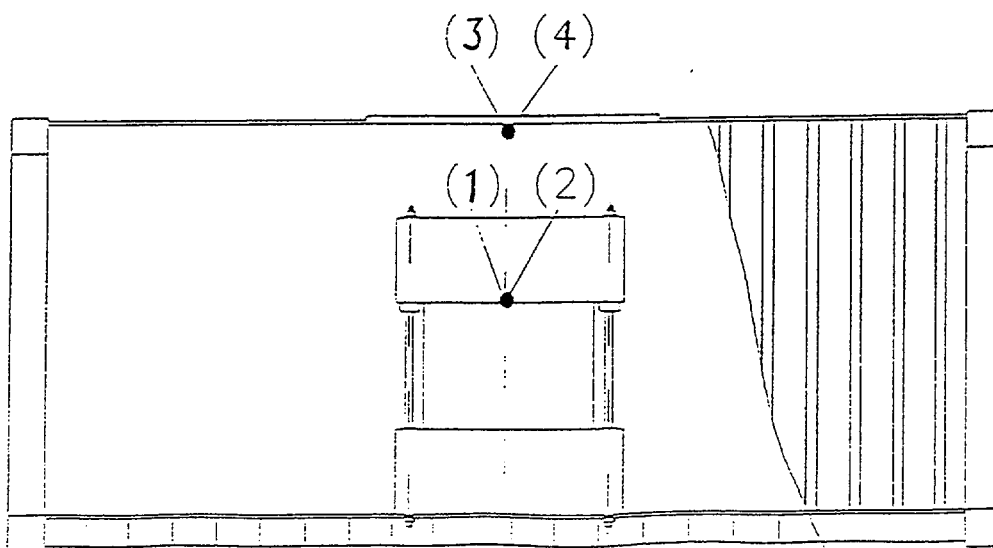
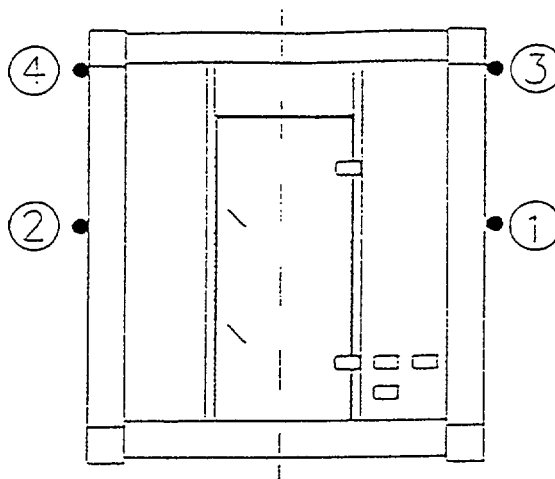
* if required



Plan of Measuring Points, Temperature Measurement for PV 730/2 E

Type of cask : GNS 16

Ident No.: _____



GNB	Plan for Periodic inspections on a GNS 16 Transport Cask after 15 Transport Runs or, at the Latest, after 3 Years		WKP No.: 510.060-01 E (WKP 01 for PV 120)		Index: 02	Page: 1 of: 6	
			ID No.:				
Inspection Step	Description of the Inspection Step	Specification	Tester B K (K) T/S	Certificate cate	R e v .	Inspection Carried out B K T/S	Certificate No. Remarks/

1	Release of the cask by the radiation-protection department so that the periodic inspection can be carried out		X										
2	Checking of the log book		X			S							
3	<u>Cask Body:</u> Comparison of the stamping of the components with the documentation	MV 32	X										
3.1	Visual inspection of the outer surface and of the inner surface of the shaft	PV 19, Appendix XII	X										
3.2	Visual inspection of the sealing faces; if re-processing is necessary, leak test after completion of the work	PV 19, Appendix I * MV 32 PV 361/1	X			X							* to be applied analogously for the GNS 16 cask
3.3	Checking of the threaded boreholes for the cask-lid bolts in the cask body using gauges	PV 119	X										

Drafted: Name: Crefeld Dept: TIG2 Date: 20.03.1998		Approved by Special-Dept.: Name: G.Greven Dept.: BEP Date: 23.03.1998		Preliminary Inspection Approved by TZQ: Name: Eberhardt Dept.: TZQ 3 Date: 23.03.1998		Check mark external:		Documentation Inspection Inspection - B:		Inspection - K:		Inspection - T or S:	
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Explanations B = Expert from the user K = Customer, (participation binding) (K) = Customer (invitation necessary) T = Technical control organisation S = Expert from the BAM

PV 120 "b"

Translation approved: Crefeld, GNS-TIG 2

[Signature] 27.05.98

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<h1>GNB</h1>	Plan for Periodic Inspections on a GNS 16 Transport Cask after 15 Transport Runs or, at the Latest, after 3 Years		WKP No.: 510.060-01 E (WKP 01 for PV 120)		Index: 02	Page: 2 of: 6
	ID No.:					
Inspection Step	Description of the Inspection Step	Specification	Tester B K (K) T/S		Certificate B K T/S	Certificate No. Remarks/


4.	<u>Cask-Lid Bolt:</u> Comparison of the stamping of the components with the documentation	MV 32	X										
4.1	Visual inspection of the bolts	PV 19, Appendix VI	X										
4.2	Surface-crack inspection of the bolts	PV 24	X				X						
4.3	Checking of the bolt threads using gauges	MV 32 PV 119	X				X						
4.4	Checking of the starting torques of the bolts	MV 32	X										

Drafted: Name: Crefeld Dept: TIG2 Date: 20.03.1998		Approved by Special-Dept.: Name: G.Greven Dept.: BEP Date: 23.03.1998		Preliminary Inspection Approved by TZQ: Name: Eberhardt Dept.: TZQ 3 Date: 23.03.1998		Check mark external:		Documentation Inspection Inspection - B:		Inspection - K:		Inspection - T or S:	
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PV 120 "b"

Translation approved: Crefeld, GNS-TIG 2

 27.05.98

c:/WKP01R02.DOC;

GNB

Plan for periodic inspections on a
GNS 16 Transport Cask
after 15 Transport Runs or, at the Latest, after 3 Years

WKP
No.:510.060-01 E
(WKP 01 for PV 120)

Index:

02

Page: 3

of: 6

ID No.:

Inspection Step	Description of the Inspection Step	Specification	Tester				Certificate	R e v .	Inspection Carried out			Certificate No. Remarks/
			B	K	(K)	T/S			B	K	T/S	

5.	<u>Trunnions and Trunnion Bolts:</u> Comparison of the stamping of the components with the documentation	MV 32	X									
5.1	Visual inspection of the surface in regards to deformation, cracks, wear and corrosion	PV 19, Appendices IV and VI	X			S						
5.2	Die penetrant tests of the trunnions and trunnion bolts in dismantled condition	PV 24 PV 25, Appendix II	X			S	X					
5.3	Random checking of the bolts and threaded boreholes using gauges	PV 19, Appendix VI	X			S	X					
5.4	Checking of the starting torques of the bolts	MV 32	X			S	X					

Preliminary Inspection				Documentation Inspection		
Drafted: Name: Crefeld Dept: TIG2 Date: 20.03.1998	Approved by Special-Dept.: Name: G.Greven Dept.: BEP Date: 23.03.1998	Approved by TZQ: Name: Eberhardt Dept.: TZQ 3 Date: 23.03.1998	Check mark external:	Inspection - B:	Inspection - K:	Inspection - T or S:

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PV 120 "b"

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GNB

**Plan for Periodic Inspections on a
GNS 16 Transport Cask**
after 15 Transport Runs or, at the Latest, after 3 Years

WKP
No.:**510.060-01 E**
(WKP 01 for PV 120)Index: **02**Page: **4** of: **6**

ID No.:

Inspection Step	Description of the Inspection Step	Specification	Tester				Certificate	R e v .	Inspection Carried out			Certificate No. Remarks/
			B	K	(K)	T/S			B	K	T/S	
6	<u>Cask Lids:</u> Comparison of the stamping of the components with the documentation	MV 32	X									
6.1	Visual inspection of the surface of the cask lids	PV 19, Appendix III	X									
6.2	Checking of the threaded boreholes for the closures of the cask openings using gauges	MV 32 PV 119	X									
6.3	Visual inspection of the surface of the load-attachment point in regards to deformation, cracks, wear and corrosion	PV 19, Appendix VI	X			S	X					
6.4	Checking of the threaded borehole of the load-attachment point using a gauge	PV 119 MV 32	X			S	X					
6.5	Visual inspection of all the sealing faces	PV 19, Appendix III	X				X					
6.6	Replacement of the elastomer seals and execution of the leak test (*)	MV 32 PV 361/1	X			S	X					(* see next page

Drafted:		Preliminary Inspection		Documentation Inspection		
Name: Crefeld	Approved by Special-Dept.:	Approved by TZQ:	Check mark external:	Inspection - B:	Inspection - K:	Inspection - T or S:
Dept: TIG2	Name: G.Greven	Name: Eberhardt				
Date: 20.03.1998	Dept.: BEP	Dept.: TZQ 3				
	Date: 23.03.1998	Date: 23.03.1998				

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S = Expert from the BAM

PV 120 "b"

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GNB

**Plan for Periodic Inspections on a
GNS 16 Transport Cask**
after 15 Transport Runs or, at the Latest, after 3 Years

WKP
No.:**510.060-01 E**
(WKP 01 for PV 120)

Index:

02Page: **5**of: **6**

ID No.:

Inspection Step	Description of the Inspection Step	Specification	Tester				Certificate	Review	Inspection Carried out			Certificate No. Remarks/
			B	K	(K)	T/S			B	K	T/S	

7	<u>Closures of the Cask Openings</u> Comparison of the stamping of the components with the documentation	MV 32	X									
7.1	Visual inspection of the component surface	PV 19, Appendix III	X									
7.2	Visual inspection of the sealing faces	PV 19, Appendix III	X									
7.3	Replacement of the elastomer seals and execution of the leak test (*)	MV 32 PV 361/1	X			S	X					
7.4	Checking of the starting torques of the bolts	MV 32	X									
	*It must be ensured that only seals are used which have been stored according to DIN 7716 and are not older than 10 years.											

Preliminary inspection				Documentation inspection		
Drafted: Name: Crefeld Dept: TIG2 Date: 20.03.1998	Approved by Special-Dept.: Name: G.Greven Dept.: BEP Date: 23.03.1998	Approved by TZQ: Name: Eberhardt Dept.: TZQ 3 Date: 23.03.1998	Check mark external:	Inspection - B:	Inspection - K:	Inspection - T or S:

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S = Expert from the BAM

PV 120 "b"

Translation approved: Crefeld, GNS-TIG 2

 27.05.98

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GNB

**Plan for Periodic Inspections on a
GNS 16 Transport Cask**
after 60 Transport Runs or, at the Latest, after 6 Years

WKP
No.:**510.060-02 E**
(WKP 02 for PV 120)

Index:

04Page: **1**of: **7**

ID No.:

Inspection Step	Description of the Inspection Step	Specifications	Tester				Certificate	Review	Inspection Carried out			Certificate No. Remarks/
			B	K	(K)	T/S			B	K	T/S	

1	Release of the cask by the radiation-protection department so that the periodic inspection can be carried out		X									
2	Checking of the log book		X			S						
3	<u>Cask Body:</u> Comparison of the stamping of the components with the documentation	MV 32	X									
3.1	Visual inspection of the outer surface and of the inner surface of the shaft	PV 19, Appendix XII	X			S	X					
3.2	Visual inspection of the sealing faces; if re-processing is necessary, leak test after completion of the work	PV 19, Appendix I * MV 32 PV 361/1	X			S	X					* to be applied analogously for the GNS 16 cask
3.3	Checking of the threaded boreholes for the cask-lid bolts in the cask body using gauges	PV 119	X			S	X					
3.4	Leak test of the welded seams of the side wall cover sheet (Overpressure max.: 0,2 bar), drilling of a test opening and after testing tight welding and followed by a die penetrant test											

Preliminary Inspection				Documentation Inspection		
Drafted: Name: Heck Dept: TIG1 Date: 14.05.1998	Approved by Special-Dept.: Name: G.Greven Dept.: BEP Date: 15.05.1998	Approved by TZQ: Name: Eichel Dept.: TZQ 3 Date: 15.05.1998	Check mark external	Inspection - B:	Inspection - K:	Inspection - T or S:

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(K) = Customer (invitation necessary)

T = Technical control organisation

S = Expert from the BAM

PV 120 "b"

Translation approved: Crefeld, GNS-TIG 2

 28.05.98

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<h1>GNB</h1>	Plan for Periodic Inspections on a GNS 16 Transport Cask after 60 Transport Runs or, at the Latest, after 6 Years		WKP No.: 510.060-02 E (WKP 02 for PV 120)		Index: 04	Page: 2 of: 7
	ID No.:					
Inspection Step	Description of the Inspection Step	Specifications	Tester B K (K) T/S		Certificate cate	Inspection Carried out B K T/S Certificate No. Remarks/

4.	<u>Cask-Lid Bolts:</u> Comparison of the stamping of the components with the documentation	MV 32	X									
4.1	Visual inspection of the bolts	PV 19, Appendix VI	X			S	X					
4.2	Die penetrant inspection of the bolts	PV 24	X			S	X					
4.3	Checking of the bolt threads using gauges	PV 119 MV 32	X			S	X					
4.4.	Checking of the starting torques of the bolts	MV 32	X			S						

Drafted: Name: Heck Dept: TIG1 Date: 14.05.1998		Approved by Special-Dept.: Name: G.Greven Dept.: BEP Date: 15.05.1998		Preliminary Inspection Approved by TZQ: Name: Eichel Dept.: TZQ 3 Date: 15.05.1998		Check mark external	Documentation Inspection Inspection - B:		Inspection - K:	Inspection - T or S:
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Explanations B = Expert from the user

K = Customer, (participation binding)

(K) = Customer (invitation necessary)

T = Technical control organisation

S = Expert from the BAM

PV 120 "b"

Translation approved: Crefeld, GNS-TIG 2

[Signature] 28.05.98

c:/WKP02R04.DOC;

<div style="font-size: 2em; font-weight: bold; text-align: center;">GNB</div>		<div style="text-align: center;"> Plan for Periodic Inspections on a GNS 16 Transport Cask after 60 Transport Runs or, at the Latest, after 6 Years </div>			WKP No.:		510.060-02 E (WKP 02 for PV 120)		Index:	04	Page: 3	of: 7
					ID No.:							
Inspection Step	Description of the Inspection Step	Specifications	Tester B K (K) T/S		Certificate	Review	Inspection Carried out B K T/S		Certificate No. Remarks/			

5	<u>Trunnions and Trunnion Bolts:</u> Comparison of the stamping of the components with the documentation	MV 32	X										
5.1	Visual inspection of the surface in regard to deformation, cracks, wear and corrosion after dismantling of the trunnions	PV 19, Appendices IV and VI	X			S	X						
5.2	Die penetrant inspection of the trunnions and trunnion bolts	PV 25, Appendix II PV 24	X			S	X						
5.3	Checking of the bolts and threaded boreholes using gauges	PV 119 MV 32	X			S	X						
5.4	Over load test when the trunnions have been assembled (only 2 trunnions; cask upright)	PV 111 MV 32	X			S	X						
5.5	Die penetrant inspection of all the parts located in the flux of force	PV 25, Appendix II PV24	X			S	X						
5.6	Checking of the starting torques of the bolts	MV 32	X			S	X						

		Preliminary Inspection		Documentation Inspection		
Drafted: Name: Heck Dept: TIG1 Date: 14.05.1998	Approved by Special-Dept.: Name: G.Greven Dept.: BEP Date: 15.05.1998	Approved by TZQ: Name: Eichel Dept.: TZQ 3 Date: 15.05.1998	Check mark external	Inspection - B:	Inspection - K:	Inspection - T or S:

PV 120 "b"

Translation approved:Crefeld, GNS-TIG 2

28.05.98

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GNB

**Plan for Periodic Inspections on a
GNS 16 Transport Cask**
after 60 Transport Runs or, at the Latest, after 6 Years

WKP
No.:**510.060-02 E**
(WKP 02 for PV 120)

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Inspection Step	Description of the Inspection Step	Specifications	Tester				Certificate	R e v .	Inspection Carried out			Certificate No. Remarks/
			B	K	(K)	T/S			B	K	T/S	

6	Cask Lid: Comparison of the stamping of the component with the documentation	MV 32	X									
6.1	Visual inspection of the surface of the cask lid	PV 19, Appendix III	X			S	X					
6.2	Checking of the threaded boreholes for the closures of the cask openings using gauges	MV 32 PV 119	X			S	X					
6.3	Visual inspection of the surface of the load-attachment point in regards to deformation, cracks, wear and corrosion	PV 19, Appendix VI	X			S	X					
6.4	Checking of the threaded borehole of the load-attachment point using a gauge	PV 119 MV 32	X			S	X					
6.5	Over load test on the load-attachment point	PV 112 MV 32	X			S	X					
6.6	Visual inspection of all the sealing faces	PV 19, Appendix III MV 32	X			S	X					
6.7	Replacement of the elastomer seals and execution of the leak test (*)	MV 32 PV 361/1	X			S	X					(* see next page

Preliminary Inspection				Documentation Inspection		
Drafted: Name: Heck Dept: TIG1 Date: 14.05.1998	Approved by Special-Dept.: Name: G.Greven Dept.: BEP Date: 15.05.1998	Approved by TZQ: Name: Eichel Dept.: TZQ 3 Date: 15.05.1998	Check mark external	Inspection - B:	Inspection - K:	Inspection - T or S:

Explanations B = Expert from the user

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PV 120 "b"

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<h1>GNB</h1>	Plan for Periodic Inspections on a GNS 16 Transport Cask after 60 Transport Runs or, at the Latest, after 6 Years		WKP No.: 510.060-02 E (WKP 02 for PV 120)		Index: 04	Page: 5 of: 7
	ID No.:					
Inspection Step	Description of the Inspection Step	Specifications	Tester B K (K) T/S		Certificate cate	Inspection Carried out B K T/S Certificate No. Remarks/

7	<u>Closures of the Cask Openings</u> Comparison of the stamping of the components with the documentation	MV 32	X										
7.1	Visual inspection of the component surface	PV 19, Appendix III	X			S	X						
7.2	Visual inspection of the sealing faces	PV 19, Appendix III	X			S	X						
7.3	Replacement of the elastomer seals and execution of the leak test (*)	MV 32 PV 361/1	X			S	X						
	*It must be ensured that only seals are used which have been stored according to DIN 7716 and are not older than 10 years'												

Drafted: Name: Heck Dept: TIG1 Date: 14.05.1998		Approved by Special-Dept.: Name: G.Greven Dept.: BEP Date: 15.05.1998		Preliminary Inspection Approved by TZQ: Name: Eichel Dept.: TZQ 3 Date: 15.05.1998		Check mark external		Documentation Inspection Inspection - B:		Inspection - K:		Inspection - T or S:	
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PV 120 "b"

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<div style="font-size: 2em; font-weight: bold; text-align: center;">GNB</div>		<div style="text-align: center;"> Plan for Periodic Inspections on a GNS 16 Transport Cask after 60 Transport Runs or, at the Latest, after 6 Years </div>			WKP No.: 510.060-02 E (WKP 02 for PV 120)			Index: 04	Page: 6	of: 7
					ID No.:					
Inspection Step	Description of the Inspection Step	Specifications	Tester B K (K) T/S	Certificate	Review	Inspection Carried out B K T/S	Certificate No. Remarks/			

8	<u>Basket:</u> Comparison of the stamping of the components with the documentation	MV 32	X										
8.1	Visual inspection of the basket in mounted stage; random checking of the basket shafts using an endoscope Checking has also to be performed with respect criticality to safety	PV 19, Appendix V	X			S	X						
9	<u>Checking of the Loaded Cask:</u>												
9.1	Checking of the shielding function of the cask by evaluating the dose-rate measurement of the last load and of the first load	AV 25 PV 430/2	X			S	X						
9.2	Checking of the heat-dissipation function by evaluating the surface-temperature measurement of the last load and of the first load	AV 28 PV 730/2	X			S	X						

		Preliminary Inspection		Documentation Inspection		
Drafted: Name: Heck Dept: TIG1 Date: 14.05.1998	Approved by Special-Dept.: Name: G.Greven Dept.: BEP Date: 15.05.1998	Approved by TZQ: Name: Eichel Dept.: TZQ 3 Date: 15.05.1998	Check mark external	Inspection - B:	Inspection - K:	Inspection - T or S:

S = Expert from the BAM

28.05.98

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GNB	Plan for Periodic Inspections on a GNS 16 Transport Cask after 60 Transport Runs or, at the Latest, after 6 Years	WKP No.: 510.060-02 E (WKP 02 for PV 120)		Index: 04	Page: 7 of: 7
		ID No.:			
Test Step	Description of the Test Step	Regulations	Tester B K (K) T/S	Anal- ysis	R e v .
			Inspection Carried out B K T/S		Analysis No. Remarks/

10	<u>Results of the Periodic Inspection:</u>														
10.1	Assessment of the inspection results		X			S	X								
10.2	Documentation check of all the above inspections		X			S	X								
10.3	Marking of the cask with the date of the next periodic inspection and drafting of a comprising certificate					S	X								
10.4	Approval for further use					S	X								

Drafted: Name: Heck Dept: TIG1 Date: 14.05.1998	Test Mark - Specialist Dept.:	Preliminary Inspection		Documentation Inspection		
		Test Mark - TZQ:	Test Mark - S (external):	Inspection - B:	Inspection - K:	Inspection - T or S:

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 PV 120 "b"

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GNB

Plan for Periodic Inspections on Shock Absorbers of a
GNS 16 Transport Cask
after 15 Transport Runs or, at the Latest, after 3 Years
- at the Earliest, prior to the next Transport Run

WKP
No.:**510.060-04 E**
(WKP 04 for PV 120)

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ID No.:

Inspection Step	Description of the Inspection Step	Specification	Tester				Certificate	Review	Inspection Carried out			Certificate No. Remarks/
			B	K	(K)	T/S			B	K	T/S	

1	Visual inspection for deformation, wear and corrosion	Deformation > 25 mm deep are undued Corrosiondefects must be repaired	X									
2	Leak tests on the welding seams	PV 117	X				X					
3	Surface-crack inspection of load-attachment points,	PV 24	X				X					
4	Checking of the bolt- elements	PV 119	X				X					
5	Marking of the shock absorbers with the date of the next periodic inspection		X									
6	Drafting of a comprising certificate		X				X					

		Preliminary Inspection		Documentation Inspection		
Drafted: Name: Crefeld Dept: TIG2 Date: 20.03.1998	Approved by Special-Dept.: Name: G.Greven Dept.: BEP Date: 23.03.1998	Approved by TZQ: Name: Eberhardt Dept.: TZQ 3 Date: 27.03.1998	Check mark external	Inspection - B:	Inspection - K:	Inspection - T or S:

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Fa. V+V

1. Bitte 2 Ordus bereitstellen und mit Deckklappen versehen (außen / innen), auch Rückenschild

2. Geordnete 2x kopieren und in die Ordus einsortieren; grobe ^{Register} ~~Leistung~~ aus Kunststoff verwenden;

~~Rechnung: Farbabbildung in der Breite
brauchen und fertig kopieren PD~~

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Kst: 79026021

Termin: 19.4.01, 11 00

Referenz: Hr. Valentin, GUS, Raum 1102
Tel: 0201/108-1209

