

WORKING SPEC. DEN\_10\_ASME rev.0 12-12-03

## Design/Manufacturing/Testing DEN-10-ASME

DEN\_10 Design\_Manuf\_Test\_ASME

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## **1 Design.**

### **1.1 Scope of validity.**

This part of the procedure describes in what manner the design has to be defined.

### **1.2 Applicable codes and standards.**

The following design codes are applicable:

General:	ISO 9001 European quality system
Pressure vessels:	ASME Section VIII
Piping:	ASME B31.3
Materials:	ASTM A269/A312/A182 ANSI B16.5/B16.9
Earthquake:	Uniform building code
Axial Bellows:	EJMA

A third party inspection company (Lloyds-Stoomwezen) will verify the design when necessary.

### **1.3 Scope of work.**

The following design calculations can be made:

Strength:	Pipe stress calculations according the codes Pressure calculations Earthquake loads and stresses on piping, vessels and supports
Process:	Pressure drop Heat load
Various:	Adsorbent volume for vacuum spaces Thermal cycle and pressure for bellows (EJMA)

### **1.4 Load cases.**

Load cases to be considered:

Cooling down mode  
Normal operation mode  
Warming up mode  
Testing modes

### **1.5 Material specification**

Shell and heads:	AISI 304 (L)
Shield:	Cu or SS thermplate
Inner-lines:	AISI 304 (L) welded
Bellows:	AISI 321 (wnr 1.4541) welded
Outer-lines:	AISI 304 (L) welded
Spacer material:	Glass epoxy type: Hgw 2372.4
Super-insulation:	Aluminium foil/glass paper
Supports:	Galvanized steel clamps and beams

## **1.6 Progress and Quality.**

In order to keep maximum control of the progress and quality of the product, the working order is defined in a production schedule and a quality plan. These documents are regularly updated.

## **2 Manufacturing**

### **2.1 Scope of validity.**

This part of the procedure describes in what manner the manufacturing has to be defined.

### **2.2 Applicable codes and standards.**

General:	ISO 9001 European quality system
Pressure vessels:	ASME Section VIII
Piping:	ASME B31.3
Materials:	ASTM A269/A312 ANSI B16.5/B16.9

A third party inspection company (Lloyds-Stoomwezen) will verify the manufacturing when necessary

### **2.3 Cleaning.**

The method and criteria for cleaning during manufacturing of vacuum-insulated lines, vessels or other work pieces in the workshop is defined in working procedure DEN-20-Cleaning.

All Piping and other work pieces are cleaned before assembly and welding. After the last production or testing step the entire inner and outer surfaces are again cleaned according above mentioned procedure.

All products, which are cleaned by DeMaCo Holland bv according to this specification, shall be labeled with a sticker: "Process clean. Keep sealed until required for use"

### **2.4 Welding**

The method and criteria for welding during manufacturing of vacuum-insulated lines, vessels or other work pieces in the workshop is defined in working procedure DEN-21-Welding.

### **2.5 Insulating procedure**

Insulating of vacuum-insulated lines, vessels or other work pieces in the workshop is defined in working procedure DEN-22-Insulating. Special trained people are assigned for applying the insulation, molecular sieves and Demaliet.

### **2.6 Evacuating and bake-out procedure.**

Evacuating and baking out vacuum-insulated lines, vessels or other work pieces in the workshop is defined in working procedure DEN-24-EB. Special trained people are assigned for vacuum application, and are responsible for maintenance and proper functioning of the vacuum and testing equipment.

The procedure is divided in three phases:

Pre-pump phase.  
Leaktesting phase  
Turbo pumping phase

The Vacuumlevel 24 hrs after finishing the last phase must be better then  $1 \times 10^{-3}$  mbar

## **2.7 Packaging procedure.**

Packaging of vacuum-insulated lines, vessels or other work pieces in the workshop is defined in working procedure DEN-24-Packing. Depending on the means of transport, road, air etc, precautions will be taken and proper materials will be used. Special trained people are assigned for packaging the goods in this way risk of damage during transport is minimized.

## **3 Testing**

### **3.1 Scope of validity**

This part of the procedure describes all methods of testing in the workshop during and after production.

### **3.2 Applicable codes and standards**

ISO 9001:	International Quality System
ASME IX (EN 287-288):	Welding procedures and performance tests
ASME V - RT21003/5:	Radiographic Examination Procedure
EN 10204/3.1B:	Material certificates
EJMA:	Axial Bellows for process and vacuum pipes

### **3.3 Helium leak testing**

Helium leak testing of vacuum-insulated lines, vessels or other work pieces in the workshop is defined in working procedure DEN-30-Heliumleaktest. Special trained people are assigned for helium leaktesting, and are responsible for maintenance and proper functioning of the testing equipment.

#### **3.3.1 Test description**

All pre-assemblies must be helium leak tested before final assembly. There are three possibilities to perform the test: Method 1 (for pre assembled parts), Method 2 (for outer pipes) and Method 3 Helium leak testing combined with the pressure test (for inner pipes)

After satisfied results the object shall be marked with "Tested". If there is a leak, the object shall be marked with "Rejected: and repairing shall be executed at once and the quality inspector shall be informed. All rejected items shall be re-tested according the procedure.

### **3.4 X-Ray testing**

All x-ray testing and examination will be executed by

RTD BV  
Delftweg 144  
NL-3004 AB Rotterdam  
Telephone: 31-10208 8208  
Tefax: 31-10415 8022

Testing and examination will be executed according the applicable procedures regarding the design-code.

### **3.5 Pressure testing**

Pressure testing of vacuum-insulated lines, vessels or other work pieces in the workshop is defined in working procedure DEN-31-Pressuretest. Special trained people are assigned for pressure testing, and are responsible for maintenance and proper functioning of the testing equipment.

The surrounding area shall be clearly marked as dangerous zone and kept clear of all non-authorized persons.

The pressure tests will be done with water at ambient temperature (5 °C => 30 °C).  
Pt is normally set at 1,43 x Pd. When the pressure test is done before establishing the insulation vacuum, the testing pressure should be corrected for this by or establishing a low level vacuum of 10 mbar max. Or adding 1 bar to the testing pressure.

### **3.6 Dimensional testing**

Dimensional testing of vacuum-insulated lines, vessels or other work pieces in the workshop is executed by special trained people they and are responsible for maintenance and proper functioning of the testing equipment. The dimension tests shall be done with calibrated measurement equipment.

#### **3.6.1 Material entrance**

All material purchased by others shall be subject to a dimension test. In case of serial manufactured products a random test is admissible.

Test equipment must be chosen in relation to the testing object and the required tolerances, which are indicated on the drawings.

In case of non-conformity's a report goes to the quality inspector, who will define the progress.

#### **3.6.2 Assemblies**

All assemblies shall be checked for measuring according to the approved drawing(s) and the applicable test-certificate will be signed.

After completeness of the measuring the applicable test-certificate must be handed over to the quality inspector.

### **3.7 Cold shock testing.**

Cold shock testing of vacuum-insulated lines, vessels or other work pieces in the workshop is defined in working procedure DEN-32-Coldshocktest. Special trained people are assigned for cold shock testing, and are responsible for maintenance and proper functioning of the testing equipment.

The purpose of the test is to detect possible defects in insulation materials and /or functioning of the equipment at low temperatures.

The test shall be performed in a clean environment, with a temperature varying between 10 and 30 °C and humidity below 70%.

The surrounding area shall be clearly marked as dangerous zone and kept clear of all non-authorized persons. Provisions should be taken for sufficient ventilation, to avoid asphyxiation.

The vacuum shall drop to  $1 \cdot 10^{-4}$  mbar or better.

### **3.8 Vacuum retention testing**

Vacuum retention testing of vacuum-insulated lines, vessels or other work pieces in the workshop is defined in working procedure DEN-33-Vacuumretentiontest. Special trained people are assigned for vacuum retention testing, and are responsible for maintenance and proper functioning of the testing equipment.

The purpose of this test is quantification of the insulation vacuum. With this, the behavior of this vacuum in time can be predicted.

The end-vacuum level after 24 hours must be better than  $2 \times 10^{-4}$  mbar

### **3.9 Particle testing.**

Particle testing will be performed by an independent company. The spools will be flushed by a flow of dry clean nitrogen gas. A bypass is placed on the outlet side of the pipe and an electronic pick-up will detect any particles present. Test is satisfactory when the specified values are reached.



### **3.10 Testing reports**

The testing reports are in accordance with the client specifications and in accordance with the contract.

The testing reports shall contain at least:

- Applicable test procedure
- Date of examination
- Location
- Name of tester
- Material identification (section number)
- Test data (temp.- Duration- time)
- Description of any deviation to the procedure
- Description if any retest is required
- Final results of the test(s)

### **3.11 Calibration of test equipment**

#### **3.11.1 Helium leak tester:**

The helium leak test is performed with an "Alcatel type ASM-180t" leak test unit, which is auto, calibrated every time when it starts up. The helium quality is N45 (< 99,995 %). The equipment is auto self-calibrating.

#### **3.11.2 Manometers:**

Each manometer must be calibrated before use to the measure manometer, which is calibrated and approved by a third party.

This measure manometer must be approved every year by weekly use. A calibration report must accompany the manometer.

The calibrated manometer is stored at the testing department.

#### **3.11.3 Dimension measure equipment:**

All dimension measure equipment shall be indicated with a reference number. The calibration report shall contain at least:

- Date of calibration
- Person and organization who performed the calibration
- The measure equipment for calibration
- The interval of calibration