



<u>“CIRCUIT” TYPE (NUCLEAR) ASSEMBLY</u>	<u>A(n) (nuclear) assembly intended to transport fluid inside the nuclear island. It may be considered as a single assembly as long as it transports fluids with compatible properties and it is designed in its entirety, or by charging zones, for compatible maximum allowable pressure. The assembly only includes full equipment items or full assemblies. For example, an exchanger can only be included in its entirety</u>
“SET OF EQUIPMENT” TYPE (NUCLEAR) ASSEMBLY	A(n) (nuclear) assembly that does not necessarily ensure fluid continuity, but in which the equipment is grouped together for integration needs (i.e. reactor coolant pump with its cooling and sealing systems, vessel with control rod drive mechanisms, valve with sleeves and bypass, etc.)
PRESSURISED COMPARTMENT OF A(N) (NUCLEAR) ASSEMBLY	A compartment corresponds to a pressurised part of the (nuclear) assembly that can be isolated using isolation valves or that is at the supply limit.
ASSEMBLY MANUFACTURER	Natural or legal person responsible for design and assembly of several pressure equipment or nuclear pressure equipment items to form a(n) (nuclear) assembly with an aim to provide the assembly for sale on the market under its name, or to use the assembly for its own purposes.
LINEUP	System configuration (valves open, valves closed, pump in operation, pump stopped, pressure and temperature conditions).
INSPECTOR	<p>In terms of technical inspection, a person responsible with respect to a Manufacturer or Supplier for checking compliance with the documents attached to the order received by the Manufacturer or Supplier, with the present Code and with the documents drawn up in application of the latter.</p> <p>The Inspector may or may not be a member of the Manufacturer's or the Supplier's staff, but he can in no way fulfill the role of both inspector and surveillance agent for the same equipment.</p>
SURVEILLANCE AGENT	<p>Person independent of the Supplier concerned, commissioned by the Manufacturer to ensure that the equipment is constructed and inspected in compliance with the documents attached to the order placed with the Supplier, with the present Code and with the documents drawn up in application of the latter.</p> <p>This definition does not designate the organizations to which the Surveillance Agents belong, the scope of their duties or the means of action available to them. These provisions are detailed with regard to the regulations, elsewhere.</p>

**- DETERMINATION OF  $RT_{NDT}$  TEMPERATURE**

$RT_{NDT}$  temperature is determined by conducting Pellini drop weight tests and KV impact tests.

The procedure for determining  $RT_{NDT}$  temperature is given in MC 1000.

The longitudinal axis of the KV test specimens must be located at a distance from the inner face of the wall equal to a quarter of the wall thickness.

The Pellini drop weight test specimens shall be cut out within the area between the quarter inner quarter and half the thickness of the shell.

The test-pertinent area of the test specimens must be located at a distance from the quenched end equal to the thickness of the part.

For this requirement to be met, the bottom end of the part may be protected by a thermal buffer, the height of which at least equals the thickness of the part. This buffer may be welded to the part.

The notch axes of the impact test specimens shall be perpendicular to the surface.

The number of tests to be performed, test specimen orientation and testing temperatures are given in table A1.

KV impact test specimens shall be taken from adjacent or end-to-end locations. The shape and dimensions of these specimens, as well as test procedures, are specified in MC 1000.

Each series of test will consist in the fracture of three test specimens.

Fracture appearance and lateral expansion value of test specimens shall be recorded for information purposes.

Pellini drop weight test specimens shall be taken from adjacent or end-to-end locations. The shape and dimensions of test specimens, as well as test procedures are specified in MC 1000.

**RESULTS**

$RT_{NDT}$  must be determined. The value must be less than or equal to  $-20\text{ }^{\circ}\text{C}$ .

**- DETERMINATION OF  $RT_{NDT}$  TEMPERATURE**

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The Pellini drop weight test specimens shall be cut-out within the area between the quarter inner quarter and half the thickness of the shell.

The test-pertinent area of the test specimens must be located at a distance from the quenched end equal to the thickness of the part.

For this requirement to be met, the bottom end of the part may be protected by a thermal buffer, the height of which at least equals the thickness of the part. This buffer may be welded to the part.

The notch axes of the impact test specimens shall be perpendicular to the surface.

The number of tests to be performed, test specimen orientation and testing temperatures are given in table A1.

KV impact test specimens shall be taken from adjacent or end-to-end locations. The shape and dimensions of these specimens, as well as test procedures, are specified in MC 1000.

Each series of tests will consist in the fracture of three test specimens.

Fracture appearance and lateral expansion value of test specimens shall be recorded for information purposes.

Pellini drop weight test specimens shall be taken from adjacent or end-to-end locations. The shape and dimensions of test specimens, as well as test procedures, are specified in MC 1000.

**RESULTS**

$RT_{NDT}$  must be determined. The value must be less than or equal to  $-20\text{ }^{\circ}\text{C}$ .

## 3.2 FORGING

There shall be sufficient discard to ensure elimination of shrinkage cavities and most segregation. A record of ingot weight and discard percentages shall be kept at the disposal of Surveillance Agents.

Overall ratio of reduction calculated in accordance with M 380 shall be greater than 3.

## 3.3 MACHINING

### 3.3.1 Before heat treatment for mechanical properties

Before heat treatment for mechanical properties, the profile of the rough-machined part shall correspond as closely as possible to the as-delivered profile. These profiles shall be given in the manufacturing programme (paragraph 3.1).

### 3.3.2 After heat treatment for mechanical properties

The part shall be machined to its as-delivered profile prior to final ultrasonic examination.

## 3.4 DELIVERY CONDITION - HEAT TREATMENT

The part shall be delivered in the as-treated condition. This treatment, which is called heat treatment for mechanical properties, shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling. ~~Normal~~ Nominal holding temperature for tempering shall be between 635°C and 665°C.

Temperatures shall be measured by means of thermocouples placed on the part. Thermocouple locations shall be specified in the manufacturing programme (see paragraph 3.1).

Records shall be evaluated by the Supplier.

If the part is to be retreated (see paragraph 4.4), the retreatment shall be performed in accordance with the same instructions as above.

## 3.5 STRUCTURE

Where required by the equipment specification, micrographic examination, including photography, shall be carried out on a longitudinal section.

The austenitic grain size number, as determined in accordance with MC 1330, shall be greater than or equal to 5.

**ANNEX 1 TO SPECIFICATION M 2112**  
**DETERMINATION OF  $RT_{NDT}$  TEMPERATURE**  
**AND UPPER SHELF KV ENERGY**

**SUPPLEMENTARY TESTS**

These supplementary tests shall be performed on the bottom test ring where required by equipment specifications or other relevant contractual documents.

**- KV TRANSITION CURVE**

The longitudinal axis of the KV test specimens must be located at a distance from the inner face of the wall equal to a quarter of the wall thickness.

The test-pertinent area of the test specimens must be located at a distance from the quenched end equal to the thickness of the part. For this requirement to be met, the bottom end of the part may be protected by a thermal buffer, the height of which at least equals the thickness of the part; This buffer may be welded to the part.

The notch axes of the impact test specimens shall be perpendicular to the surface.

The number of tests to be performed, test specimen orientation and testing temperatures are given in table A1.

KV impact test specimens shall be taken from adjacent or end-to-end locations. The shape and dimensions of these specimens, as well as test procedures, are specified in MC 1000.

Each series of test will consist in the fracture of three test specimens.

Fracture appearance and lateral expansion value of test specimens shall be recorded for information purposes.

**RESULTS**

The transition curve is plotted for information purposes only.

**- DETERMINATION OF KV ENERGY IN THE UPPER SHELF**

This value is determined through a series of tests.

The specimen taking and test conditions are identical to the previous paragraph except for the orientation of the notch axes, which must be parallel to the surface.

**RESULTS**

The fracture energy measured must be greater than or equal to 130 J.

**- DETERMINATION OF  $RT_{NDT}$  TEMPERATURE**

$RT_{NDT}$  temperature is determined by conducting Pellini drop weight tests and KV impact tests.

The procedure for determining  $RT_{NDT}$  temperature is given in MC 1000.

The longitudinal axis of the KV test specimens must be located at a distance from the inner face of the wall equal to a quarter of the wall thickness.

The Pellini drop weight test specimens shall be cut-out within the area between the inner quarter and half the thickness of the shell.

The test-pertinent area of the test specimens shall be located at a distance from the flat surface not smaller than the thickness of the part. For this requirement to be met, the bottom end of the part may be protected by a thermal buffer, the height of which at least equals the thickness of the part, that may be welded to the part.

The notch axes of the impact test specimens shall be perpendicular to the surface.

The number of tests to be performed, test specimen orientation and testing temperatures are given in table A1.

**TABLEAU A1**

NAME OF TEST	CONDITION OF SPECIMENS	ORIENTATION OF SPECIMEN	TEST TEMPERATURE IN °C	NUMBER OF LOTS	NUMBER OF SPECIMENS PER LOT
Ductile-to brittle transition curve (KV impact)	HTMP + SSRHT	T	(1)	2 { 1 1	8
RT <sub>NDT</sub>					7
Pellini	HTMP + SSRHT	C	(2)	2	4
KV impact	HTMP + SSRHT	T	(2)	2	9
<p>Key:</p> <p>HTMP = heat treatment for mechanical properties                      SSRHT = simulated stress relieving heat treatment                      C = circumferential                      T = transverse</p> <p>(1) Tests shall be performed at 5 temperatures, one of which must be 0° C ; the shape of the upper shelf of the curve shall be defined as accurately as possible.                      (2) Test temperatures are given in MC 1000.</p> <p><b>Note :</b> Sample results required in table III, which correspond to the same sampling and heat treatment, may be used.                      - When two sets of test specimens are called for, one of them shall be taken per sample.                      - When one set of test specimens is called for, it can be taken from any sample.</p>					

KV impact test specimens shall be taken from adjacent or end-to-end locations. The shape and dimensions of these specimens, as well as test procedures, are specified in MC 1000.

Each series of test will consist in the fracture of three test specimens.

Fracture appearance and lateral expansion value of test specimens shall be recorded for information purposes.

Pellini drop weight test specimens shall be taken from adjacent or end-to-end locations. The shape and dimensions of test specimens, as well as test procedures are specified in MC 1000.

## 3.2 FORGING

There shall be sufficient discard to ensure elimination of shrinkage cavities and most segregation. A record of ingot weight and discard percentages shall be kept at the disposal of Surveillance Agents.

Overall ratio of reduction calculated in accordance with M 380 shall be greater than 3.

## 3.3 MACHINING

### 3.3.1 Before heat treatment for mechanical properties

Before heat treatment for mechanical properties, the profile of the rough-machined part shall correspond as closely as possible to the as-delivered profile. These profiles shall be given in the manufacturing programme (see paragraph 3.1).

### 3.3.2 After heat treatment for mechanical properties

The part shall be machined to its as-delivered profile prior to final ultrasonic examination.

## 3.4 DELIVERY CONDITION - HEAT TREATMENT

The part shall be delivered in the as-treated condition. This treatment, which is called heat treatment for mechanical properties, shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling.

Nominal Holding temperature for tempering shall be between 635°C and 665°C. Temperatures shall be measured by means of thermocouples placed on the part. Thermocouple locations on the part shall be stipulated in the manufacturing programme (see paragraph 3.1).

Records shall be evaluated by the Supplier.

If the part is to be retreated (see paragraph 4.4), the retreatment shall be performed in accordance with the same instructions as above.

## 3.5 STRUCTURE

Where required by the equipment specification, micrographic examination, including photography, shall be carried out on a longitudinal section.

The austenitic grain size number, as determined in accordance with MC 1330, shall be greater than or equal to 5.

## 4 MECHANICAL PROPERTIES

### 4.1 REQUIRED VALUES

Mechanical strength requirements are shown in table II.



### 3.2 FORGING

There shall be sufficient discard to ensure elimination of shrinkage cavities and most segregation. A record of ingot weight and discard percentages shall be kept at the disposal of Surveillance Agents.

Overall ratio of reduction calculated in accordance with M 380 shall be greater than 3.

### 3.3 MACHINING

#### 3.3.1 Before heat treatment for mechanical properties

Before heat treatment for mechanical properties, the profile of the rough-machined part shall correspond as closely as possible to the as-delivered profile. These profiles shall be given in the manufacturing programme (see paragraph 3.1).

#### 3.3.2 After heat treatment for mechanical properties

The part shall be machined to its as-delivered profile prior to final ultrasonic examination.

### 3.4 DELIVERY CONDITION - HEAT TREATMENT

The part shall be delivered in the as-treated condition. This treatment, which is called heat treatment for mechanical properties, shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling.

Nominal Holding temperature for tempering shall be between 630°C and 660°C. The measured tempering temperature of the part shall not be less than 621°C. The maximum permissible deviation applicable to the tempering temperature ( $\pm 15^\circ\text{C}$  according to F 8140) is valid for the nominal temperature but it does not allow temperatures measured on the part less than 621°C, even if the nominal tempering temperature is less than 636°C. Temperatures shall be measured by means of thermocouples placed on the part. Thermocouple locations on the part shall be stipulated in the manufacturing program (see paragraph 3.1)

Records shall be evaluated by the Supplier.

If the part is to be retreated (see paragraph 4.4), the retreatment shall be performed in accordance with the same instructions as above.

### 3.5 STRUCTURE

Where required by the equipment specification, micrographic examination, including photography, shall be carried out on a longitudinal section.

The austenitic grain size number, as determined in accordance with MC 1330, shall be greater than or equal to 5.

The various heat treatment, sampling and non-destructive examination operations shall be presented in chronological order.

For parts whose weight does not exceed 250 kg in the as-delivered condition, no manufacturing programme shall be required, unless otherwise specified in the purchase order.

## **3.2 FORGING**

There shall be sufficient discard to ensure elimination of shrinkage cavities and most segregation. A record of ingot weight and discard percentages shall be kept at the disposal of Surveillance Agents.

Overall ratio of reduction calculated in accordance with M 380 shall be greater than 3.

## **3.3 MACHINING**

### **3.3.1 Before heat treatment for mechanical properties**

Before heat treatment for mechanical properties, the profile of the rough-machined part shall correspond as closely as possible to the as-delivered profile. These profiles shall be given in the manufacturing programme (paragraph 3.1).

### **3.3.2 After heat treatment for mechanical properties**

The part shall be machined to its as-delivered profile prior to final ultrasonic examination.

## **3.4 DELIVERY CONDITION - HEAT TREATMENT**

The part shall be delivered in the as-treated condition. This treatment, which is called heat treatment for mechanical properties shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water or water spraying,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling.

Nominal Hholding temperature for tempering shall be between 635°C and 665°C. Temperatures shall be measured by means of thermocouples placed on the part. Thermocouple locations on the part shall be stipulated in the manufacturing programme (see paragraph 3.1).

In the case of a heat treatment lot comprising several parts, at least a thermocouple is placed on the load. Thermocouple locations on the part shall be stipulated in the manufacturing programme (see paragraph 3.1).

Records shall be evaluated by the Supplier.

If the part is to be retreated (see paragraph 4.4), the retreatment shall be performed in accordance with the same instructions as above.

The various heat treatments, sampling and non-destructive examination operations shall be presented in chronological order.

For parts whose weight does not exceed 250 kg in the as-delivered condition, no manufacturing programme shall be required, unless otherwise specified in the purchase order.

## **3.2 FORGING**

There shall be sufficient discard to ensure elimination of shrinkage cavities and most segregation. A record of ingot weight and discard percentages shall be kept at the disposal of Surveillance Agents.

Overall ratio of reduction calculated in accordance with M 380 shall be greater than 3.

## **3.3 MACHINING**

### **3.3.1 Before heat treatment for mechanical properties**

Before heat treatment for mechanical properties, the profile of the rough-machined part shall correspond as closely as possible to the as-delivered profile. These profiles shall be given in the manufacturing programme (paragraph 3.1).

### **3.3.2 After heat treatment for mechanical properties**

The part shall be machined to its as-delivered profile prior to final ultrasonic examination.

## **3.4 DELIVERY CONDITION - HEAT TREATMENT**

The part shall be delivered in the as-treated condition. This treatment, which is called heat treatment for mechanical properties shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water or water spraying,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling.

Nominal Holding temperature for tempering shall be between 630°C and 660°C. The measured tempering temperature of the part shall not be less than 621°C. The maximum permissible deviation applicable to the tempering temperature ( $\pm 15^\circ\text{C}$  according to F 8140) is valid for the nominal temperature but it does not allow temperatures measured on the part less than 621°C, even if the nominal tempering temperature is less than 636°C. Temperatures shall be measured by means of thermocouples placed on the part. Thermocouple locations on the part shall be stipulated in the manufacturing program (see paragraph 3.1)

In the case of a heat treatment lot comprising several parts, at least a thermocouple is placed on the load. Thermocouple locations on the part shall be stipulated in the manufacturing programme (see paragraph 3.1).

Records shall be evaluated by the Supplier.

If the part is to be retreated (see paragraph 4.4), the retreatment shall be performed in accordance with the same instructions as above.

### 3.2 ROLLING

There shall be sufficient discard to ensure elimination of shrinkage cavities and most segregation. A record of ingot weight and top and bottom end discard percentages shall be kept at the disposal of Surveillance Agents.

### 3.3 DELIVERY CONDITION - HEAT TREATMENT

#### 3.3.1 Delivery in the as-treated condition

The plates shall be delivered in the as-treated condition. This treatment, which is called heat treatment for mechanical properties, shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling,

Nominal Hholding temperature for tempering shall be between 635°C and 665°C. Holding time at that temperature shall depend on the thickness of the plate, on the minimum basis of half an hour per 25 mm of thickness.

Records shall be evaluated by the Supplier.

If the part is to be retreated (see paragraph 4.4), the retreatment shall be performed in accordance with the same instructions as above.

#### 3.3.2 Delivery in a condition other than as-treated

The plates can be delivered in a condition other than the as-treated condition, at the request of the formed head Suppliers, and with the agreement of the Supplier and the Contractor, provided that the formed head Supplier can prove that the hot forming and heat treatment equipment in its possession, as well as the manufacturing methods employed and its experience in this field, enable it to obtain mechanical properties over the entire completed part equivalent to those obtained in the same areas by the steelmaker of the original steel plate after heat treatment for mechanical properties. These provisions are part of the qualification procedure according to M 140 of the head manufacturing programme.

### A - PLATES FOR FORMING WITHOUT PRIOR WELDING

The plates can be delivered untreated, in this case, the test samples shall undergo simulated heat treatment for mechanical properties according to the requirements of M 151. This treatment shall be carried out in compliance with the requirements of paragraph 3.3.1.

The cycles corresponding to the simulated heat treatment for mechanical properties shall be recorded and written up in a report.

## 3.2 ROLLING

There shall be sufficient discard to ensure elimination of shrinkage cavities and most segregation. A record of ingot weight and top and bottom end discard percentages shall be kept at the disposal of Surveillance Agents.

## 3.3 DELIVERY CONDITION - HEAT TREATMENT

### 3.3.1 Delivery in the as-treated condition

The plates shall be delivered in the as-treated condition. This treatment, which is called heat treatment for mechanical properties, shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling,

Nominal Hholding temperature for tempering shall be between 630°C and 660°C. The measured tempering temperature of the part shall not be less than 621°C. The maximum permissible deviation applicable to the tempering temperature ( $\pm 15^\circ\text{C}$  according to F 8140) is valid for the nominal temperature but it does not allow temperatures measured on the part less than 621°C, even if the nominal tempering temperature is less than 636°C. Holding time shall be selected depending on plate thickness, on the minimum basis of half an hour for every 25 mm in thickness

Records shall be evaluated by the Supplier.

If the part is to be retreated (see paragraph 4.4), the retreatment shall be performed in accordance with the same instructions as above.

### 3.3.2 Delivery in a condition other than as-treated

The plates can be delivered in a condition other than the as-treated condition, at the request of the formed head Suppliers, and with the agreement of the Supplier and the Contractor, provided that the formed head Supplier can prove that the hot forming and heat treatment equipment in its possession, as well as the manufacturing methods employed and its experience in this field, enable it to obtain mechanical properties over the entire completed part equivalent to those obtained in the same areas by the steelmaker of the original steel plate after heat treatment for mechanical properties. These provisions are part of the qualification procedure according to M 140 of the head manufacturing programme.

## A - PLATES FOR FORMING WITHOUT PRIOR WELDING

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The cycles corresponding to the simulated heat treatment for mechanical properties shall be recorded and written up in a report.

- position of acceptance test samples on the part,
- drawing with position of test specimens on samples.

The various heat treatments, sampling and non-destructive examination operations shall be presented in chronological order.

## **3.2 FORGING**

There shall be sufficient discard to ensure elimination of shrinkage cavities and most segregation. A record of ingot weight and discard percentages shall be kept at the disposal of Surveillance Agents.

Overall ratio of reduction calculated in accordance with M 380 shall be greater than 3.

## **3.3 MACHINING**

### **3.3.1 Before heat treatment for mechanical properties**

Before heat treatment for mechanical properties, the profile of the rough-machined part shall correspond as closely as possible to the as-delivered profile. These profiles shall be given in the manufacturing programme (paragraph 3.1).

### **3.3.2 After heat treatment for mechanical properties**

The part shall be machined to its as-delivered profile prior to final ultrasonic examination.

## **3.4 DELIVERY CONDITION - HEAT TREATMENT**

The parts shall be delivered in the as-treated condition. This treatment, which is called heat treatment for mechanical properties, shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling.

Nominal Holding temperature for tempering shall be between 635°C and 665°C. Temperature shall be measured by means of thermocouples placed on the part. Thermocouple locations on the part shall be stipulated in the manufacturing programme (see paragraph 3.1).

This heat treatment is performed in conformance with M 150 requirement.

Records shall be evaluated by Supplier.

If the part is to be retreated (see paragraph 4.4), the retreatment shall be performed in accordance with the same instructions as above.

## **3.5 STRUCTURE**

Where required by the equipment specification, micrographic examination, including photography, shall be carried out on a longitudinal section.

The austenitic grain size number, as determined in accordance with MC 1330, shall be greater than or equal to 5.

The various heat treatments, sampling and non-destructive examination operations shall be presented in chronological order.

## **3.2 FORGING**

There shall be sufficient discard to ensure elimination of shrinkage cavities and most segregation. A record of ingot weight and discard percentages shall be kept at the disposal of Surveillance Agents.

Overall ratio of reduction calculated in accordance with M 380 shall be greater than 3.

## **3.3 MACHINING**

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Before heat treatment for mechanical properties, the profile of the rough-machined part shall correspond as closely as possible to the as-delivered profile. These profiles shall be given in the manufacturing programme (paragraph 3.1).

### **3.3.2 After heat treatment for mechanical properties**

The part shall be machined to its as-delivered profile prior to final ultrasonic examination.

## **3.4 DELIVERY CONDITION - HEAT TREATMENT**

The parts shall be delivered in the as-treated condition. This treatment, which is called heat treatment for mechanical properties, shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling.

**Nominal Holding** temperature for tempering shall be between 630°C and 660°C. The measured tempering temperature of the part shall not be less than 621°C. The maximum permissible deviation applicable to the tempering temperature ( $\pm 15^\circ\text{C}$  according to F 8140) is valid for the nominal temperature but it does not allow temperatures measured on the part less than 621°C, even if the nominal tempering temperature is less than 636°C. Temperatures shall be measured by means of thermocouples placed on the part. Thermocouple locations on the part shall be stipulated in the manufacturing program (see paragraph 3.1)

This heat treatment is performed in conformance with M 150 requirement.

Records shall be evaluated by Supplier.

If the part is to be retreated (see paragraph 4.4), the retreatment shall be performed in accordance with the same instructions as above.

## **3.5 STRUCTURE**

Where required by the equipment specification, micrographic examination, including photography, shall be carried out on a longitudinal section.

The austenitic grain size number, as determined in accordance with MC 1330, shall be greater than or equal to 5.



### 3.3 DELIVERY CONDITION - HEAT TREATMENT

The dome shall be delivered in the heat-treated condition. This treatment for mechanical properties shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling.

The nominal holding temperature for tempering shall be between 635°C and 665°C. The temperature shall be measured by means of thermocouples placed on the part. As a minimum, one thermocouple shall be placed on the edge of the part and one on the nozzle. Thermocouple locations on the part shall be stipulated in the manufacturing programme (para. 3.1).

This heat treatment is performed in conformance with M 150 requirement.

Records shall be evaluated by the forging mill manager or the Supplier.

### 3.4 STRUCTURE

Where required by the equipment specification, micrographic examination, including photography, shall be carried out on a longitudinal section.

The austenitic grain size number, as determined in accordance with MC 1330, shall be greater than or equal to 5.

## 4 MECHANICAL PROPERTIES

### 4.1 REQUIRED VALUES

Mechanical properties requirements are shown in Table II.

### 4.2 SAMPLING

The samples for mechanical testing shall be taken from two attached test rings, one on the nozzle excess length or reinforcement (test ring 1, see Annex 1), the other one (test ring 2, see Annex 2) on the excess length at the blank edge.

Samples shall be taken after the dome has been heat treated for mechanical properties.

Test samples shall be taken from each test ring at two diametrically opposed locations X and Y from a test ring; they shall be clearly identified and the major working direction shall be indicated.

The test specimens shall be cut out in such a way that their centreline is at one quarter of the head thickness, from the inside face.

Samples taken from the nozzle excess length or reinforcement (test ring 1) shall be cut in such a way that their test pertinent area is 60 mm away from the cylindrical profile and less than 40 mm from any other surface.



### 3.3 DELIVERY CONDITION - HEAT TREATMENT

The dome shall be delivered in the heat-treated condition. This treatment for mechanical properties shall consist of the following operations :

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling.

**Nominal Holding** temperature for tempering shall be between 630°C and 660°C. The measured tempering temperature of the part shall not be less than 621°C. The maximum permissible deviation applicable to the tempering temperature ( $\pm 15^\circ\text{C}$  according to F 8140) is valid for the nominal temperature but it does not allow temperatures measured on the part less than 621°C, even if the nominal tempering temperature is less than 636°C. Temperatures shall be measured by means of thermocouples placed on the part. Thermocouple locations on the part shall be stipulated in the manufacturing program (see paragraph 3.1)

This heat treatment is performed in conformance with M 150 requirement.

Records shall be evaluated by the forging mill manager or the Supplier.

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Where required by the equipment specification, micrographic examination, including photography, shall be carried out on a longitudinal section.

The austenitic grain size number, as determined in accordance with MC 1330, shall be greater than or equal to 5.

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Samples shall be taken after the dome has been heat treated for mechanical properties.

Test samples shall be taken from each test ring at two diametrically opposed locations X and Y from a test ring; they shall be clearly identified and the major working direction shall be indicated.

The test specimens shall be cut out in such a way that their centreline is at one quarter of the head thickness, from the inside face.

Samples taken from the nozzle excess length or reinforcement (test ring 1) shall be cut in such a way that their test pertinent area is 60 mm away from the cylindrical profile and less than 40 mm from any other surface.

The part shall be delivered in the as-treated condition. This treatment, which is called heat treatment for mechanical properties, shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling.

Nominal Holding temperature for tempering shall be between 635°C and 665°C. Temperature shall be measured by means of thermocouples placed on the part. Selected temperatures and thermocouple locations on the part shall be stipulated in the manufacturing programme (see paragraph 3.1).

Records shall be evaluated by the Supplier.

If the part to be retreated (see paragraph 4.4), the retreatment shall be performed in accordance with the same instructions as above.

### **3.4 STRUCTURE**

Where required by the equipment specification, micrographic examination, including photography, shall be carried out on a longitudinal section.

The austenitic grain size number, as determined in accordance with MC 1330, shall be greater than or equal to 5.

## **4 MECHANICAL PROPERTIES**

### **4.1 REQUIRED VALUES**

Mechanical strength requirements are shown in table II.

### 3.3 DELIVERY CONDITION - HEAT TREATMENT

Before heat treatment for mechanical properties, the profile of the rough machined part shall correspond as closely as possible to the as-delivered profile.

The part shall be delivered in the as-treated condition. This treatment, which is called heat treatment for mechanical properties, shall consist of the following operations:

- austenitizing at a temperature between 850°C and 925°C,
- quenching by immersion in water,
- tempering at a temperature selected so as to obtain the required properties, followed by still air cooling.

Nominal Hholding temperature for tempering shall be between 630°C and 660°C. The measured tempering temperature of the part shall not be less than 621°C. The maximum permissible deviation applicable to the tempering temperature ( $\pm 15^\circ\text{C}$  according to F 8140) is valid for the nominal temperature but it does not allow temperatures measured on the part less than 621°C, even if the nominal tempering temperature is less than 636°C. Temperatures shall be measured by means of thermocouples placed on the part. Thermocouple locations on the part shall be stipulated in the manufacturing program (see paragraph 3.1)

Records shall be evaluated by the Supplier.

If the part to be retreated (see paragraph 4.4), the retreatment shall be performed in accordance with the same instructions as above.

### 3.4 STRUCTURE

Where required by the equipment specification, micrographic examination, including photography, shall be carried out on a longitudinal section.

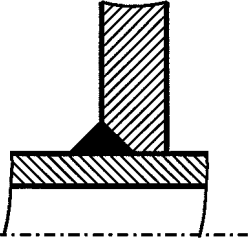
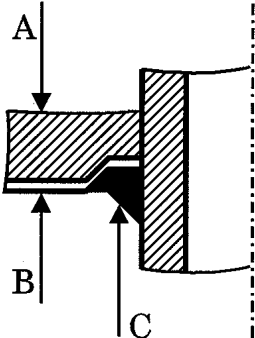
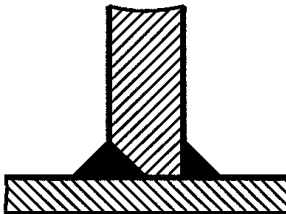
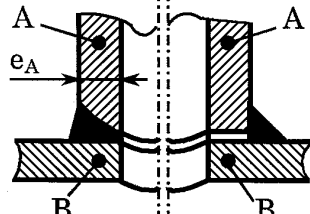
The austenitic grain size number, as determined in accordance with MC 1330, shall be greater than or equal to 5.

## 4 MECHANICAL PROPERTIES

### 4.1 REQUIRED VALUES

Mechanical strength requirements are shown in table II.

**TABLE S 7710.1 (cont. 2)**  
**GENERAL REQUIREMENTS**

TYPE	EXAMINATION AFTER WELDING			
	AUSTENITIC →	FERRITIC →	Non-destructive examination	Criteria
<b>3 : PARTIAL PENETRATION FILLET WELD</b>  3.1 General case  (as per B 3353.3)			MT or PT (if MT cannot be performed)  RT*  PT  RT*	S 7714.2 S 7714.1  S 7714.3  S 7714.1  S 7714.3
3.2 (with buttering for dissimilar joint) 	On finished buttering (B) before welding (C)		PT UT PT	S 7714.1 S 7714.4 S 7714.1
	On finished weld (C)		PT RT*	S 7714.1 S 7714.3
* If RAD cannot be performed, carry out UT If neither RT or UT can be performed, see « Examination during operation »				
3.3 Minor permanent attachment  (Suivant B 3354)			MT ou PT (if MT cannot be performed)  PT	S 7714.2 S 7714.1  S 7714.1
<b>4 : TEMPORARY ATTACHMENTS</b> 	On part B after elimination and reworking of surface condition <u>surface finishing</u>		MT UT (5) PT UT (5)	S 7714.2  See TOME II S 7714.1  See TOME II

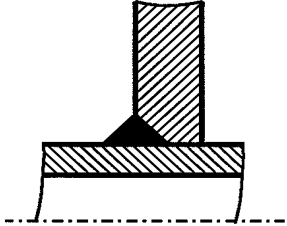
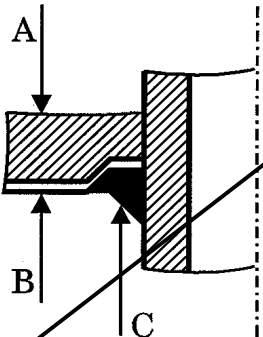
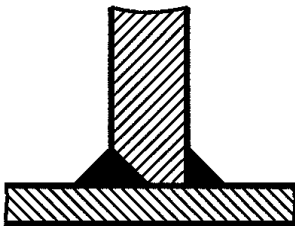
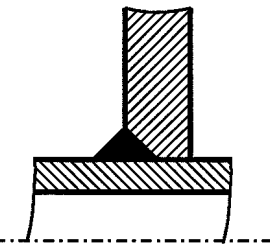
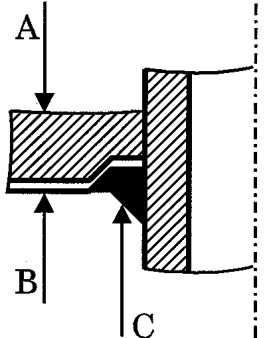
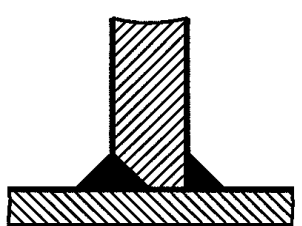
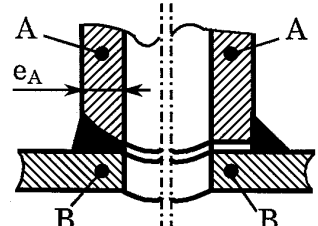
TYPE	EXAMINATION AFTER WELDING			
	AUSTENITIC →	FERRITIC →	Non-destructive examination	Criteria
<p>3 : PARTIAL PENETRATION FILLET WELD</p> <p>3.1 General case</p>  <p>(as per B 3353.3)</p>		x	MT or PT (if MT cannot be performed)  RT* PT RT*	S 7714.2 S 7714.1  S 7714.3 S 7714.1 S 7714.3
<p>3.2 (with buttering for dissimilar joint)</p> 	On finished buttering (B) before welding (C)  if UT cannot be performed : inside surface of hole after drilling to defined diameter on buttering base metal weld junction	x x x	PT UT PT	S 7714.1 S 7714.4 S 7714.1
	On finished weld (C)	x x	PT RT*	S 7714.1 S 7714.3
* If RAD cannot be performed, carry out UT If neither RT or UT can be performed, see « Examination during operation »				
<p>3.3 Minor permanent attachment</p>  <p>(as per B 3354)</p>		x	MT or PT (if MT cannot be performed)  PT	S 7714.2 S 7714.1  S 7714.1

TABLE S 7720.1 (cont. 2)

GENERAL REQUIREMENTS

TYPE	CONTROLE APRES SOUDAGE				
	AUSTENITIC →	FERRITIC →		Non-destructive examination	Criteria
3 : PARTIAL PENETRATION FILLET WELD 3.1 General case  (as per C 3353.3)		X	X	PT RT*	S 7724.1 S 7724.3
3.2 (with buttering for dissimilar joint) 	On finished buttering (B) before welding (C)  If UT cannot be performed : inside surface of hole after drilling to defined diameter on buttering base metal weld junction		X	PT UT PT	S 7724.1 S 7724.4 S 7724.1
	On finished weld (C)		X	PT RT*	S 7724.1 S 7724.3
* If RT cannot be performed, carry out UT If neither RT or UT can be performed, see « Examination during operation »					
3.3 Minor permanent attachment  (Suiwant B 3354)		X	X	PT	S 7724.1
4 : TEMPORARY ATTACHMENTS 	On part B after elimination and reworking of surface condition <u>surface finishing</u>	X	X	PT or MT UT (4) PT UT (4)	S 7724.1 S 7724.2 See TOME II S 7724.1 See TOME II

Two cases are to be considered for criterion 4:

⋮  
a) Corrosion resistant surfaces

Scattered superficial rust stains shall be acceptable provided that the aggregate area of rust does not exceed 1% on the total surface area.

⋮  
b) Non-corrosion resistant surfaces

Thin uniform films of local or generalized initial rust formation (\*) shall be acceptable.

(\*) : As an example, refer to the photographs illustrating thin uniform film of rust by comparison with photos illustrating rust

⋮  
**Note: Criteria 2 to 4**

Performance of this test does not entail determination of the exact percentage of rust stains. Only conformance to test criteria shall be recorded in the test report (F 6340).

**Test B - White cloth test - Criteria 6 and 7**

Procedure

~~Doubtful areas shall be rubbed with a clean lint-free white cloth made from a non-synthetic material:~~

A clean, lint-free white cloth made from a non-synthetic material shall be rubbed, preferably in doubtful areas:

- if this operation is repeated 24 hours later, the same results must be obtained,
- when stipulated in the equipment specification, the test shall be performed with a cloth wetted in acetone.

. Criterion 6

The cloth must remain clean. No stains shall be acceptable.

. Criterion 7

Stains from superficial rust shall be acceptable. Stains caused by oil or foreign materials shall not be acceptable.

⋮  
**Test D, Da - Surface passivity - Criteria 8 and 9**

This test is used to detect iron or iron oxides on corrosion resistant surfaces.

Ferritic contamination may be either superficial or in the form of inclusions.

- Test D

Procedure:

- . the surface to be tested shall be placed in contact with water of quality equivalent to that used for final rinsing continuously oxygenated by bubbling with clean, oil-