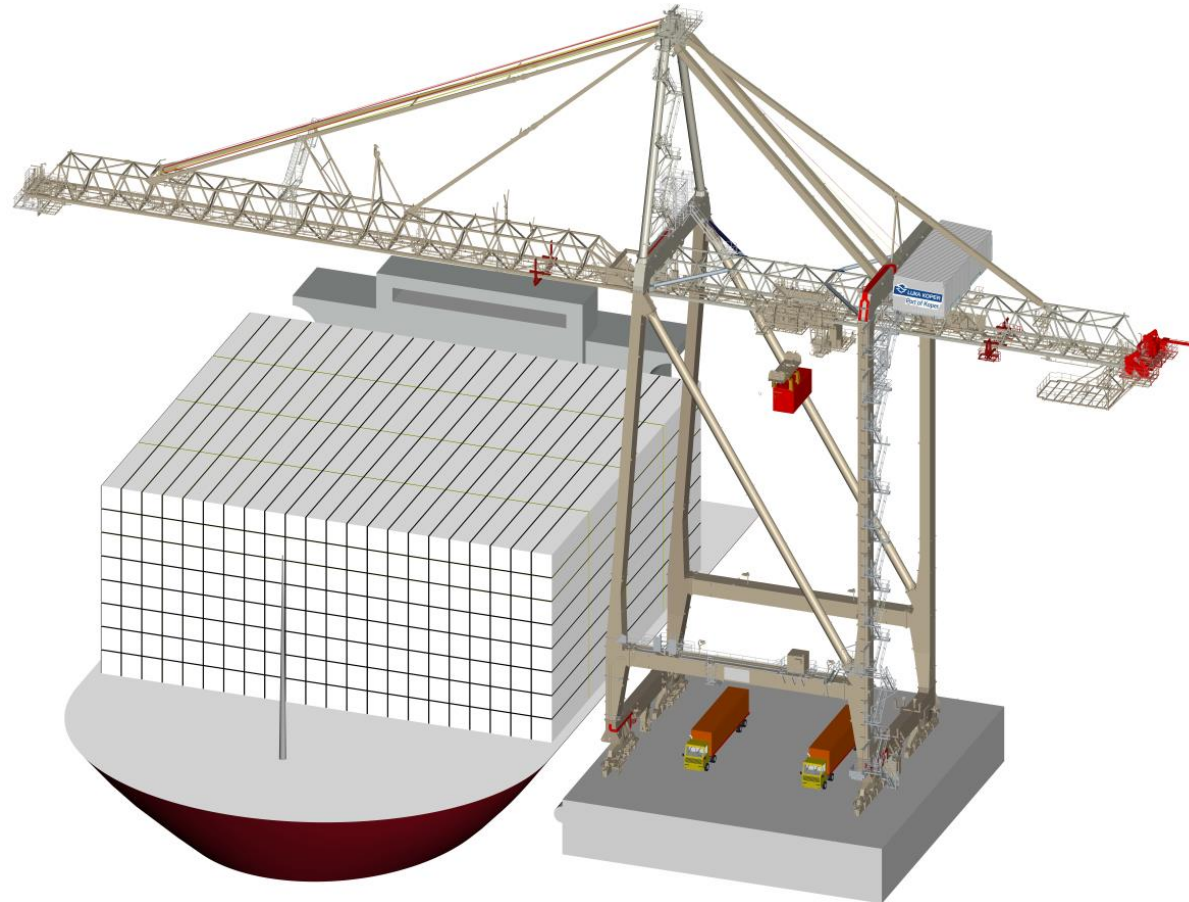


## Structural Inspection Manual (SIM)

Liebherr Cranes CC2147-48 – Luka Koper D.D., Port of Koper, Slovenia



February 2022

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## 1.0 Introduction

This document is designed to outline the Structural inspection manual (SIM) for Liebherr crane work numbers CC2147-48. It describes the components which need to be examined and the methods of examination. It is an engineered approach to standardise crane inspections, focusing on the structurally (or fracture) critical items, based on experience of similar cranes.

The purpose of this approach is to have a framework from which to establish a structural inspection program regardless of crane type and integrate into the maintenance and repair regime.

This Structural inspection manual (SIM) approach shall also ensure a 'closed loop' with respect to reporting, whereby feedback and 'early warnings' can be notified to Liebherr.

This manual should be read in conjunction with Liebherr's supplied Mechanical and maintenance manual.

## **2.0 General Notes**

### **2.1 Inspections**

The inspections described in this manual do not over-ride local statutory requirements which in all instances must take precedence. Any inspection(s) shall be carried out in accordance with locally applicable codes, i.e.: BS EN or AWE. Please refer to Section 2 for more details.

### **2.2 Paint removal**

Paint removal is only necessary when the visual inspection outlines there may be a potential defect underneath the paintwork i.e. paint cracking. Extensive paint removal is not necessary, only that required to view the inspected area should be removed by hand tools, wire brush etc., or light grinding. Once inspection is complete the area should be re-painted using the same paint system as that recommended by Liebherr. If more extensive inspection is judged necessary then more paint may need to be removed to facilitate NDT examination.

### **2.3 Cleaning of structure**

Cleaning of the structure is critical in order to adequately view inspection areas. In particular grease or oil spills, or debris for example, beside the trolley rail, should be removed. Failure to ensure a thoroughly clean service will impede an inspector's ability to carry out an accurate visual inspection and could lead to an unwanted and unexpected incident.

### **2.4 Examinations**

The specified examinations shall be generally visual by nature, but in any case shall be as defined in tables below. More detailed examination by NDT or other suitable methods, or closer examination using mobile access equipment, shall be used in the event any suspicious areas are identified, needing further inspection. The need for the detailed examination shall be determined by local competent engineering personnel.

The intermediate inspection examinations, 3 month, 6 month, annual, can be performed at remote positions, nearest vantage point. These examinations are only prudent checks when a competent maintenance person is carrying out their routine maintenance checks. The competent person is only checking for crane misuse damage where adverse damage can be visual from a distance.

The intermediate inspection examinations can be carried out by the normal crane maintenance personnel as part of their good engineering maintenance practice.

The critical inspection examination should be carried out every 4-6 years depending on level of maintenance carried out within the port. The critical inspection examination requires close up visual inspection for surface indications of structural cracks such as hairline cracks in paint and rust stains. Some critical inspections will require the use of high level temporary access.

The critical inspection examinations have to be carried out by a qualified structural/mechanical engineer or qualified NDT technician who has relevant experience in crane structures.

### **2.5 Inspection regime**

The inspection regime is intended to work in parallel with the maintenance regime, visits to particular areas should be arranged to complete both maintenance and inspection tasks.

## **2.6 Structural pins**

Structural pins shall be examined visually for signs of wear or distress. Bores shall be checked for wear, excessive gaps etc., externally only. Should more extensive inspection be necessary then the use of NDT methods such as Dye Penetrant Testing (PT), Magnetic Particle Testing (MT), Ultrasonic Testing (UT), Eddy Current (EC) or Phased Array (PA) examination shall be employed.

## **2.7 Temporary access**

For the critical inspection examination or accidents, some structural inspections will require the use of high level temporary access, such as mobile access platforms i.e. cherry pickers, or man cages/baskets suspended from mobile cranes. In all instances where these are used the local site requirements, in terms of safety harnesses and means of communication, shall be adhered to.

### **3.0 End of crane design life**

#### **3.1 Life extension assessment**

For a crane nearing the end of its designated design life, a 'Competent Engineer/Inspection Body' is to fully assess the crane structure and mechanisms by whatever means necessary and appropriate, in order to advise and confirm extension of life/operating lifting cycles, that can be applied to the particular crane.

The SIM shall be amended accordingly to reflect changes, if any, identified during the life extension assessment.

#### **3.2 Crane assessment following major events**

##### **3.2.1 Major repair**

Cranes should be thoroughly examined after major repairs, modifications or following extreme weather conditions. Examples of major repair or modification include:

**3.2.1.1** Any revision to the rated capacity, travel, outreach, crane height

**3.2.1.2** Structural damage due to collision with a ship, another crane etc.

**3.2.1.3** Replacement or repair of significant structural components

**3.2.1.4** Extreme weather conditions would include storms, typhoons or hurricanes where the maximum out of service wind speed specified by the manufacturer has been exceeded.

The competent person undertaking thorough examination may require supplementary tests and examinations to be undertaken. These may include overload testing.

#### **3.3 Negative impact activities**

This document does not take into account day to day activities that can negatively impact the integrity of a crane, for example:

**3.3.1** A technician, whether mechanical or electrical, who penetrates a 'sealed beam' structure by inadvertently drilling the structure to secure, or re-secure, a component to the sealed beam structure. This action will cause the sealed beam to be open to all elements and allow water ingress/atmospheric conditions to enter, which in turn will commence the corrosion activities within that beam.

**3.3.2** A technician, whether mechanical or electrical, who inadvertently cuts an access hole, i.e.: whether through drilling or burning, to gain access for a component repair and/or replacement. This could (a) possibly weaken the structure from its original design and/or (b) open structure to the elements as described above.

The above examples are common failures of people not trained and/or sufficiently aware of subtle actions that can change/alter the cranes structural integrity.



### 3.4 Recording results

Results shall be recorded in the format particular to the site. Engineering shall review and advise further actions; NDT examinations, repairs, effect on crane operation etc.

### 3.5 Abbreviations

<b>BU</b>	Business Unit
<b>EAMS</b>	Engineering Asset Management System
<b>EC</b>	Eddy Current
<b>FCM</b>	Fracture Critical Member
<b>LCC</b>	Liebherr Container Cranes
<b>MT</b>	Magnetic Particle Testing
<b>NDT</b>	Non Destructive Testing
<b>NFCM</b>	Non – Fracture Critical Member
<b>OEM</b>	Original Equipment Manufacturer (Crane)
<b>PA</b>	Phased Array
<b>PT</b>	Dye Penetrant Testing
<b>PTI</b>	Predictive Testing & Inspection
<b>QC</b>	Quay Crane
<b>SIM</b>	Structural Inspection Manual
<b>UT</b>	Ultrasonic Testing
<b>VT</b>	Visual Testing

## **4.0 Terms and definitions**

For the purposes of this SIM, the following terms and definitions apply.

### **4.1 General examination**

Examination by a competent person/maintenance person or crane operator in such depth and detail as the person considers necessary to enable them to determine whether the equipment being examined is safe to continue in use.

In the event the operator visually see's something untoward, they will inform the maintenance personnel immediately to investigate in more detail.

### **4.2 Thorough examination**

Examination by a competent person in such depth and detail as the competent person considers necessary to enable them to determine whether the equipment being examined is safe to continue in use.

**NOTE:** The thorough examination is not part of the maintenance regime for the equipment but provides owners with information which could be used to determine the effectiveness of the regime.

### **4.3 Competent person**

Person who has such practical and theoretical knowledge and experience of the equipment to be thoroughly examined which enables them to detect defects or weaknesses and to assess their importance in relation to the safety and continued use of the equipment.

### **4.4 Competent engineer**

Person who has such theoretical knowledge of the design of the equipment as enables them to assess the design of the item in order to establish appropriate criteria for a thorough examination.

### **4.5 Inspection body**

Employer of the competent person(s) who provide examination and testing services.

### **4.6 Non destructive testing (NDT)**

Testing carried out on the structure of the appliance to establish the presence, location and extent of any defects that can affect the integrity of that structure.

**NOTE:** The techniques employed for non-destructive testing are such that they do not damage or alter the material under test. NDT is also known as non-destructive examination (NDE).

### **4.7 Responsibility of user**

Person or organisation that has control of both the lifting operation and the crane operator, and has a responsibility to ensure that cranes and other equipment are properly maintained and thoroughly examined by a competent person.

## 5.0 Inspection standards

This SIM procedure shall ensure that the relevant quay crane personnel involved; in-house or subcontracted, follow the locally applicable standards and codes during inspections.

Examples of applicable international standards are as follows:

- a. VT/MT/PT/UT: Inspector's qualification, Instrument calibration, NDT Procedure and Acceptance criteria: AWS D 1.1 2006 section 6.
- b. The operator: ASNT TC-1A Level II qualified.
- c. NDT reports: vetted by a level III inspector.
- d. Applicable European Standards are:
  - EN 473 – for the qualification and certification of personnel
  - EN 13018 – Visual testing principles
  - EN 970 – Visual testing of fusion welded joints
  - EN 1290 – Magnetic Particle testing
  - EN 1714 – Ultrasonic testing
  - EN 571 – Penetrant testing
  - BS7121 – Code of practice for the safe use of cranes, Part 2: Inspection, maintenance and thorough examination.

In the absence of a local standard, the relevant European standards could be used subject to approval by an appropriate "Competent person".

All reports shall be accompanied by the relevant operators' certificate and instrument calibration certificate.

## 6.0 Weld category

For structural components 'STRINGENT B' is considered – quality level for welds and tacks ISO5817.  
Such members are – structural members that are subjected to structural loads and fatigue.

For non-structural components 'INTERMEDIATE C' is considered – quality level for welds and tacks ISO5817.  
Such members are defined as members that are not subjected to structural fatigue loads.

For access/maintenance platforms and their supports 'INTERMEDIATE C' is considered – quality level for welds and tacks ISO5817.

## **7.0 How to use the structural inspection manual document**

### **7.1 Aligning and integrating SIM to maintenance schedule**

The SIM must be incorporated into the maintenance/inspection program.

All tasks/inspections must be recorded.

If possible, port engineering shall ensure the inspection requirements defined in the SIM are integrated and implemented in a manner that combines standard maintenance tasks with SIM inspection requirements. The inspection requirements should be implemented in a practical and most 'ergonomic' manner, in order to minimise outage and disruption of the operational requirements of a crane.

### **7.2 Maintaining SIM**

Periodic reviews of the SIM shall be conducted as defined and required, but in any case shall be no longer than 12 months.

Port engineering is responsible for ensuring all history, experience and events during review periods are captured and amended in the SIM.

All amendments shall be approved by a "Competent person".

## 8.0 Inspection requirements

The following sections describe the areas of a quay crane that shall be examined in a structural inspection.

It should be noted and understood that many cranes are constructed differently and thus the inspections shown in the following sections are indicative only and shown here for guidance.

Port engineering is ultimately responsible to ensure all aspects of implementing the SIM and have clearly and accurately documented and approved by appropriate 'Bodies/Authorities', 'Competent person(s)', Regulatory bodies (as applicable) etc.

### 8.1 Preparation for thorough examination

A meeting should be held between the port operator and the competent person in advance of the thorough examination. Prior to this meeting the port should prepare all relevant information regarding the crane to be examined. Information required by the competent person in undertaking thorough examination will include, but not limited to, the following:

- Declaration of conformity i.e.: EC if a European Crane
- Rated capacity indicator/load limiter calibration certificate/settings
- The last report of thorough examination
- In-service inspection reports
- Maintenance records relating to rectification of defects, malfunctions and modifications since last examination
- Information on the number of lifts, type of lifts and hours the crane has been used since last examination. Information on any overloads, dropping of loads or collisions with the crane.
- Records of any supplementary tests or inspections requested at the previous thorough examination
- General arrangement drawings
- Wire rope certificates
- Original design codes if available

At the meeting the competent person should request any further information they may require prior to undertaking the thorough examination. Discussion and agreement should be reached as to assistance that will be provided to the competent person and the safe system of work to be followed during the examination. The scope of the discussions should include;

- The date and time the examination is to take place.
- The timing, sequence and extents of the examination.

**Note:** It is essential that the time required by the competent person undertaking thorough examination is discussed and agreed with the port operator. It is important that sufficient time is allocated and that the competent person is not put under undue time constraints and pressure.

- Arrangements for the isolation of sources of power and establishment of a safe system of work
- Access arrangements for working at height
- Removal of inspection covers and hatches
- Arrangements for parts of the crane to be cleaned prior to thorough examination by appropriate means, e.g. pressure washed, to remove all spoil/dirt that would otherwise conceal the structure or mechanisms and prevent an effective examination.
- Provision of supplementary lighting
- Provision of specialist instruments, tools and equipment
- Arrangements for functional checks of the crane
- Communication methods between the competent person, crane operators and maintenance personnel during examination of the crane, i.e. radio communication.

In the event that the competent person has not examined the crane on a previous occasion, it is strongly recommended that they are given the opportunity to view the crane prior to the thorough examination commencing.

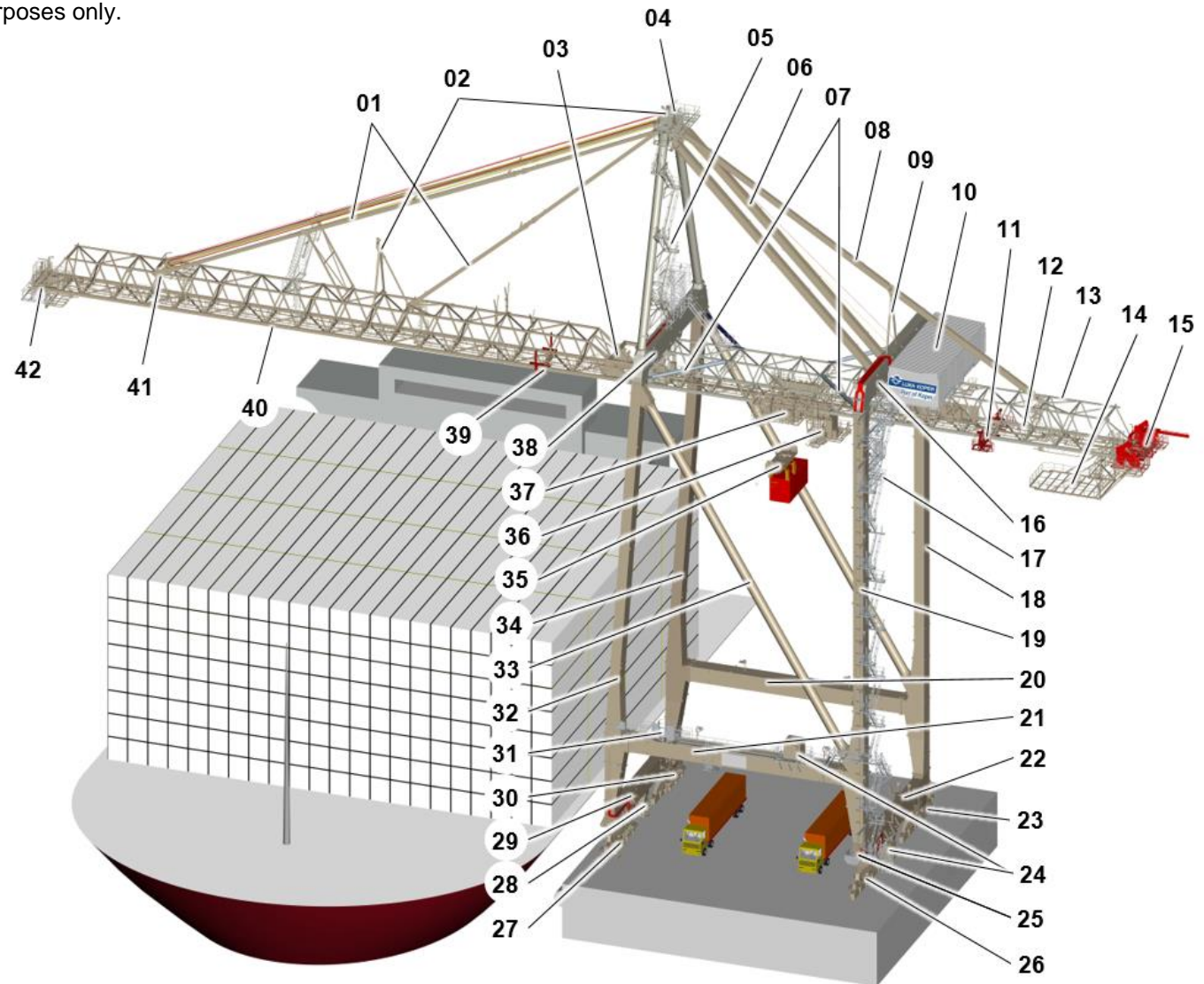
Prior to the examination commencing, the competent person should hold a briefing meeting with any operational or maintenance personnel that may be providing assistance. At this meeting they should;

- Explain and confirm the safe system of work they will be following.
- Provide information as to the extents and sequence of the examination they will be undertaking.
- Confirm the assistance they will require from each individual.
- Confirm and check communication methods within the team.

## 9.0 Crane legend

The crane legend is generic and for reference purposes only.

- 01 Holding arms
- 02 Derrick boom latch
- 03 Hoist rope deflection arm
- 04 A-frame
- 05 A-frame access
- 06 A-frame back ties (twin ties)
- 07 Carrier plan bracing
- 08 Backreach tie
- 09 Landside a-frame
- 10 Machinery/electrical house
- 11 Hoist rope support trolley (HRST) - landside
- 12 Energy chain support system
- 13 Main beam
- 14 Cabin cleaning platform
- 15 Trim/list/skew system
- 16 Landside carrier
- 17 Main entry
- 18 Landside leg 3
- 19 Landside leg 4
- 20 Sill beam 2-3 (portal cross beam)
- 21 Sill beam 1-4 (portal cross beam)
- 22 Endcarriage landside (sill beam above gantry travel)
- 23 Travel unit 3 landside leg
- 24 Checker cabins
- 25 Personnel lift (elevator)
- 26 Travel unit 4 landside leg
- 27 Travel unit 1 seaside leg
- 28 Rail brakes and storm anchors (pins)
- 29 Endcarriage seaside (sill beam above gantry travel)
- 30 Travel unit 2 seaside leg
- 31 Cable reeling drum (CRD)
- 32 Seaside leg 1
- 33 Portal diagonals
- 34 Seaside leg 2
- 35 Headblock (pulley frame)
- 36 Operator's cabin
- 37 Trolley
- 38 Seaside carrier
- 39 Hoist rope support trolley (HRST) - seaside
- 40 Derrick boom
- 41 Derrick boom cross beam
- 42 Hoist overload system



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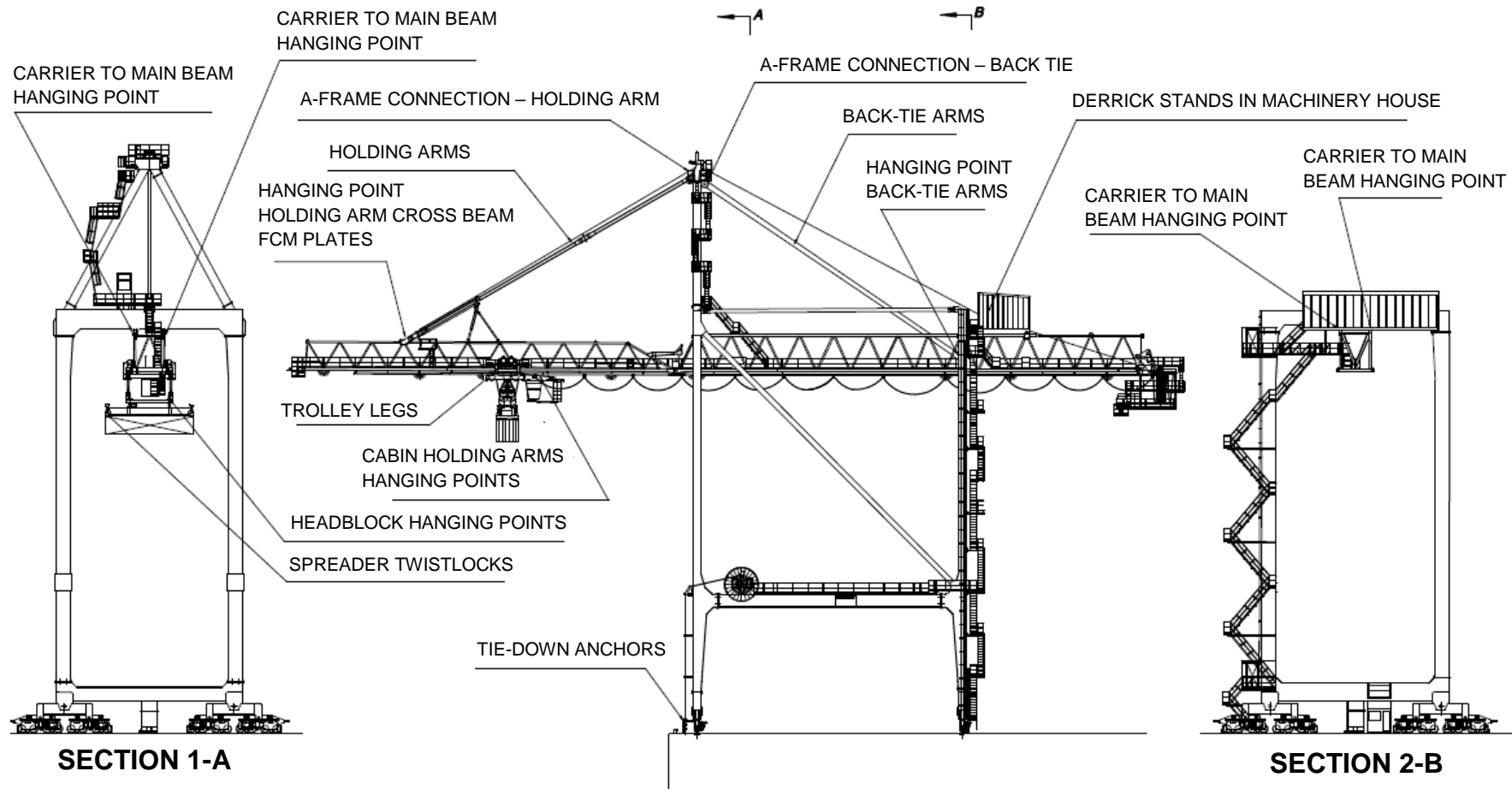
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## 10.0 Fracture critical members (FCM)

A FCM is a tension member or tension component of a member whose failure would be expected to result in collapse of the crane, collapse or dropping of the trolley or operator's cabin, or dropping the load.

### FRACTURE CRITICAL MEMBERS - FCMS



Note: This drawing is generic and for reference purposes only.

## 11.0 A-frame - Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Connection of boom pulley block	3 months	VT	Competent person	General examination	FCM
B	Back tie(s) connections (including pins), in particular the welding at the ends of the insert plates.	Annual	VT	Competent person	General examination	FCM
C	Holding arm(s) connections (including pins), in particular the welding at the ends of the insert plates.	Annual	VT	Competent person	General examination	FCM
D	Visual inspection of welds between legs and A-frame head (viewed from walkway)	Annual	VT	Competent person	General examination	NFCM
E	Structural inspection of A-frame head, including base plate (viewed from walkway)	3 months	VT	Competent person	General examination	FCM
F	Visual inspection of pulley pins	3 months	VT	Competent person	General examination	FCM
G	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	FCM / NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

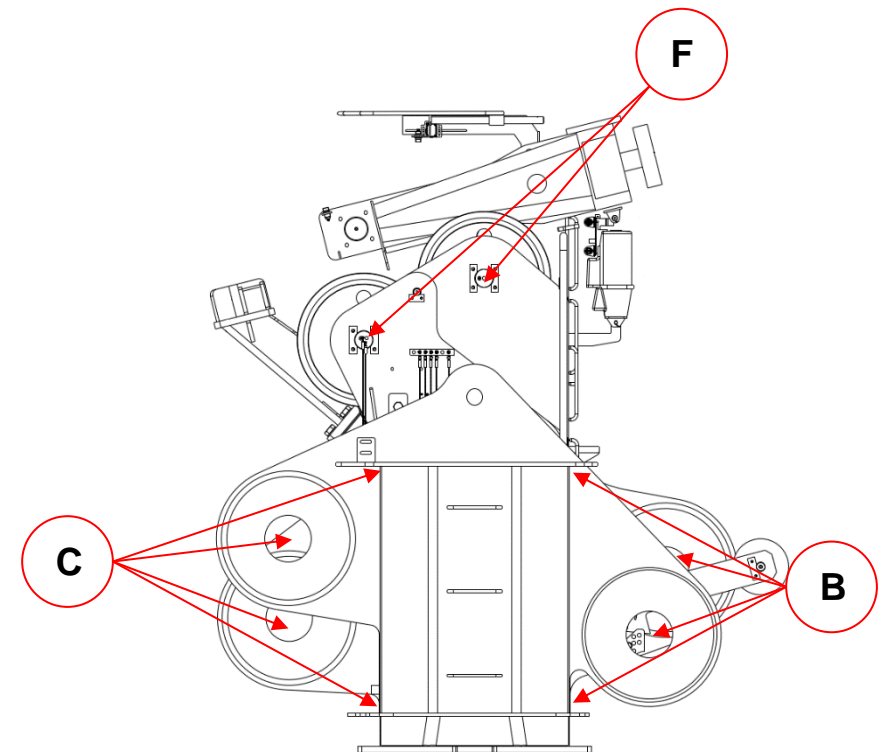
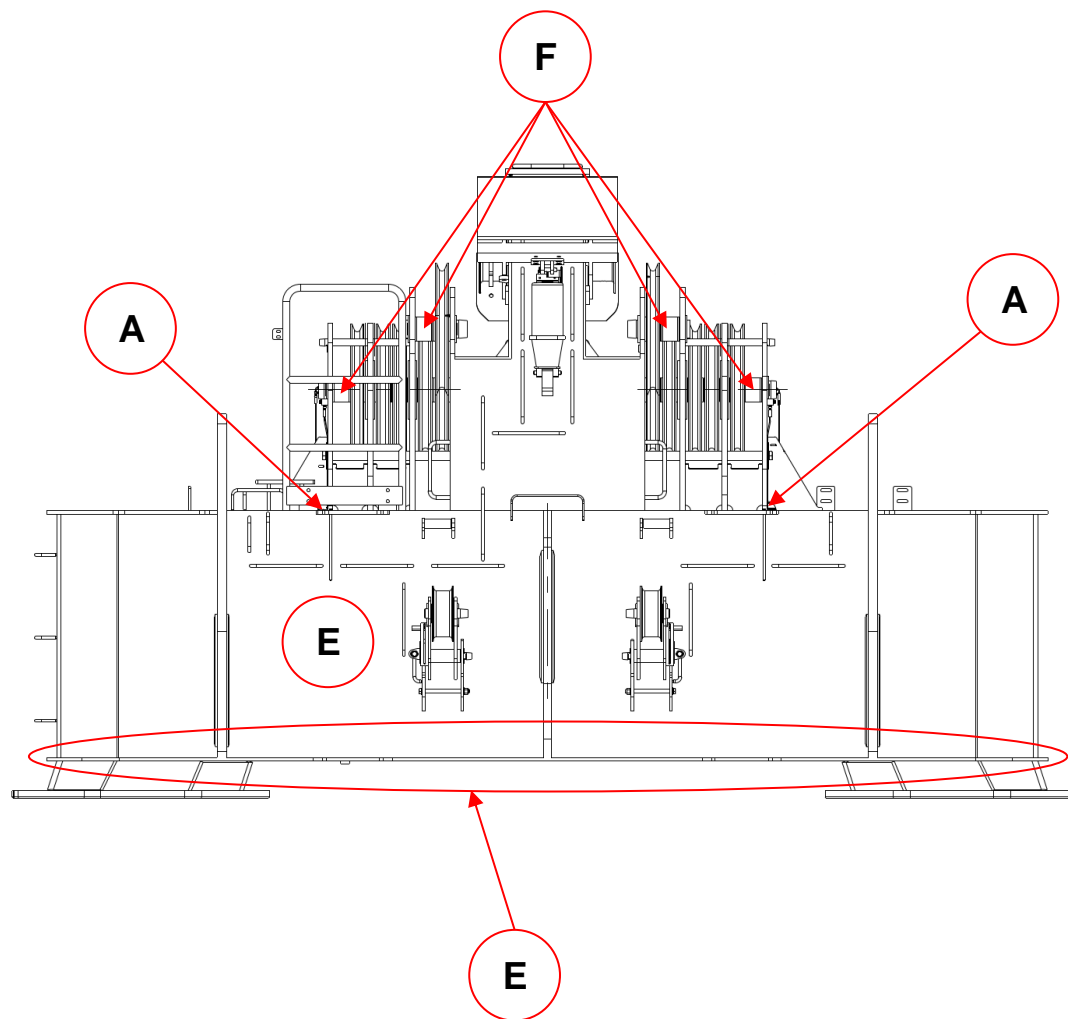
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

### Inspections

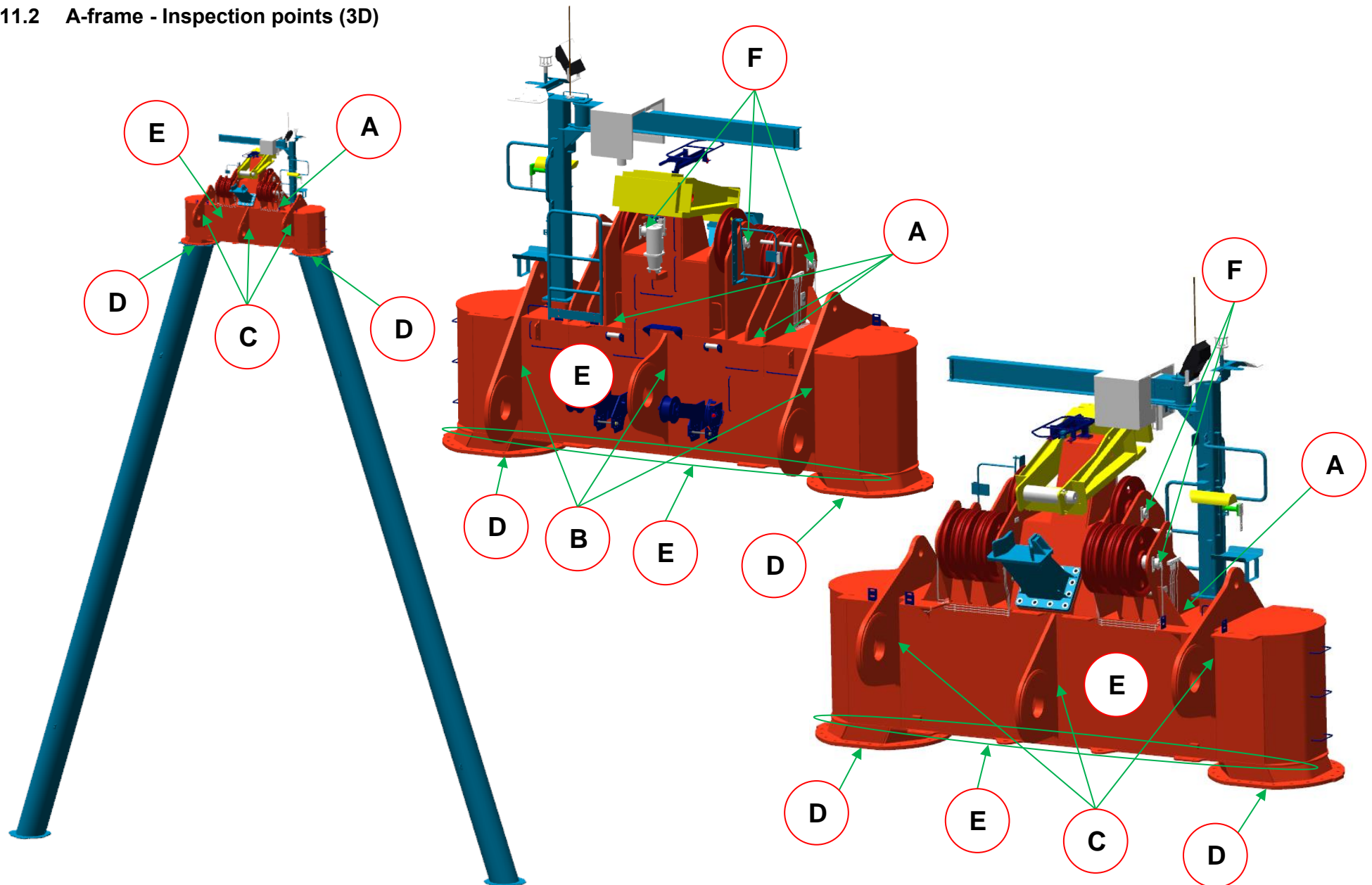
General examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

## 11.1 A-frame - Inspection points



## 11.2 A-frame - Inspection points (3D)



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## 12.0 Seaside carrier - Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Connection of A-frame legs (viewed from platform on top of carrier)	3 months	VT	Competent person	General examination	NFCM
B	Connection to seaside legs (viewed from platform on top of carrier)	Annual	VT	Competent person	General examination	NFCM
C	Connection to main beam (viewed from main beam walkway/trolley)	Annual	VT	Competent person	General examination	FCM
D	Seaside carrier structure (viewed from walkway)	3 months	VT	Competent person	General examination	NFCM
E	Connection to carrier plan bracing connections (viewed from walkway)	3 months	VT	Competent person	General examination	NFCM
F	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	FCM / NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

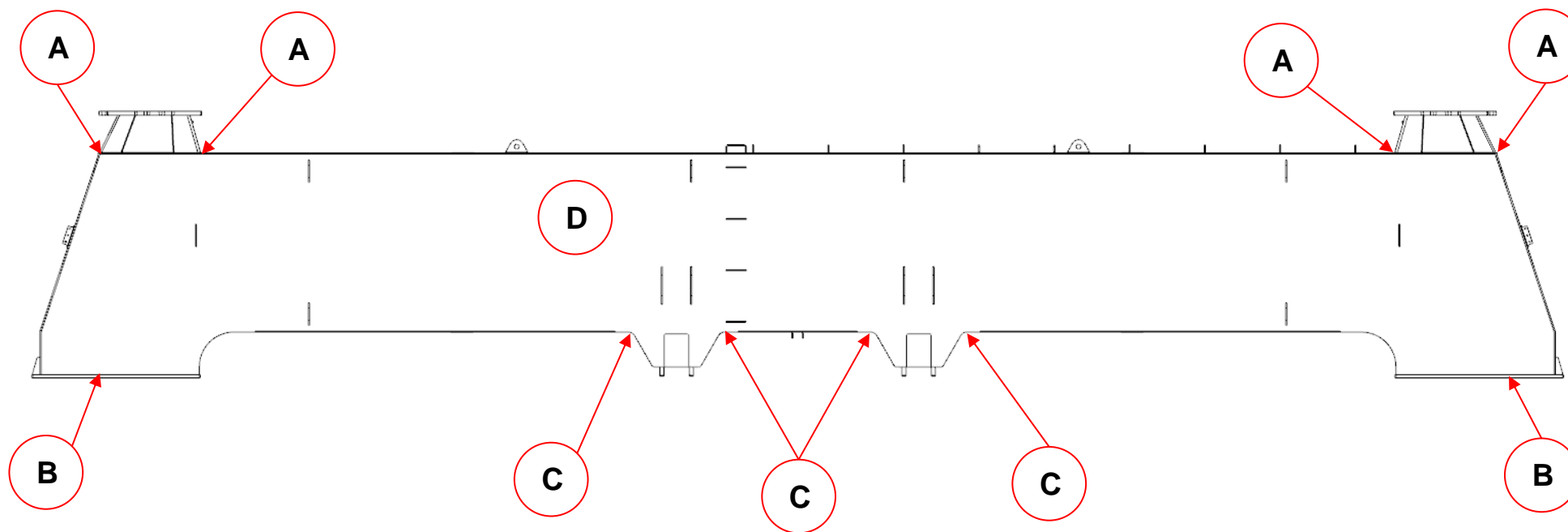
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

### Inspections

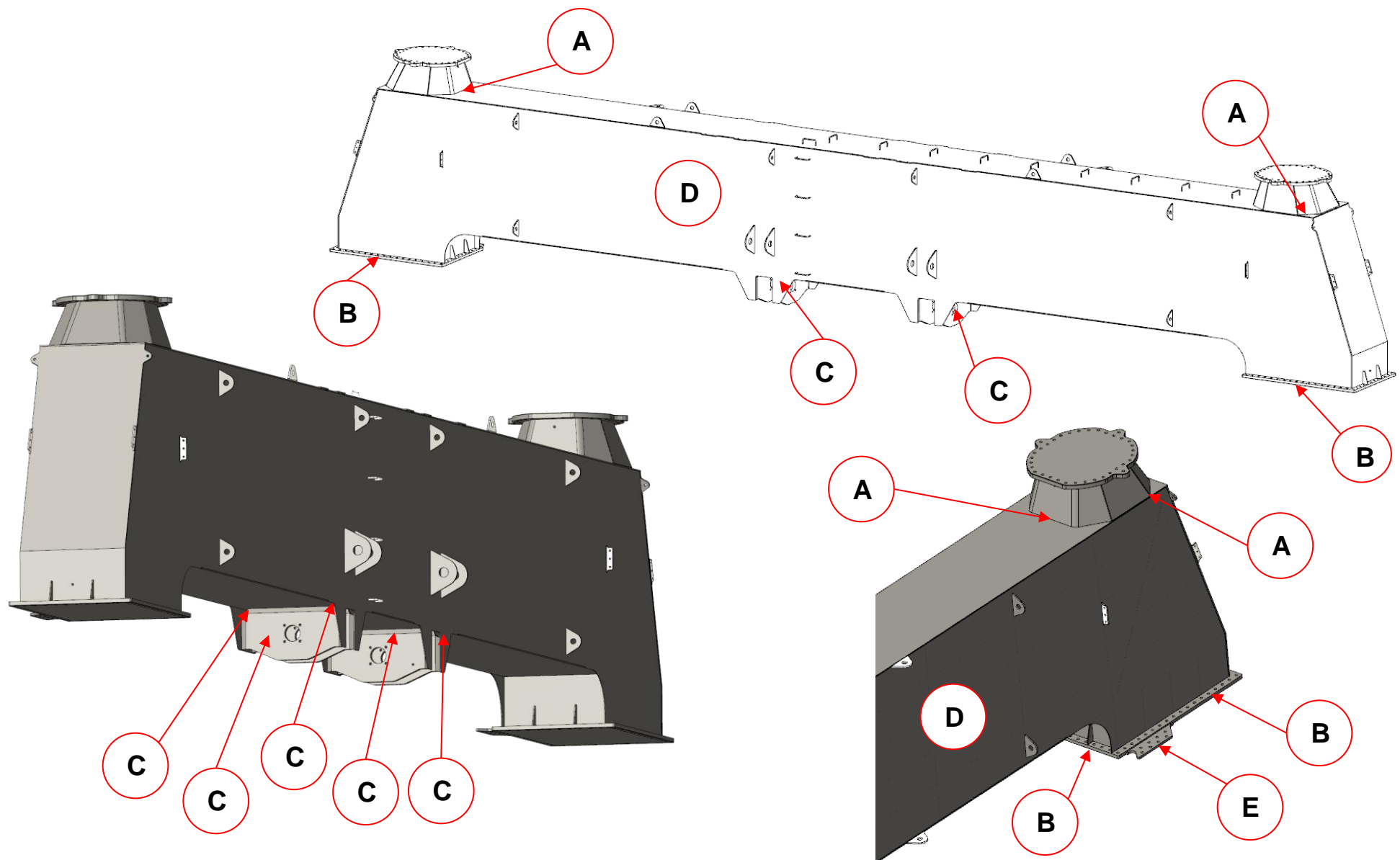
General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

## 12.1 Seaside carrier – Inspection points



## 12.2 Seaside carrier – Inspection points (3D)



### 13.0 Landside carrier - Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Connection to landside legs (viewed from walkway)	Annual	VT	Competent person	General examination	NFCM
B	Connection to main beam (viewed from main beam walkway/trolley)	Annual	VT	Competent person	General examination	FCM
C	Landside carrier structure (viewed from walkway)	3 months	VT	Competent person	General examination	NFCM
D	Connection to landside A-frame legs (viewed from seaside A-frame head)	3 months	VT	Competent person	General examination	NFCM
E	Connection to carrier plan bracing connections (viewed from walkway)	3 months	VT	Competent person	General examination	NFCM
F	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	FCM / NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

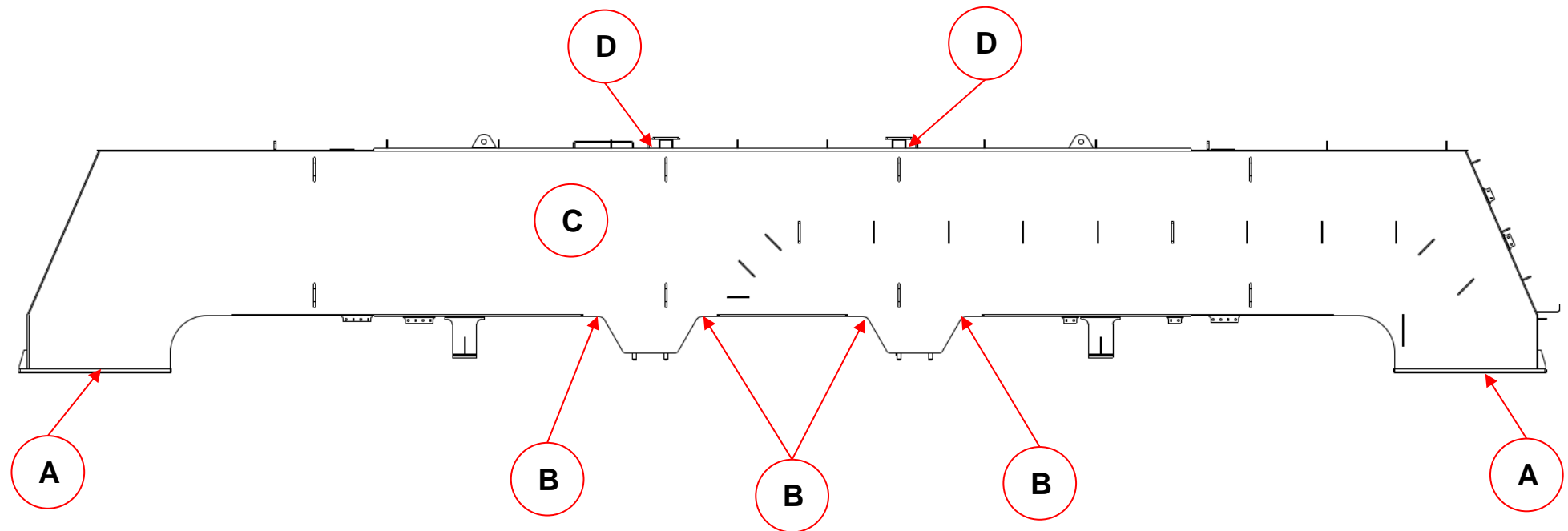
#### Inspections

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

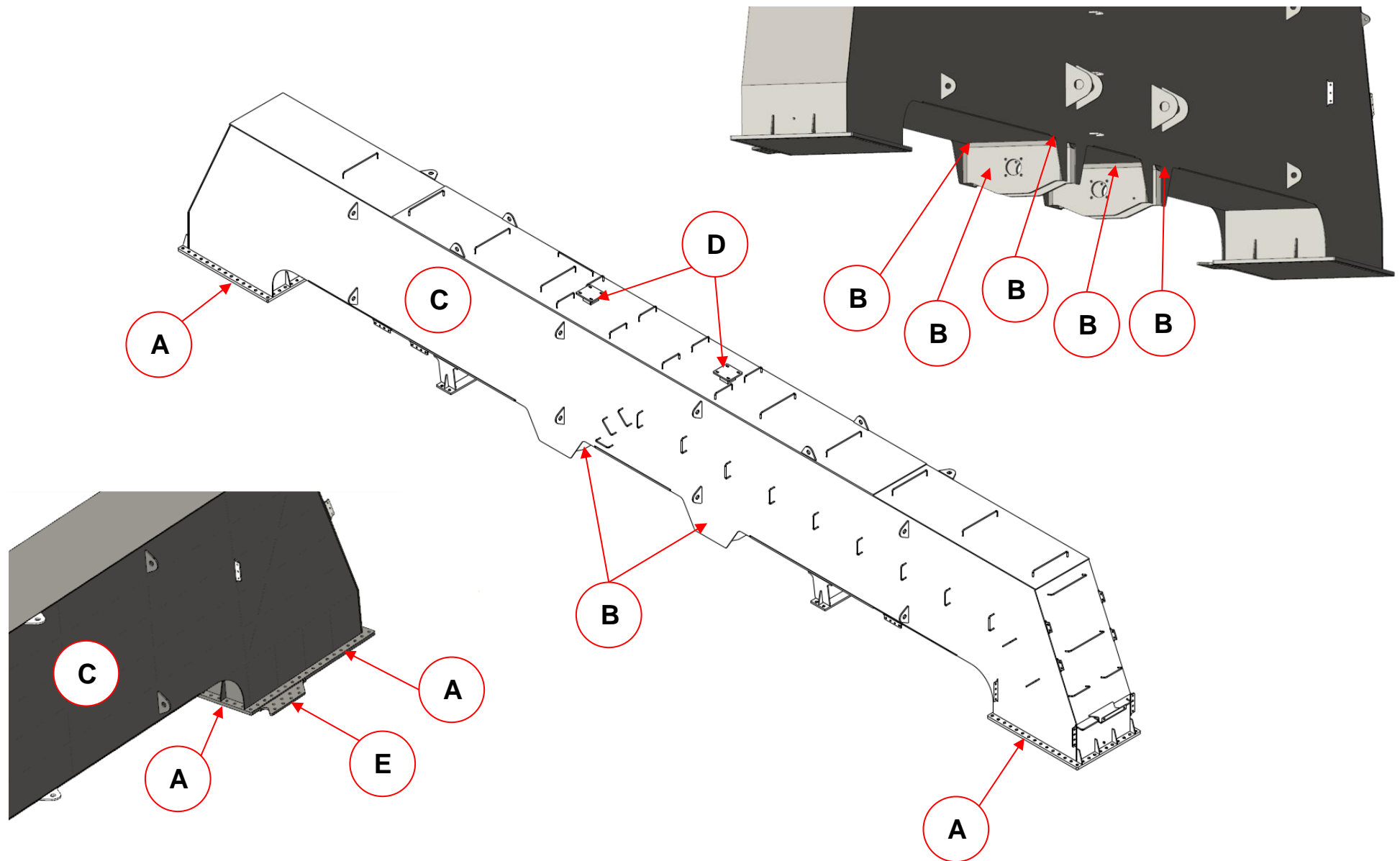
Thorough Examination: This is compulsory.



### 13.1 Landside carrier – Inspection points



### 13.2 Landside carrier – Inspection points (3D)



## 14.0 A-frame back ties - Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Visual inspections of the ends, top and bottom. In particular the welding at the ends of the insert plates. Visual inspection of pin connection assembly (viewed from main beam walkway).	3 months	VT	Competent person	General examination	FCM
B	Visual inspection for the full length, concentration on any welded joints (butt welds) or attachments	6 years	VT	Competent person	Thorough examination	FCM
C	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	FCM / NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

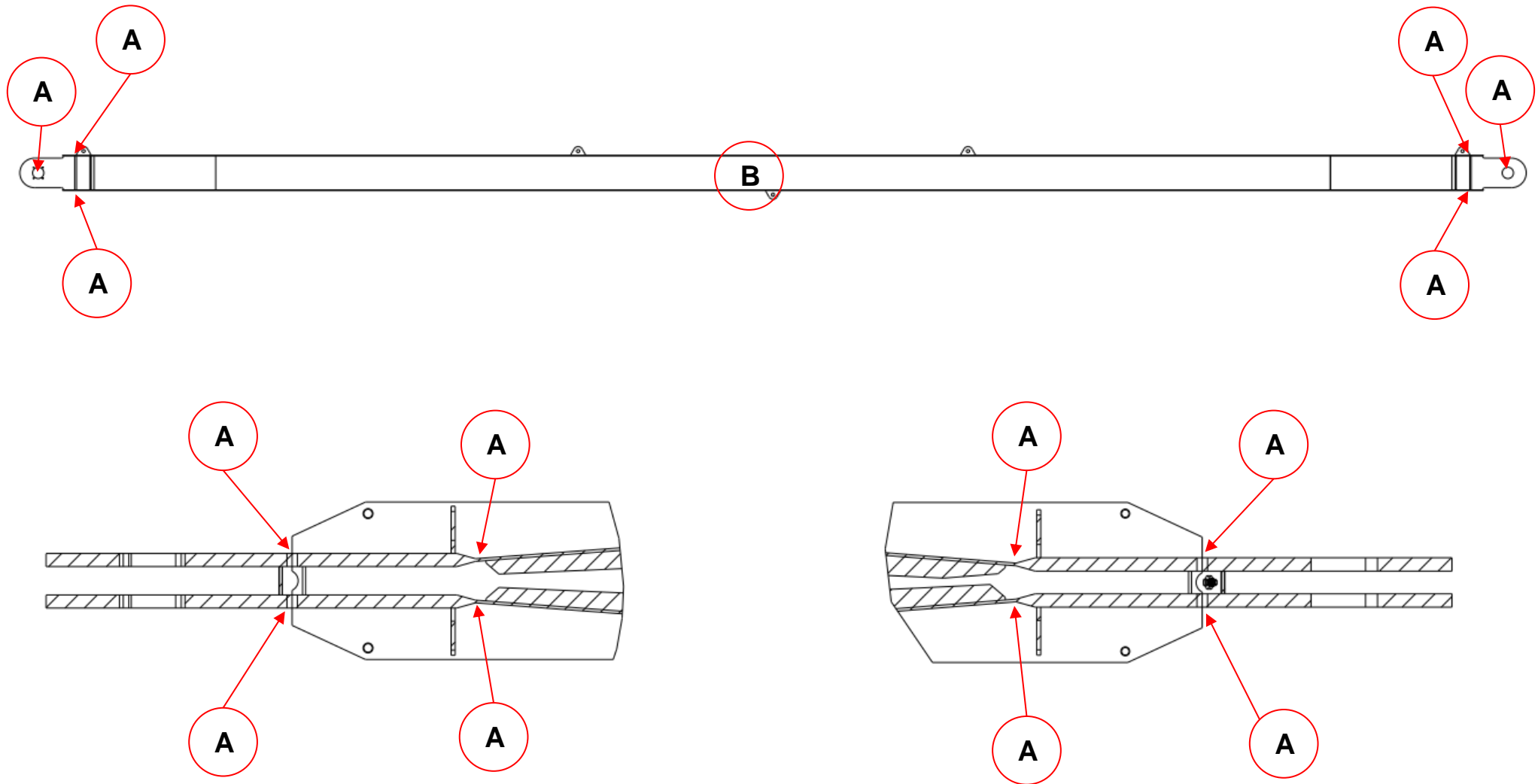
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

### Inspections

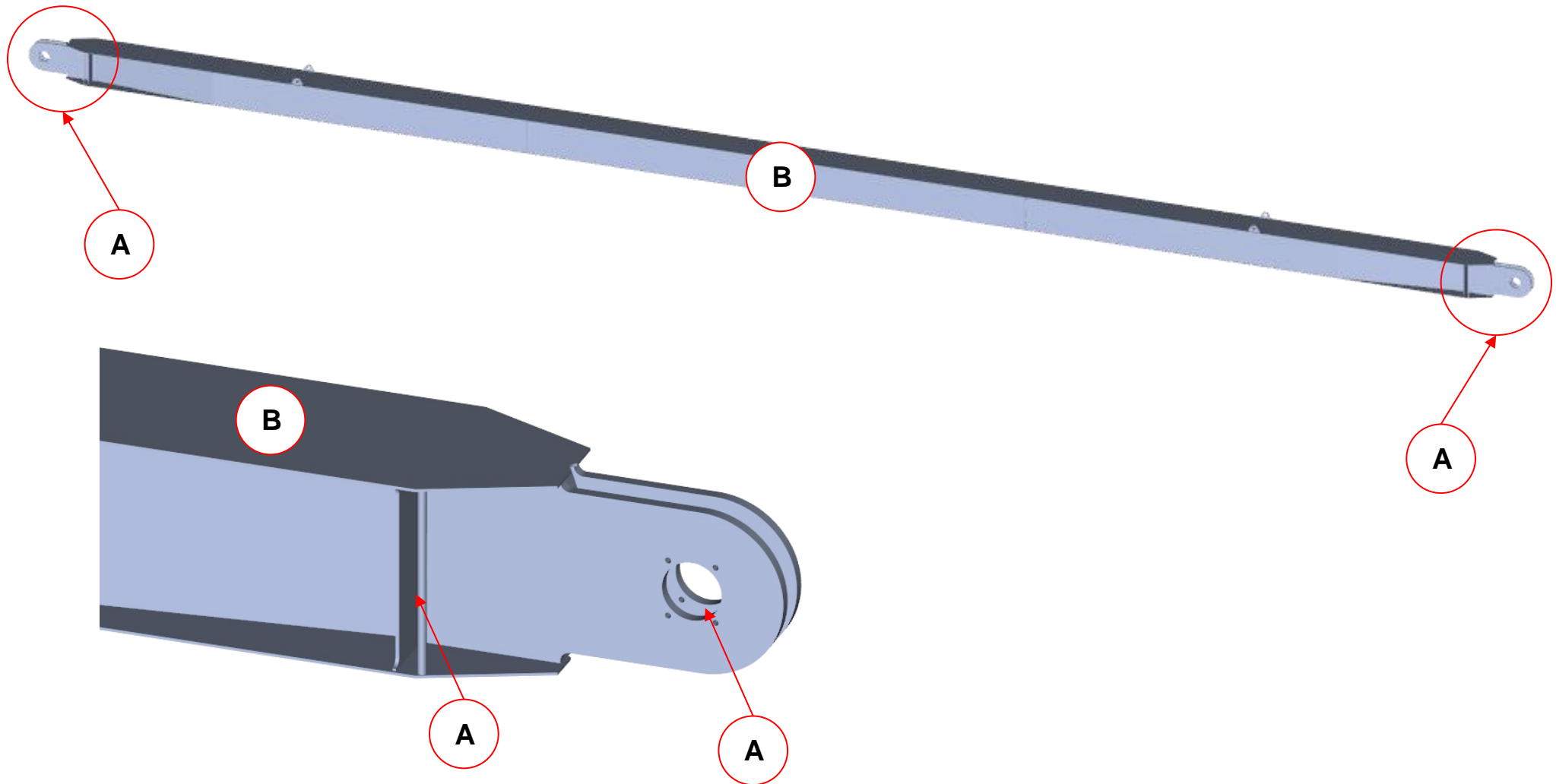
General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

### 14.1 A-frame back ties – Inspection points



## 14.2 A-frame back ties – Inspection points (3D)



**15.0 Main beam (lattice construction) - Instruction**

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Inspection of support beam hanger plates, where connected to top chords - including pins (Detail 1) (viewed from walkway)	Annual	VT	Competent person	General examination	FCM
B	Inspection of support beam hanger plates, where connected to vertical and diagonal members (Detail 1) (viewed from walkway)	Annual	VT	Competent person	General examination	FCM
C	Inspection of A-frame back tie connection plates, where connected to chords - including pins (Detail 2) (viewed from walkway)	3 months	VT	Competent person	General examination	FCM
D	Inspection of A-frame back tie connection plates, where connected to vertical and diagonal members (Detail 2) (viewed from walkway)	Annual	VT	Competent person	General examination	FCM
E	Examination of all main member connections	Annual	VT	Competent person	General examination	NFCM
F	Examination of hinge section, where welded to main sections (Detail 3)	Annual	VT	Competent person	General examination	NFCM
G	Examination of vertical and diagonal bracings where connected to hinge sections (Detail 3)	Annual	VT	Competent person	General examination	NFCM
H	Examination of the base of each vertical and diagonal member, where welded to bottom chord (Detail 4)	3 months	VT	Competent person	General examination	NFCM
I	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	FCM / NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

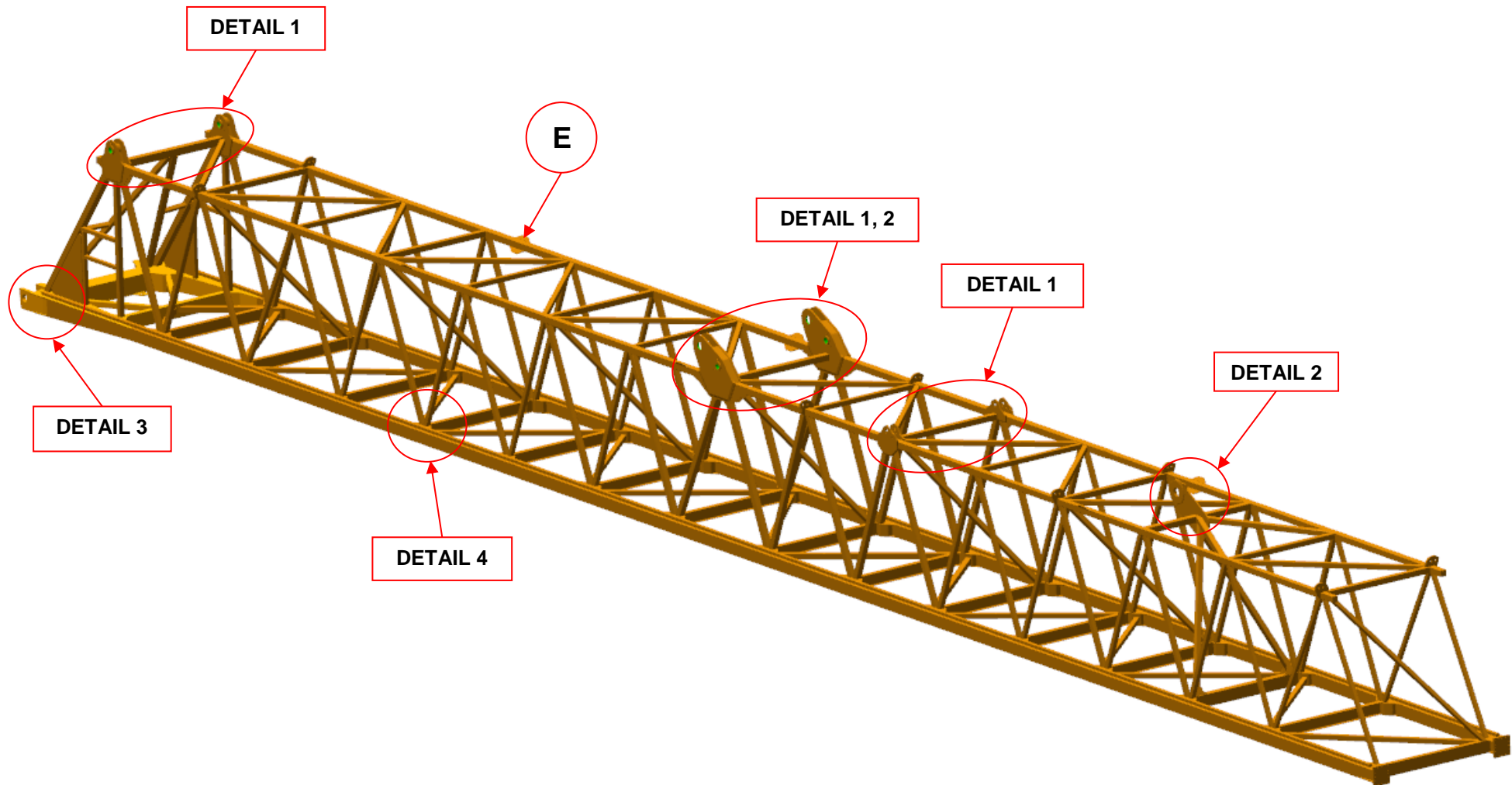
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

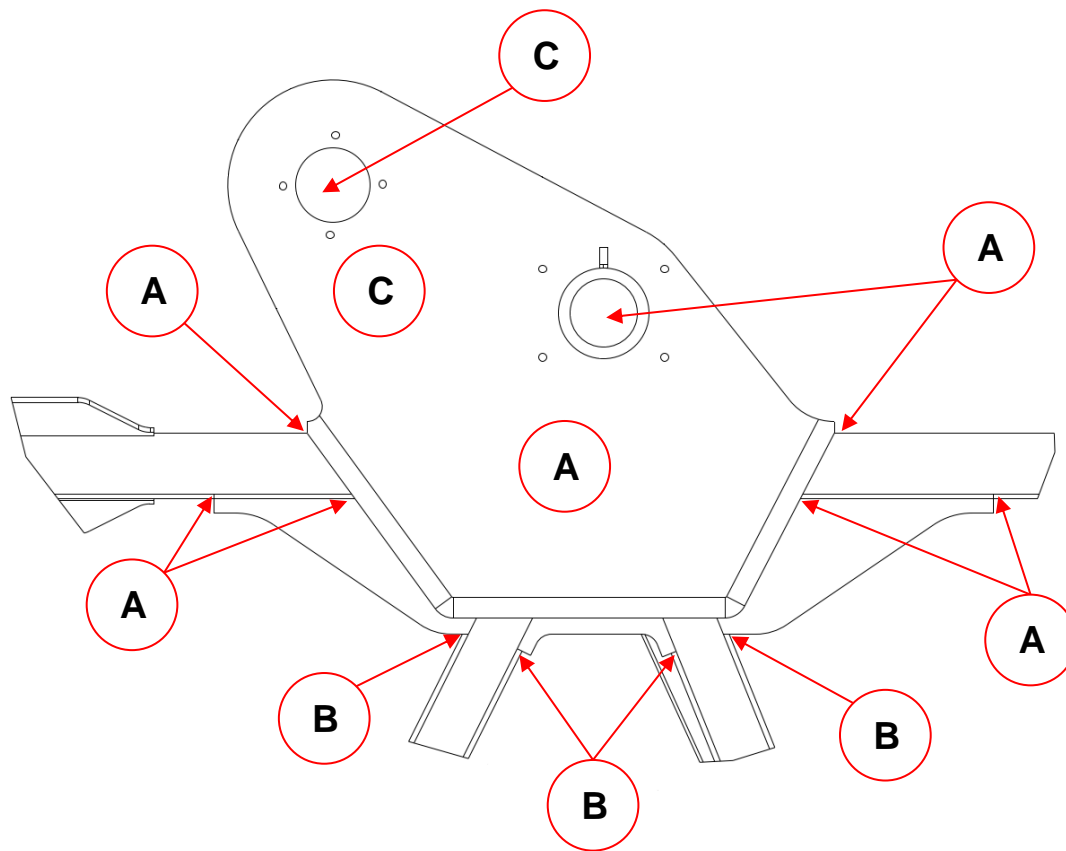
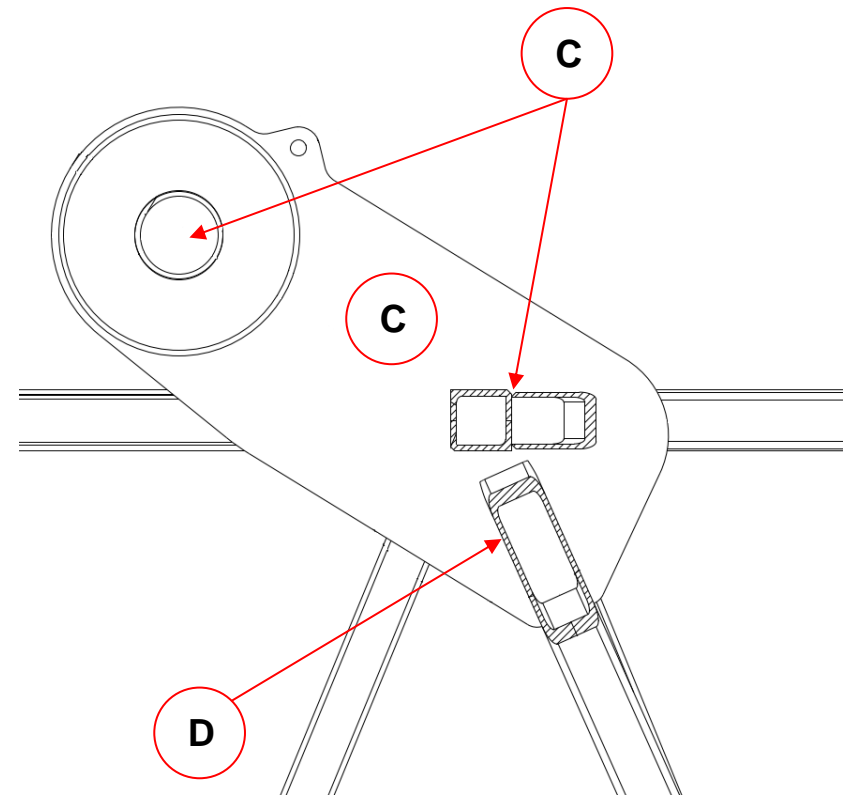
**Inspections**

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

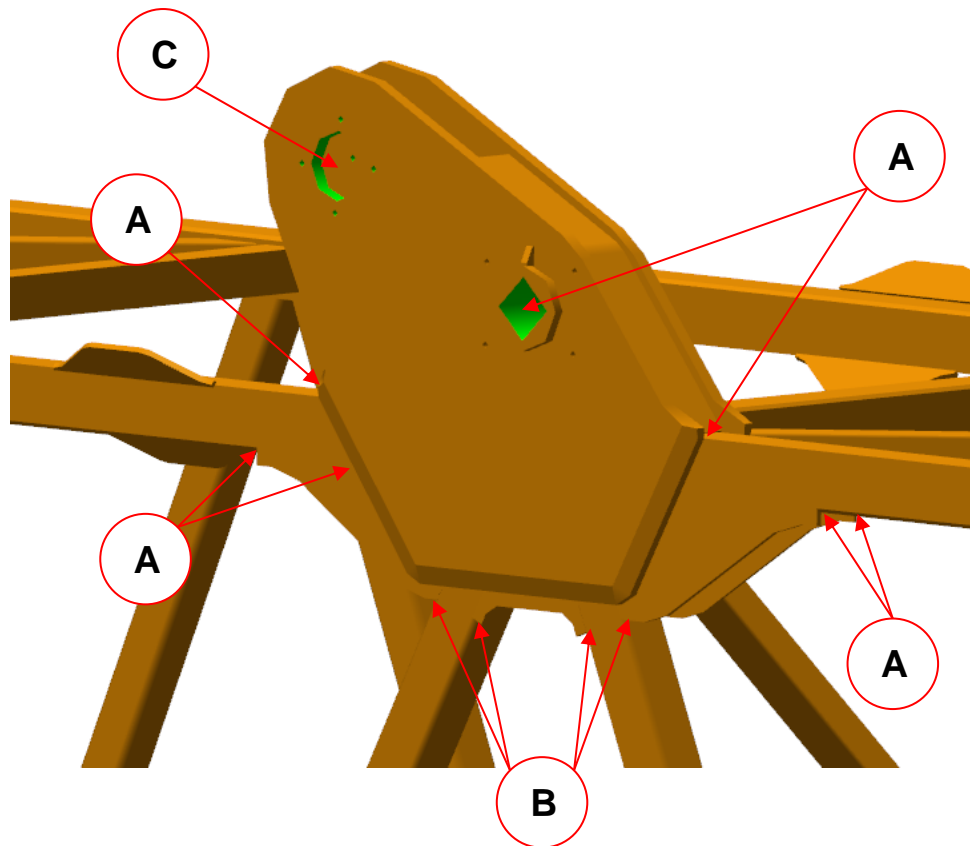
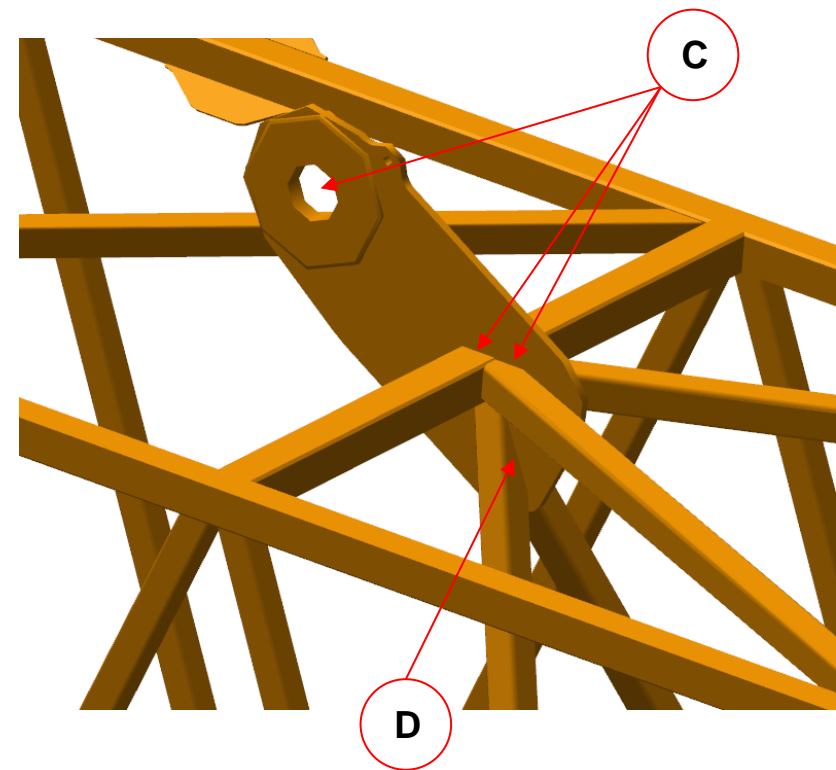
Thorough Examination: This is compulsory.

### 15.1 Main beam (lattice construction) – Inspection points

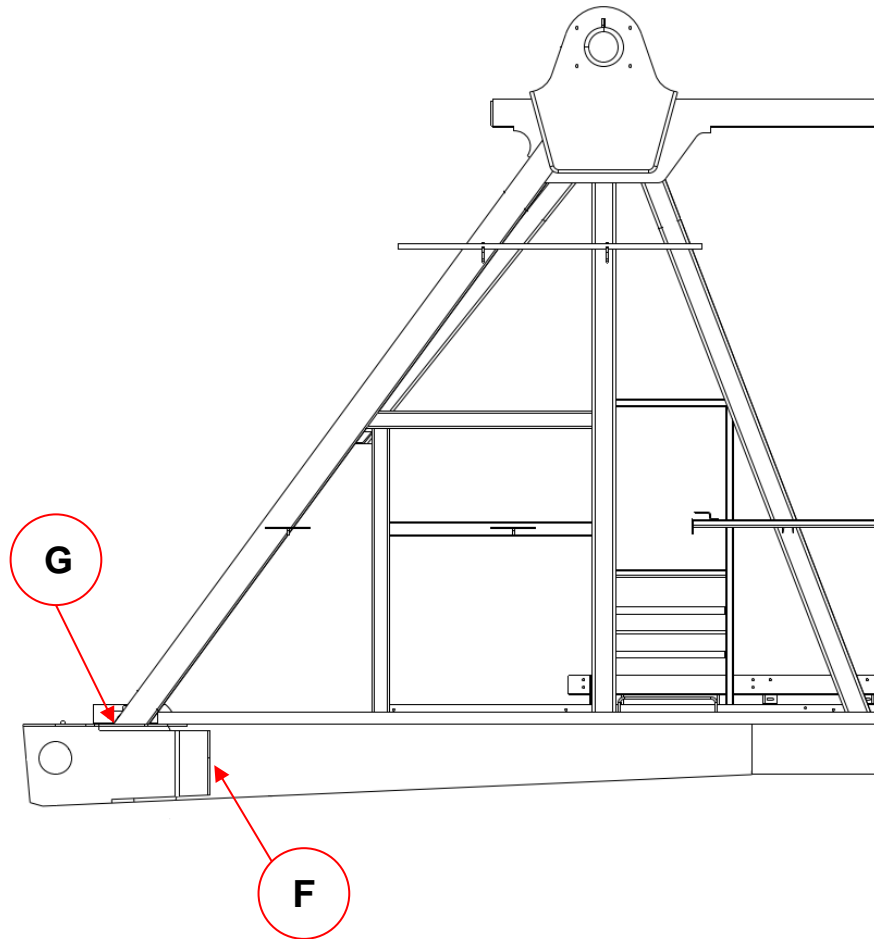


**15.2 Main beam (lattice construction) – Inspection points continued****DETAIL 1, 2****DETAIL 2**

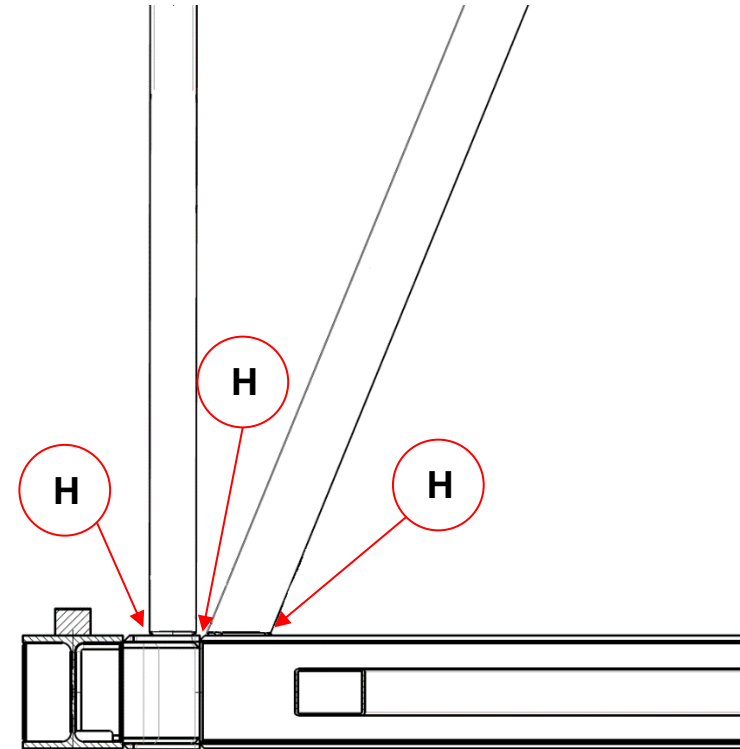


**15.3 Main beam (lattice construction) – Inspection points continued (3D)****DETAIL 1, 2****DETAIL 2**

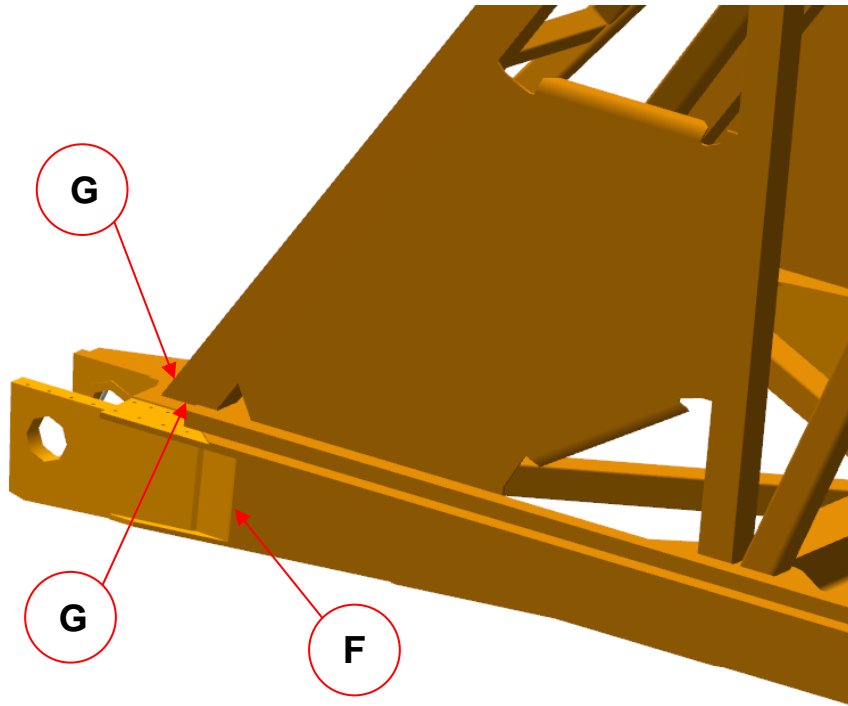
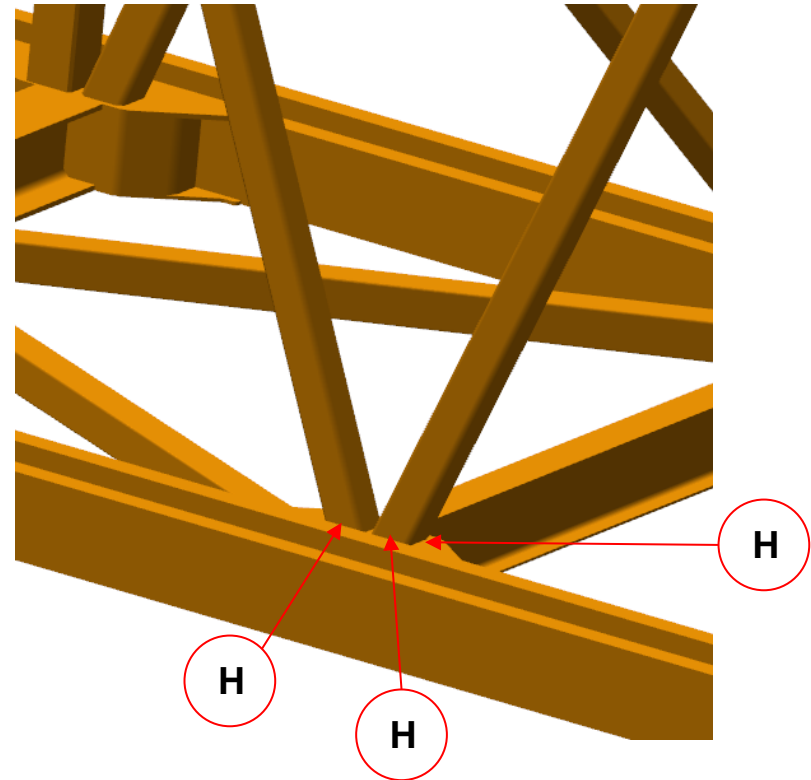
### 15.4 Main beam (lattice construction) – Inspection points continued



DETAIL 3



DETAIL 4 (Typical)

**15.5 Main beam (lattice construction) – Inspection points continued (3D)****DETAIL 3****DETAIL 4 (Typical)**

**16.0 Boom (lattice construction) - Instruction**

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Inspection of holding arm(s) connection crossbeam, hanger plates, where connected to top chords – including pins (Detail 1) (viewed from walkway)	Annual	VT	Competent person	General examination	FCM
B	Inspection of holding arm(s) connection crossbeam, hanger plates, where connected to vertical and diagonal members (Detail 1) (viewed from walkway)	Annual	VT	Competent person	General examination	FCM
C	Inspection of holding arm(s) connection plates – including pins (Detail 1) (viewed from walkway)	Annual	VT	Competent person	General examination	FCM
D	Inspection of boom pulley plates, where connected to vertical and diagonal members (Detail 1)	Annual	VT	Competent person	General examination	FCM
E	Examination of vertical and diagonal bracings where connected to hinge sections (Detail 2)	Annual	VT	Competent person	General examination	NFCM
F	Examination of hinge section, where welded to main sections (Detail 2)	Annual	VT	Competent person	General examination	NFCM
G	Examination of all main member connections	Annual	VT	Competent person	General examination	NFCM
H	Examination of the base of each vertical and diagonal member, where welded to bottom chord (Detail 3)	3 months	VT	Competent person	General examination	NFCM
I	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	FCM / NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

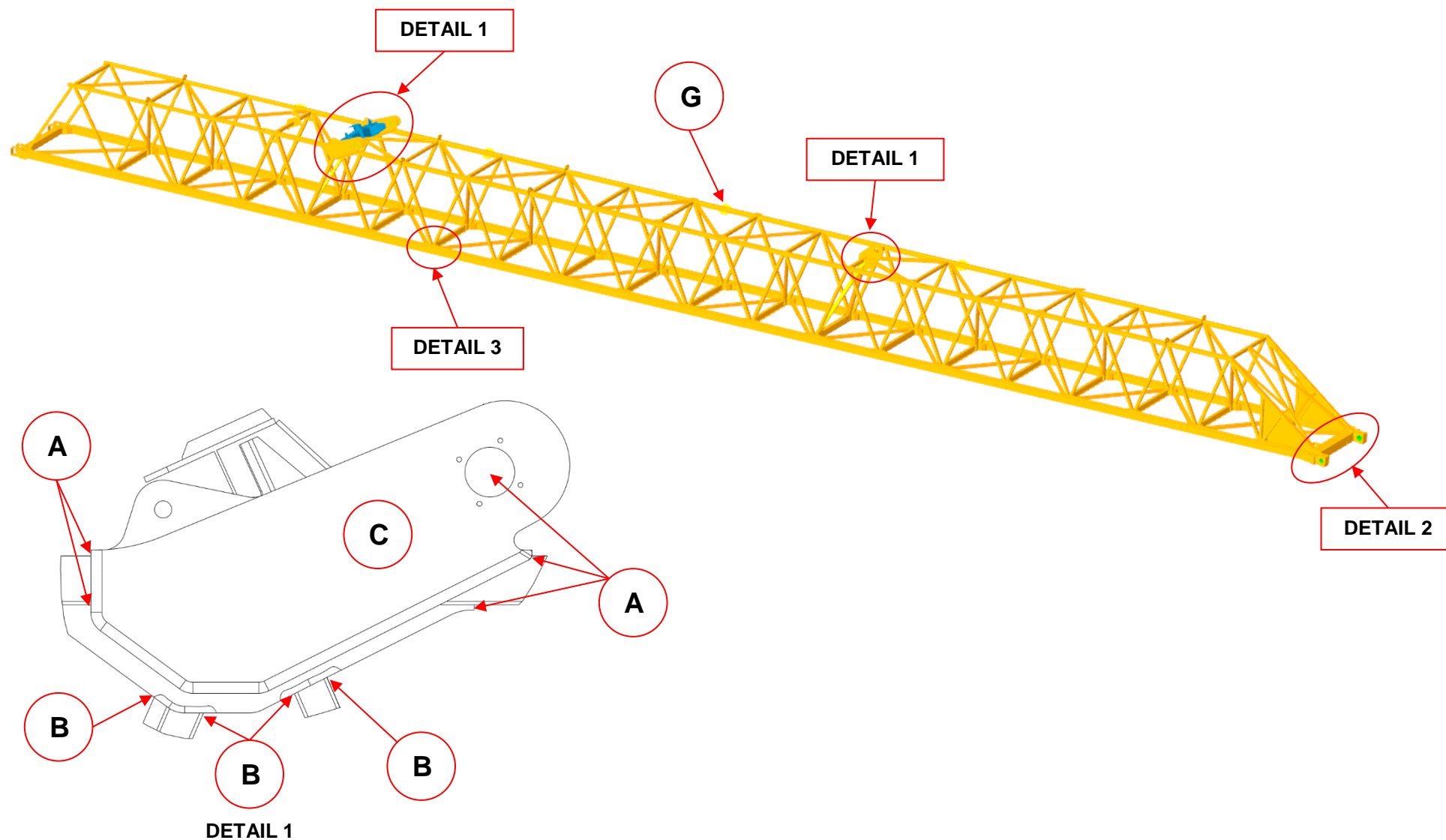
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

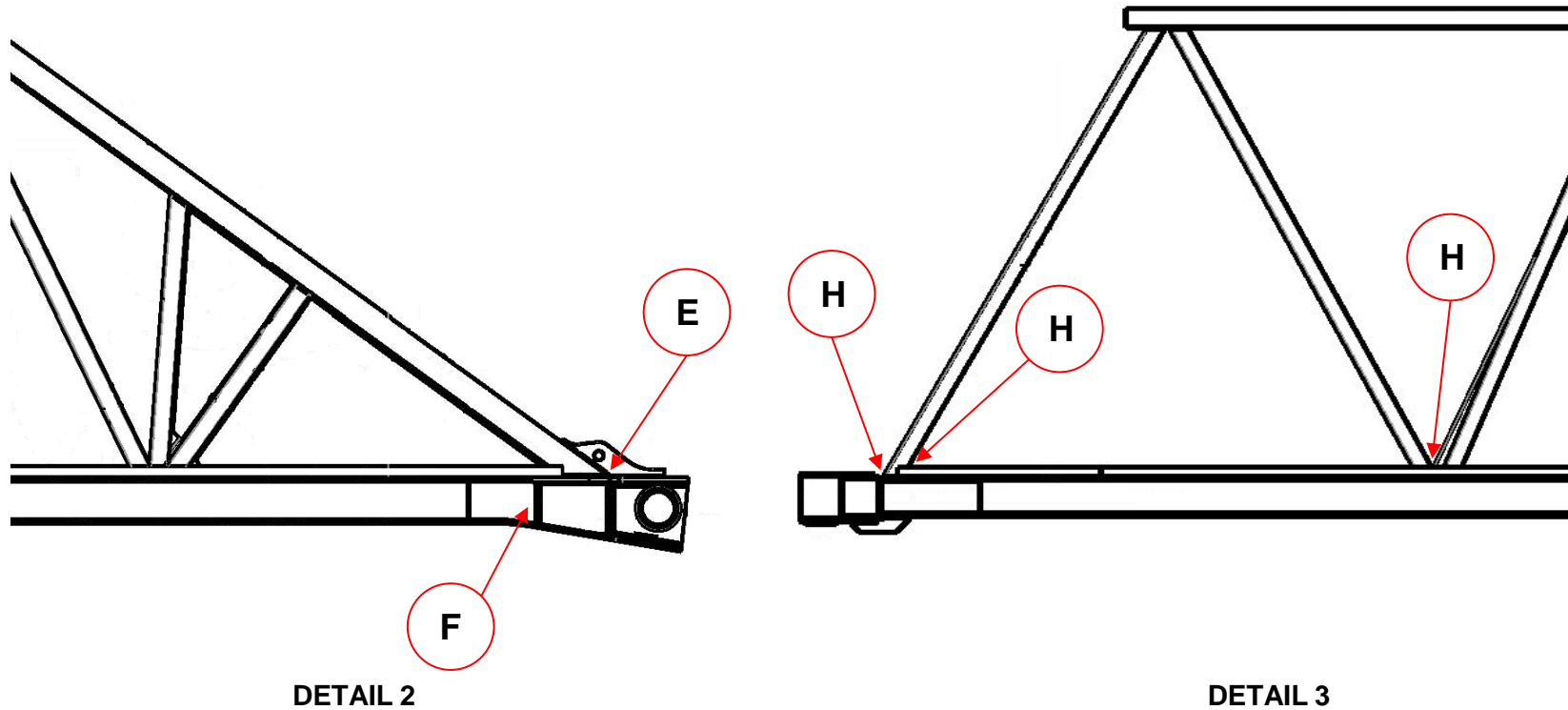
**Inspections**

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

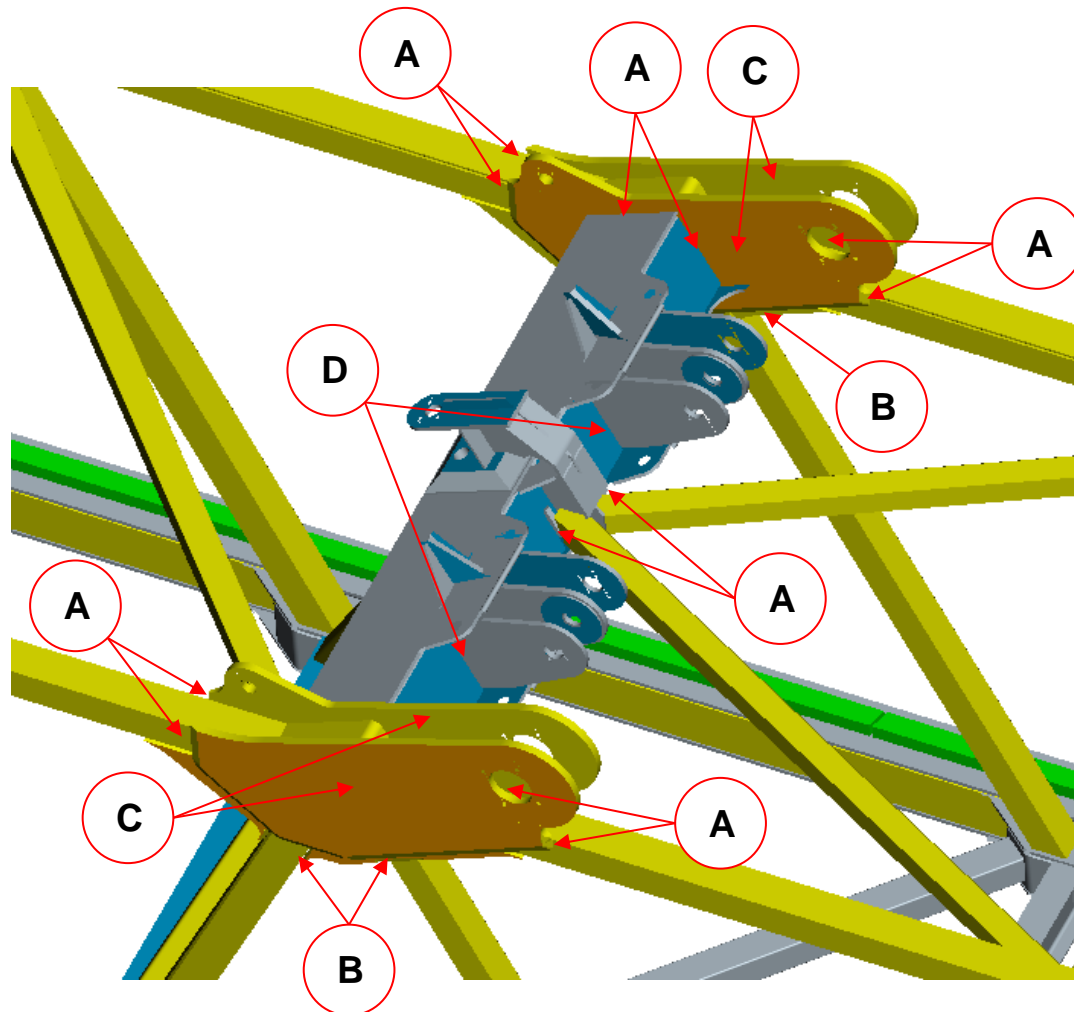
Thorough Examination: This is compulsory.

## 16.1 Boom (lattice construction) – Inspection points



**16.2 Boom (lattice construction) – Inspection points continued**

### 16.3 Boom (lattice construction) – Inspection points (3D)



DETAIL 1

## 17.0 Holding arm(s) – Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Inspections of the ends, top, bottom and centre links, in particular the welding at the ends of the insert plates.	3 months	VT	Competent person	General examination	FCM
B	Visual inspection of pin connection assembly	3 months	VT	Competent person	General examination	FCM
C	Inspection of the full length, concentrating on any welded joints (butt welds)	6 years	VT	Competent person	Thorough examination	FCM
D	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	FCM / NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

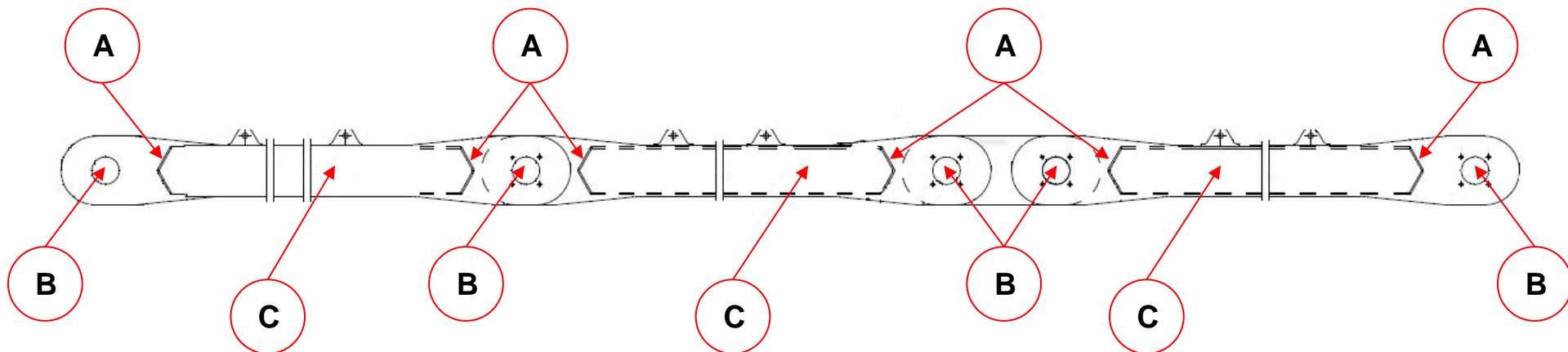
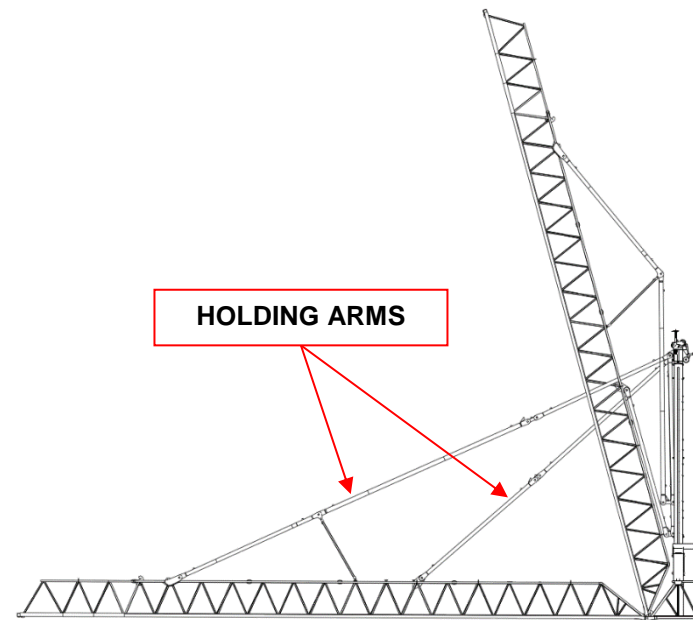
### Inspections

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.



## 17.1 Holding arm(s) – Arrangement and inspection points



## 18.0 Carrier plan bracing – Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Inspections of the ends, top and bottom. In particular the welding at the ends of the insert plates	Annual	VT	Competent person	General examination	NFCM
B	Inspection for the full length, concentration on any welded joints (butt welds)	6 years	VT	Competent person	Thorough examination	NFCM
C	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

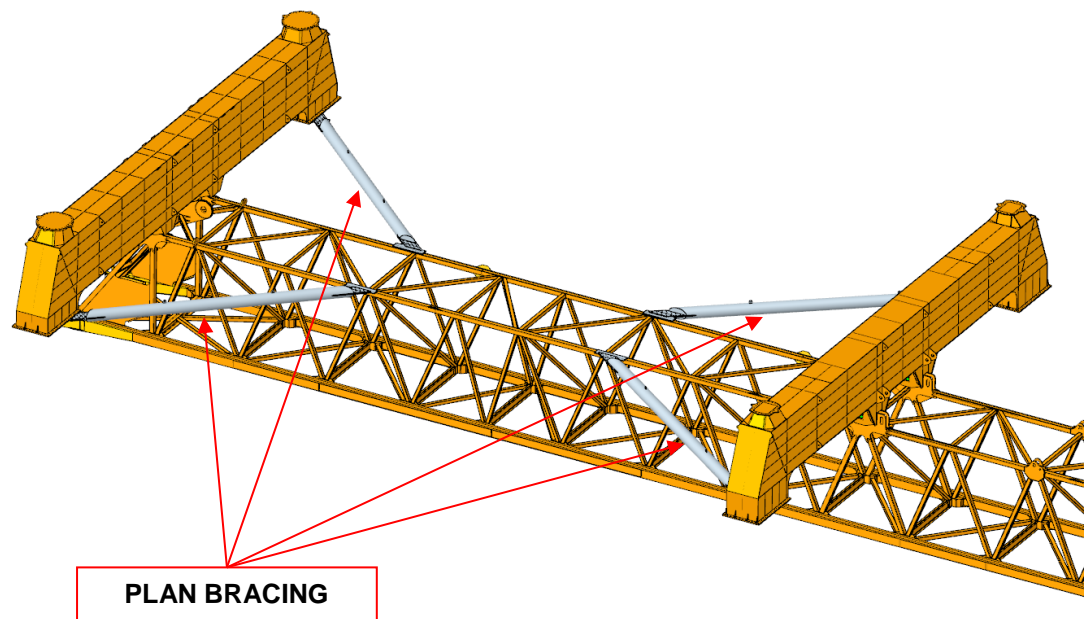
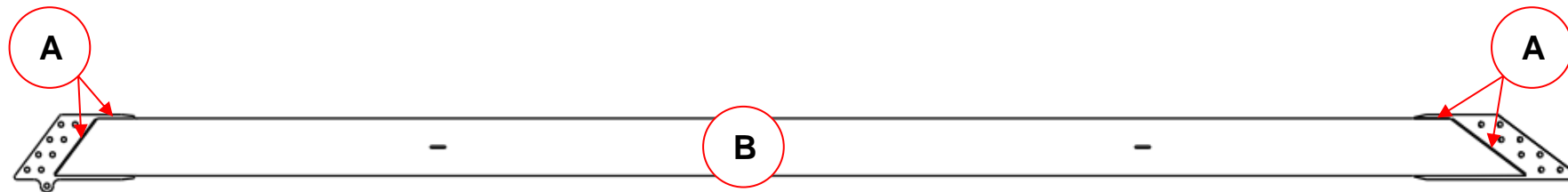
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

### Inspections

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

## 18.1 Carrier plan bracing – Inspection points



## 19.0 Legs - Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Full length external examination. In particular any welded joints and radii (in particular top of lower section)	6 years	VT	Competent person	Thorough examination	NFCM
B	Connections to carriers, sill beams and leg portals (viewed from walkway)	3 months	VT	Competent person	General examination	NFCM
C	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

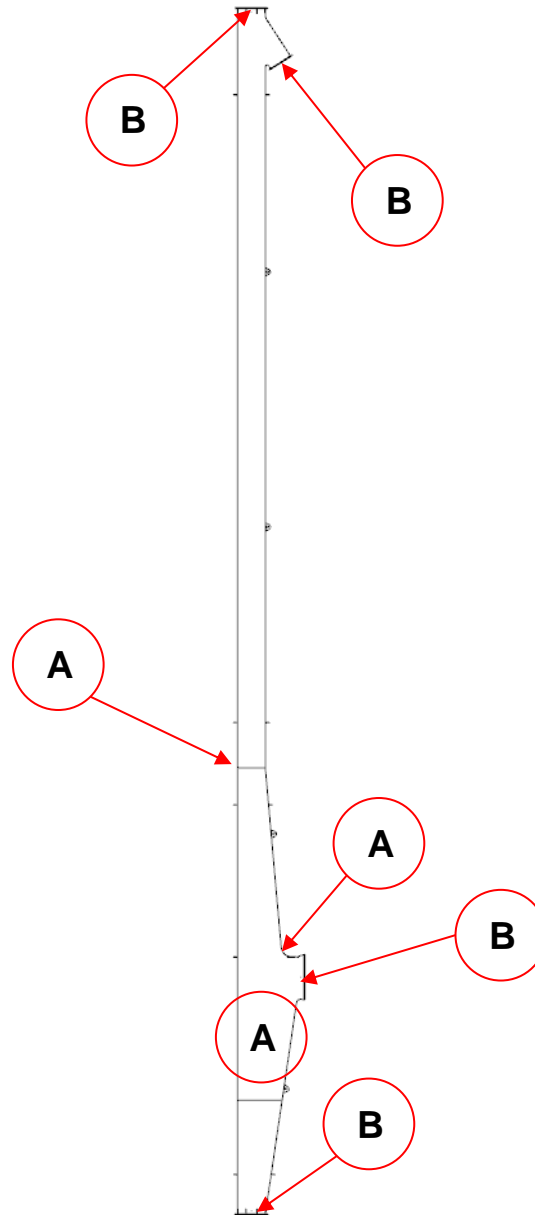
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

### Inspections

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

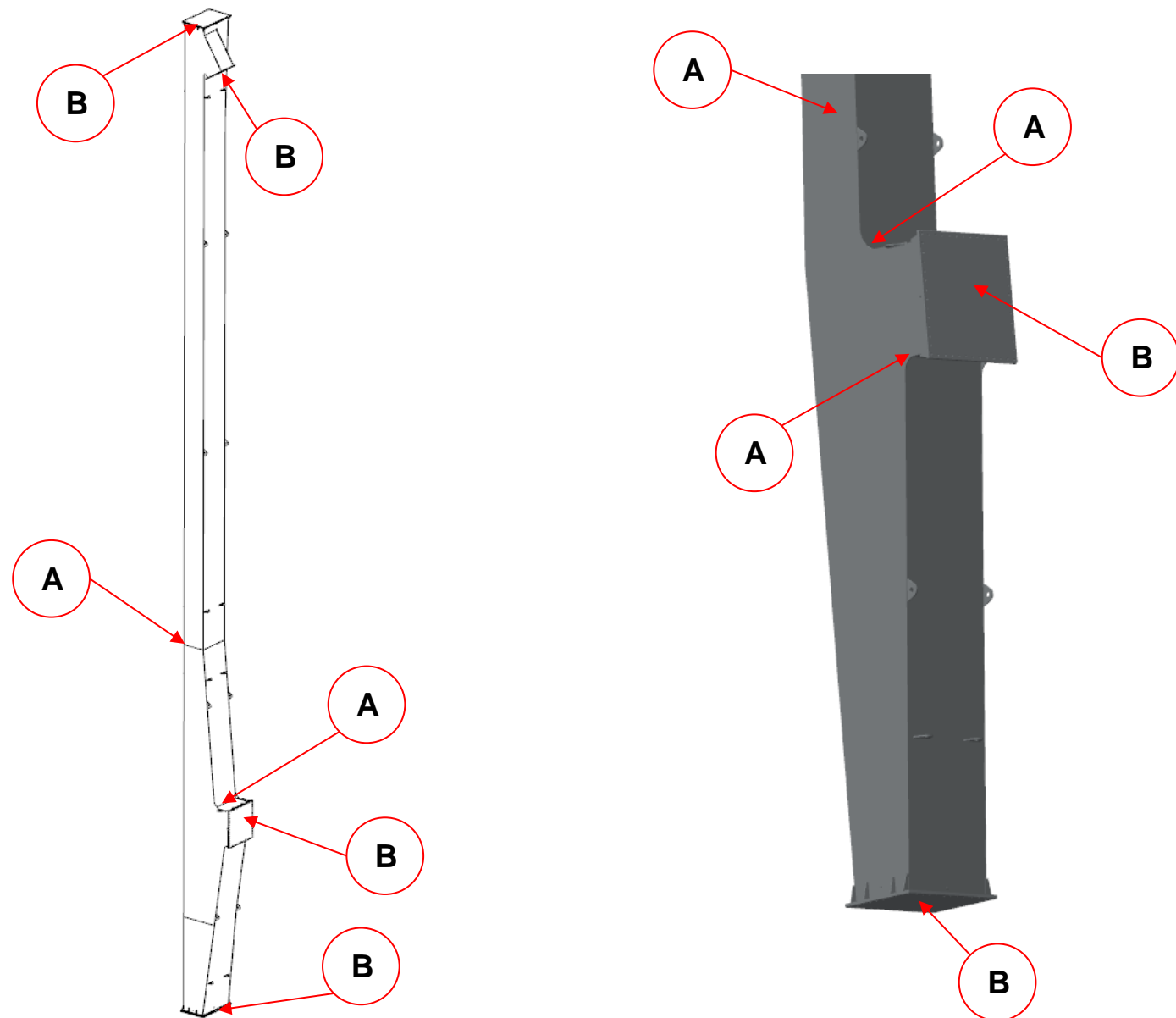
## 19.1 Legs – Inspection Points



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## 19.2 Legs – Inspection points (3D)



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## 20.0 Portal diagonals (leg braces) – Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Inspections of the ends, top and bottom. In particular the welding at the ends of the insert plates	Annual	VT	Competent person	General examination	NFCM
B	Inspection for the full length, concentration on any welded joints (butt welds)	6 years	VT	Competent person	Thorough examination	NFCM
C	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

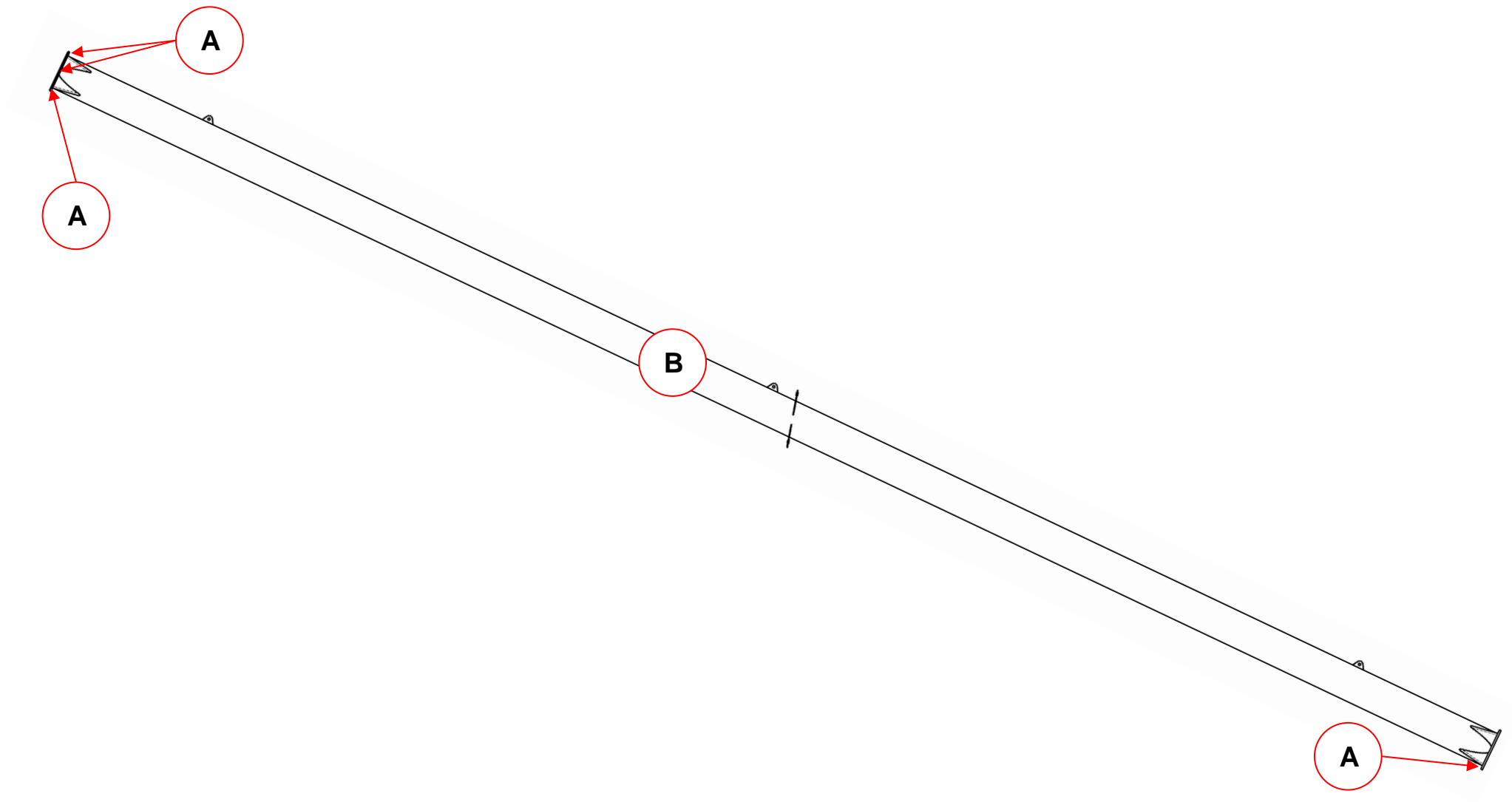
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

### Inspections

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

## 20.1 Portal diagonals (leg braces) – Inspection points





## 21.0 Sill beams – Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Structure (viewed from walkway)	Annual	VT	Competent person	General examination	NFCM
B	Examination of the connection to the legs (viewed from walkway)	6 years	VT	Competent person	Thorough examination	NFCM
C	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

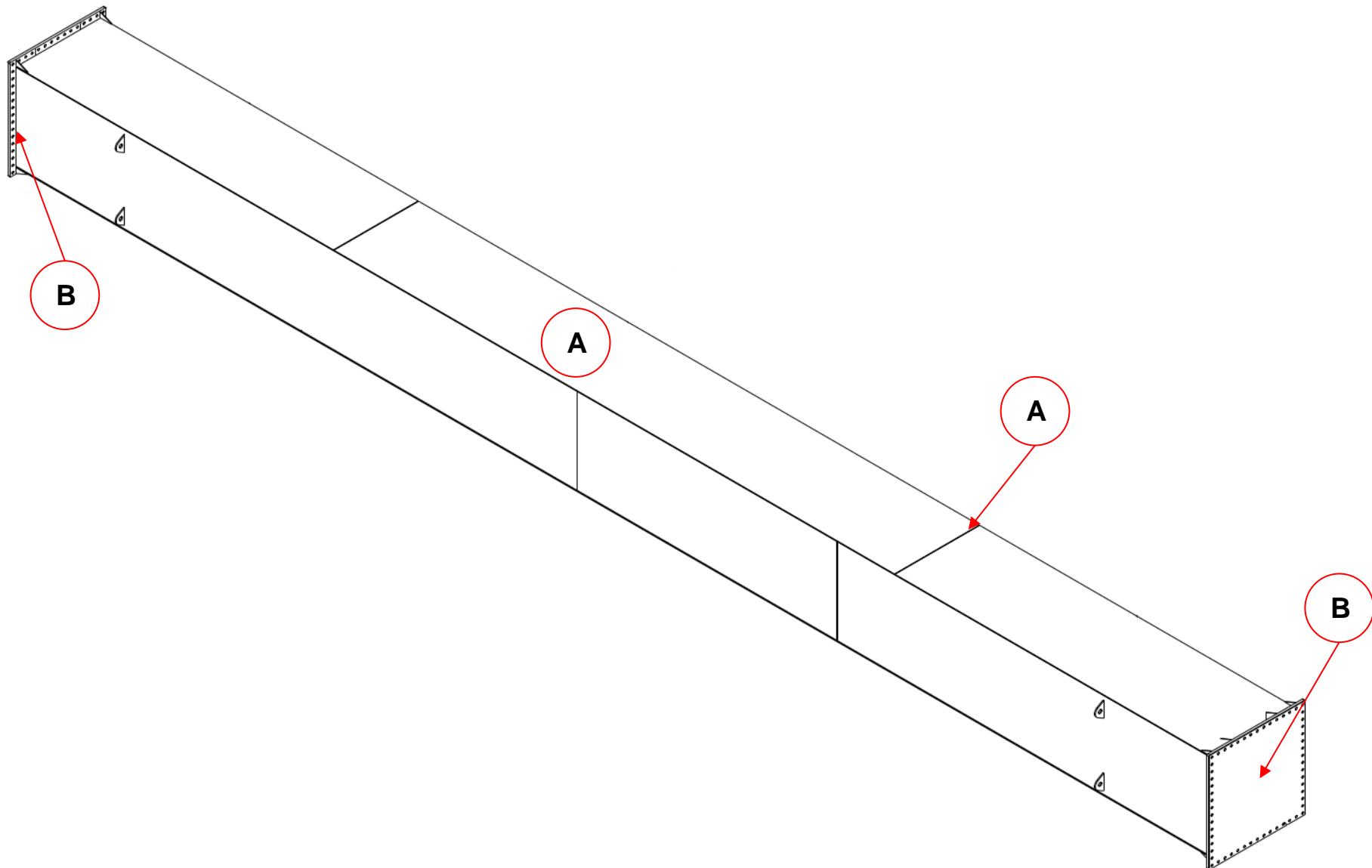
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

### Inspections

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

## 21.1 Sill beams – Inspection points



## 22.0 Endcarriages – Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Structure - including rail brake and storm anchor fabrications (viewed from walkways and/or ground level)	Annual	VT	Competent person	General examination	NFCM
B	Examination of the connection to the legs and gantry travel system (viewed from walkways and/or ground level)	Annual	VT	Competent person	General examination	NFCM
C	Inspection of the full length (viewed from walkways and/or ground level)	Annual	VT	Competent person	General examination	NFCM
D	Inspection of tie-down crane anchor points and tie-down anchors (viewed from walkways and/or ground level)	Annual, and after storm conditions	VT	Competent person	General examination	FCM
E	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

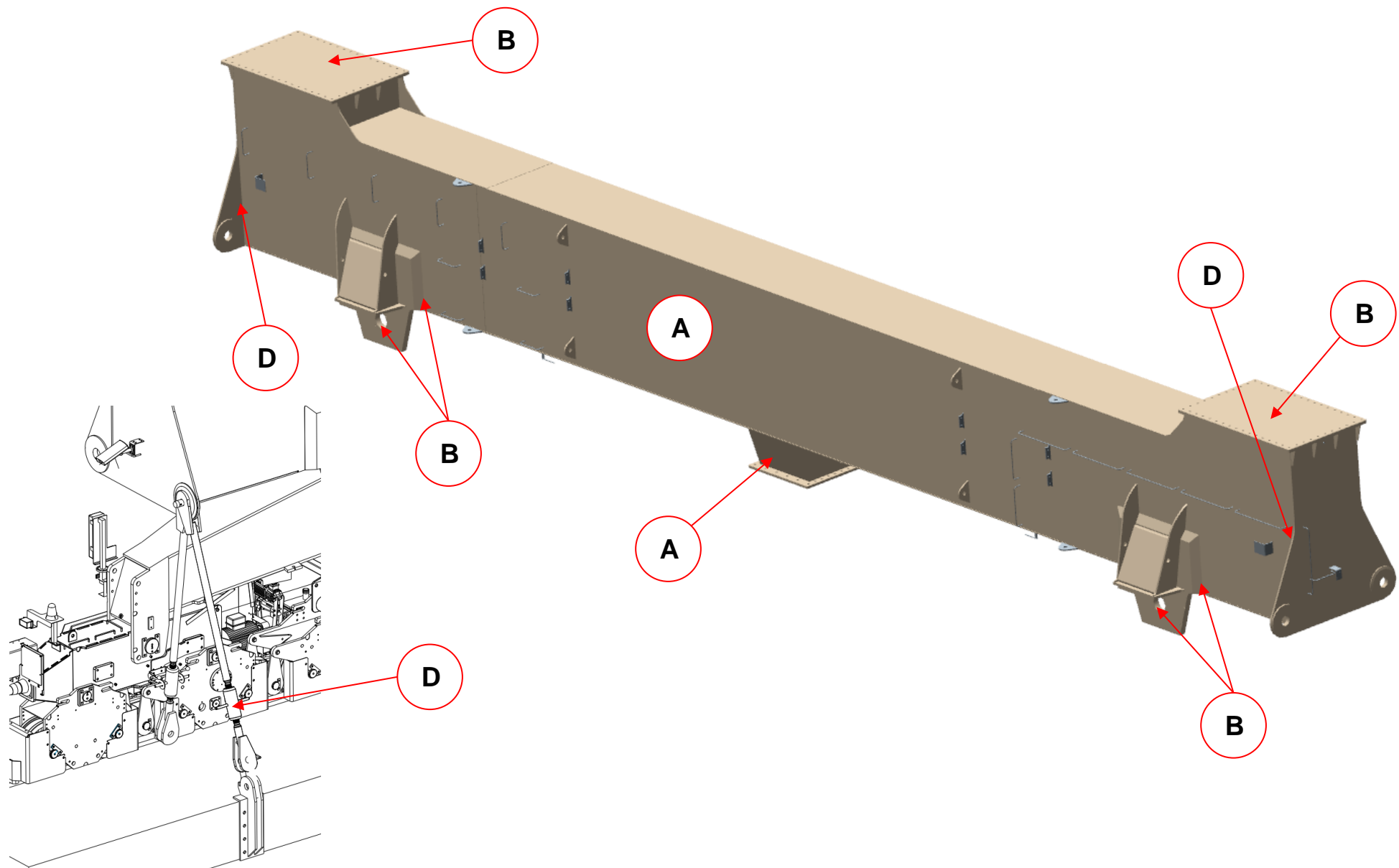
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

### Inspections

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

## 22.1 Endcarriages – Inspection points



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### 23.0 Gantry travel arrangement - Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Examination of the rocker (equaliser) and bogie fabrications; in particular the corners (viewed from walkways and/or ground level)	6 months	VT	Competent person	General examination	NFCM
B	Attachment of welded pieces for pivot pins (viewed from walkways and/or ground level)	6 months	VT	Competent person	General examination	NFCM
C	Bores and pivot pins (viewed from walkways and/or ground level)	6 months	VT	Competent person	General examination	NFCM
D	Examination of motor and gearbox mounts (viewed from walkways and/or ground level)	6 months	VT	Competent person	General examination	NFCM
E	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

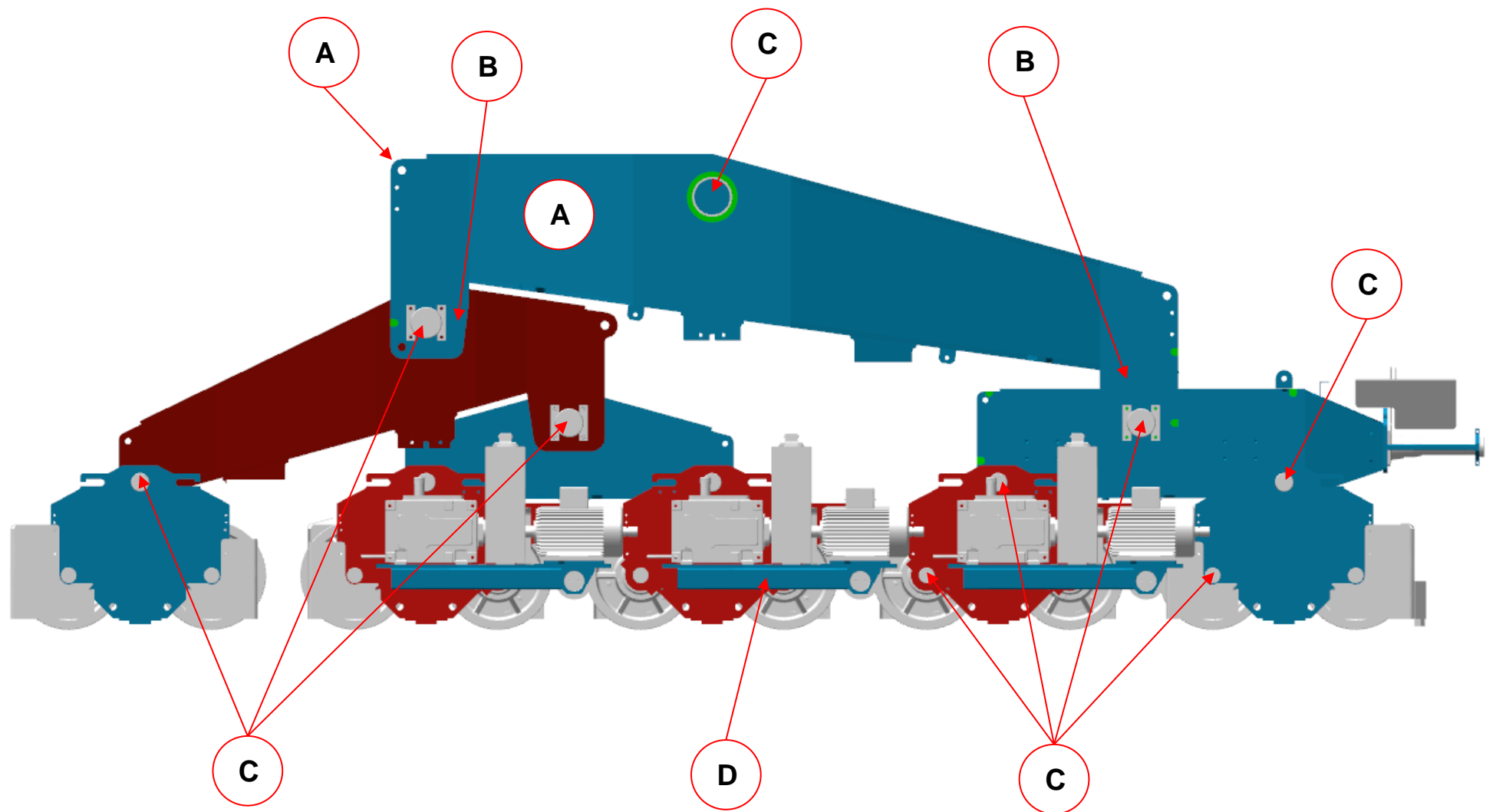
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

#### Inspections

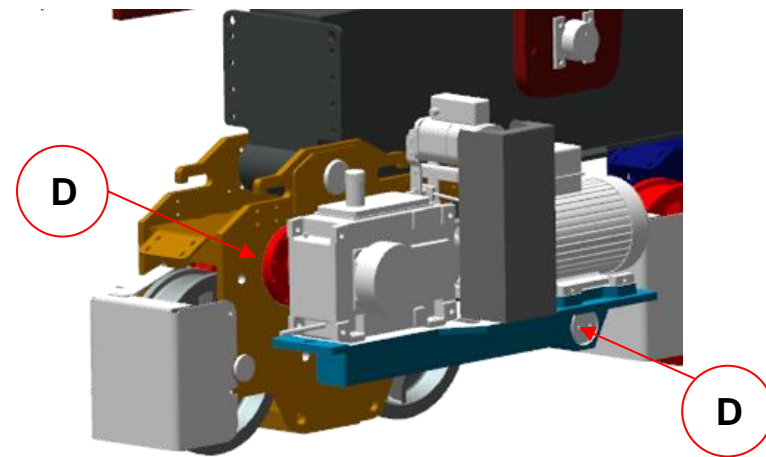
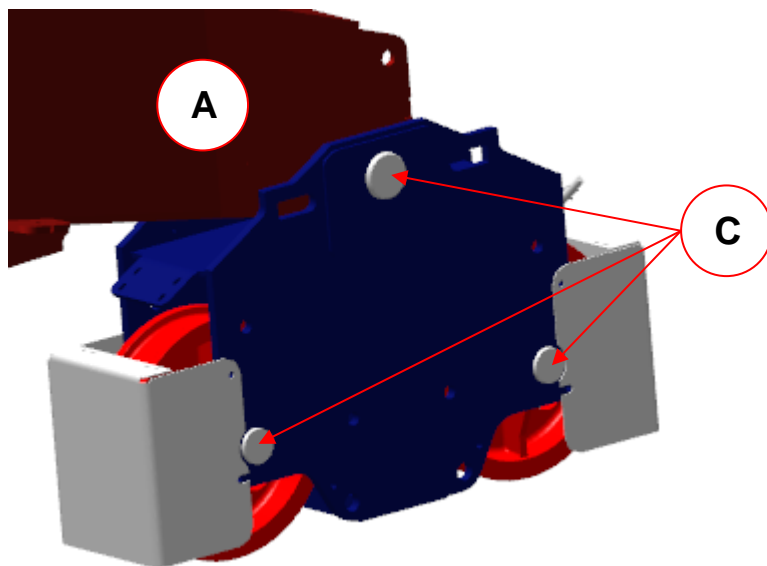
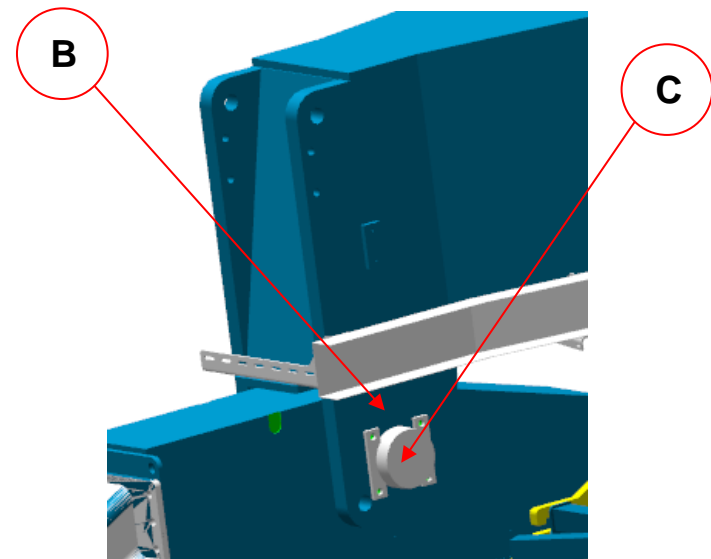
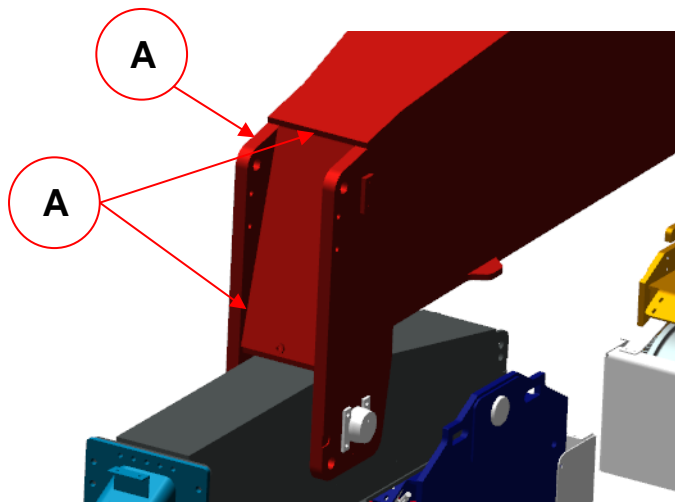
General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

### 23.1 Gantry travel arrangement – Inspection points



## 23.2 Gantry travel arrangement – Inspection points (3D)



## 24.0 Machinery house – Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Examination of the structure from the underside, using the trolley for access. Particular attention paid to joints and members supporting the drums and gearboxes, and areas around connections to main beam.	Annual	VT	Competent person	General examination	NFCM
B	Inspection of the plinths for the motors, gearboxes and brakes, for the hoist and boom hoist.	Annual	VT	Competent person	General examination	FCM
C	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	FCM / NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

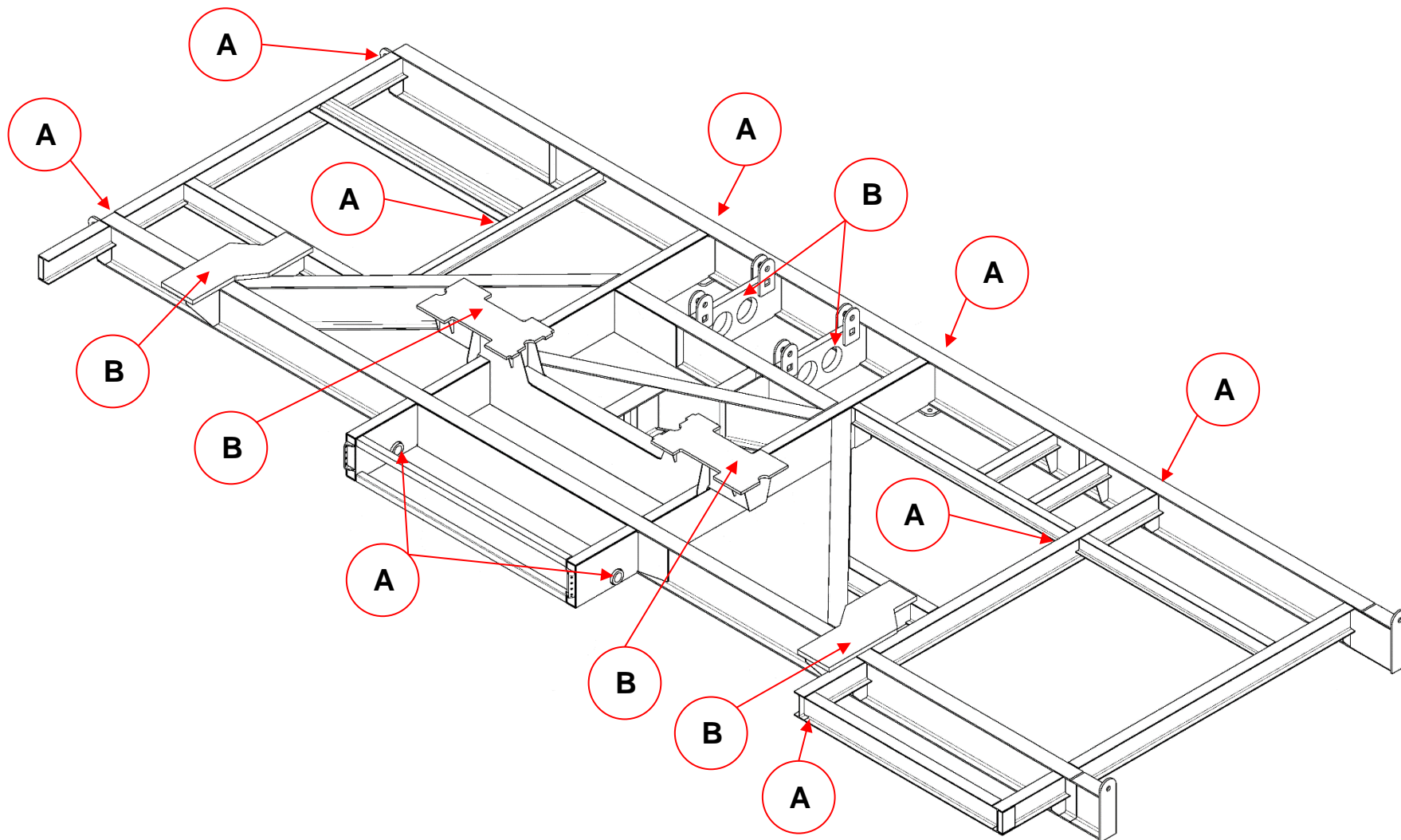
### Inspections

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.



## 24.1 Machinery house – Inspection points



## 25.0 Trolley – Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Inspection of the trolley top structure, and the platform to the cab.	6 months	VT	Competent person	General examination	NFCM
B	Examination of the trolley legs	6 months	VT	Competent person	General examination	FCM
C	Examination of the mounts for the trolley wheels and the connection to the trolley.	6 months	VT	Competent person	General examination	NFCM
D	Examination of the hoist pulley mounts	6 months	VT	Competent person	General examination	FCM
E	Examine the cab mount arrangement	6 months	VT	Competent person	General examination	FCM
F	Visual inspection of cabin hanging points	6 months	VT	Competent person	General examination	FCM
G	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	FCM / NFCM

- If some areas are inaccessible or require more detailed examination, some added access equipment may be necessary.

**Inspect all areas of member. Take particular care at indicated areas.**

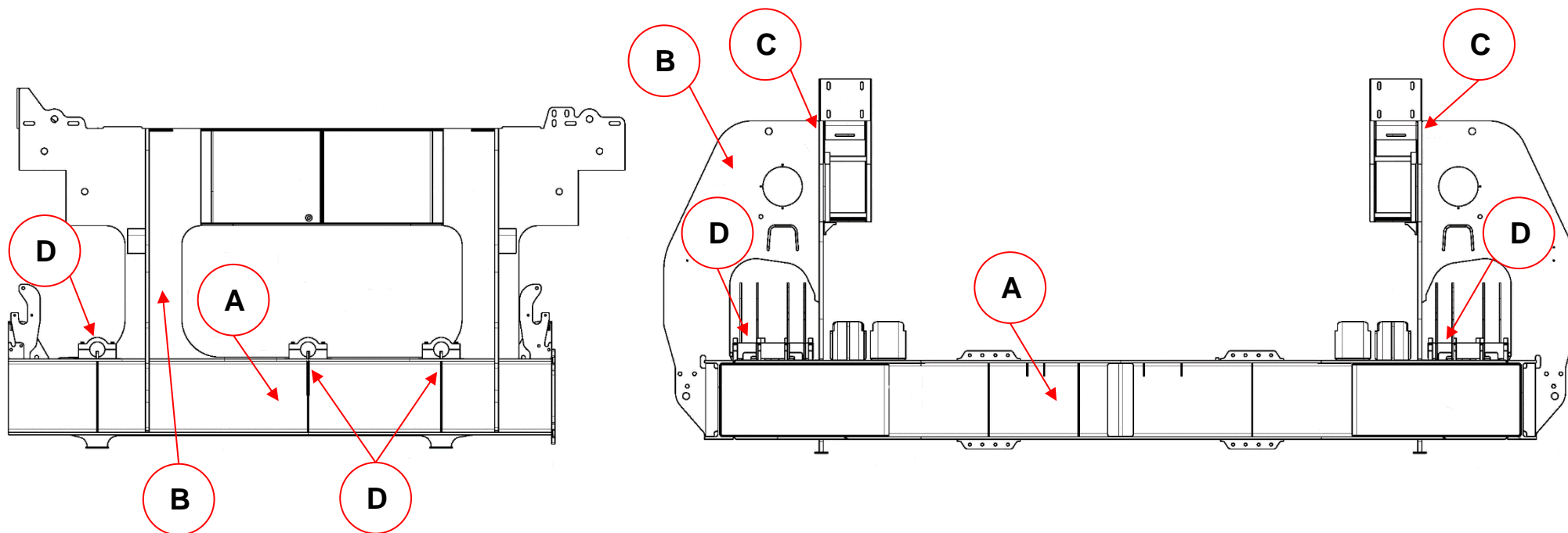
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

### Inspections

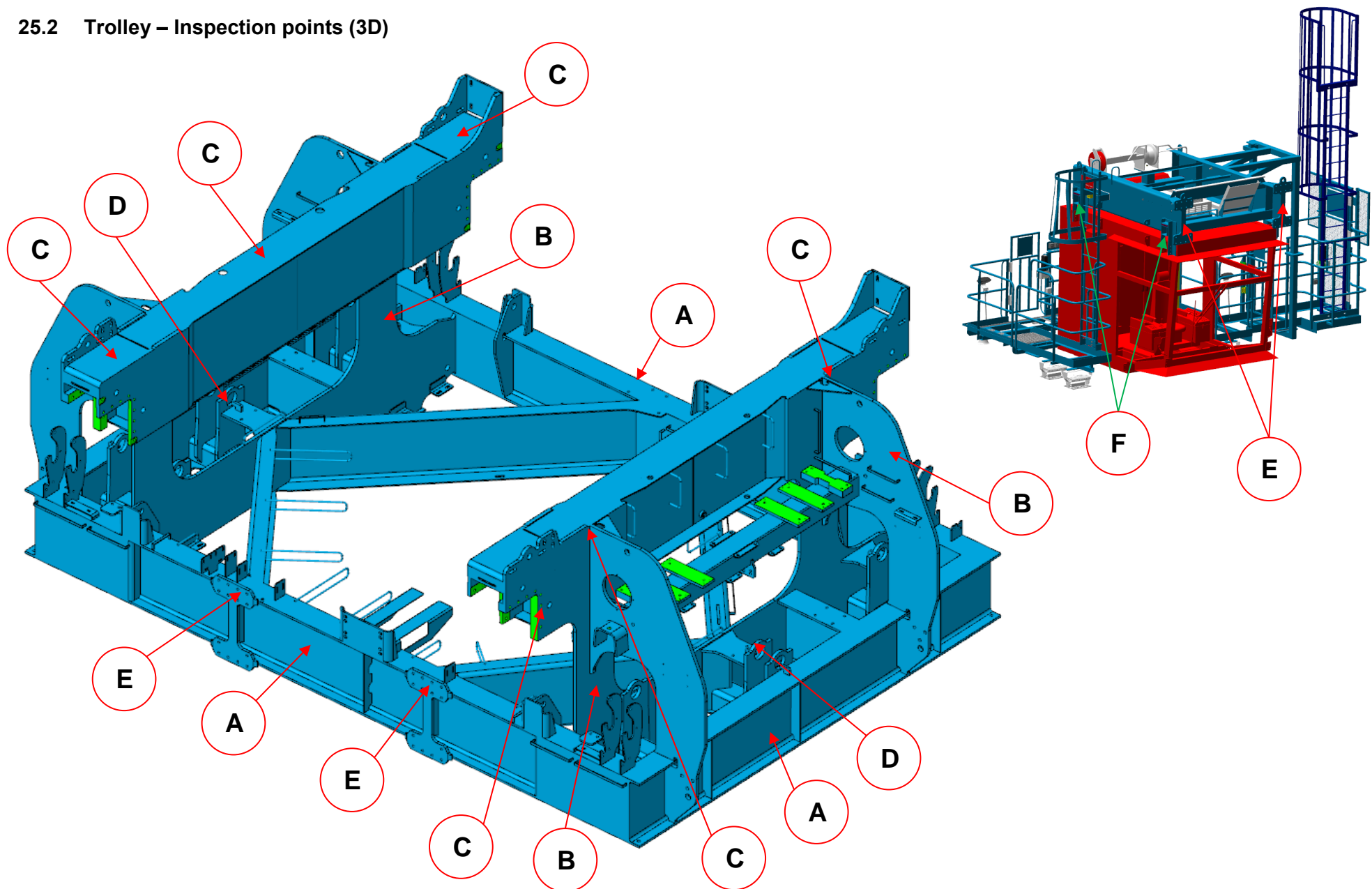
General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

## 25.1 Trolley – Inspection points



## 25.2 Trolley – Inspection points (3D)



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## 26.0 Hoist rope support trolleys (HRST) – Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Inspection of the trolley top structure, and the platforms.	Annual	VT	Competent person	General examination	NFCM
B	Examination of the mounts for the trolley wheels and the connection to the trolley.	Annual	VT	Competent person	General examination	NFCM
C	Examination of the hoist pulley mounts	Annual	VT	Competent person	General examination	NFCM
D	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	NFCM

- If some areas are inaccessible or require more detailed examination, some added access equipment may be necessary.

**Inspect all areas of member. Take particular care at indicated areas.**

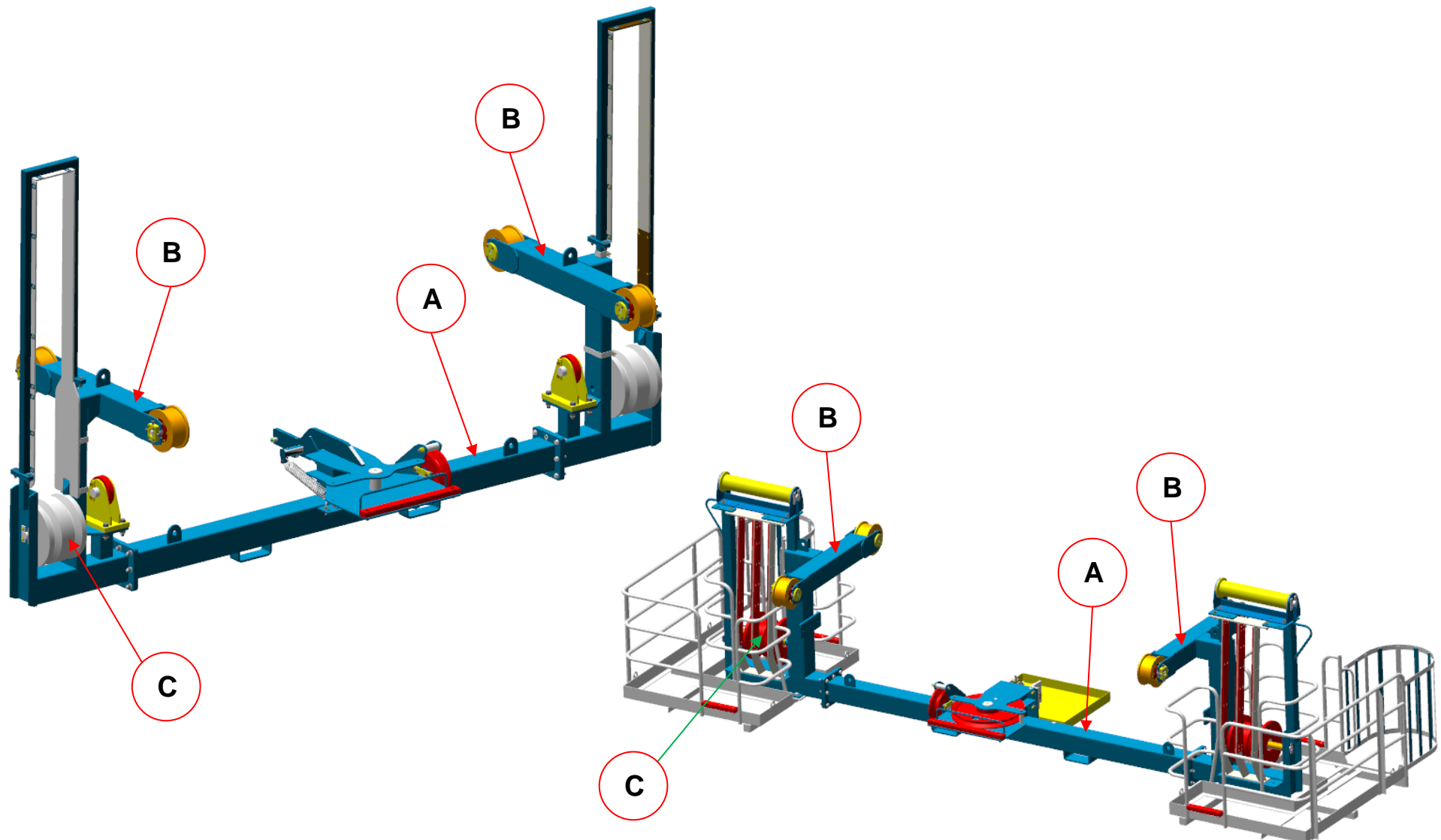
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

### Inspections

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

## 26.1 Hoist rope support trolleys (HRST) – Inspection points



**27.0 Headblock - Instruction**

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Examination of the structure at the ends of the headblocks longitudinal members, in particular the ends of any gussets.	3 months	VT	Competent person	General examination	NFCM
B	Examination of the headblock hanging plates and end frames, in particular adjacent to the twistlocks	3 months	VT	Competent person	General examination	FCM
C	Inspection around any welded on attachments	3 months	VT	Competent person	General examination	NFCM
D	Inspection of the pulley pin bores, noting any gaps	3 months	VT	Competent person	General examination	FCM
E	Inspection of twistlocks	9 months	VT	Competent person	General examination	FCM
		2 years	MT	Competent person	Thorough examination	
F	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	FCM / NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

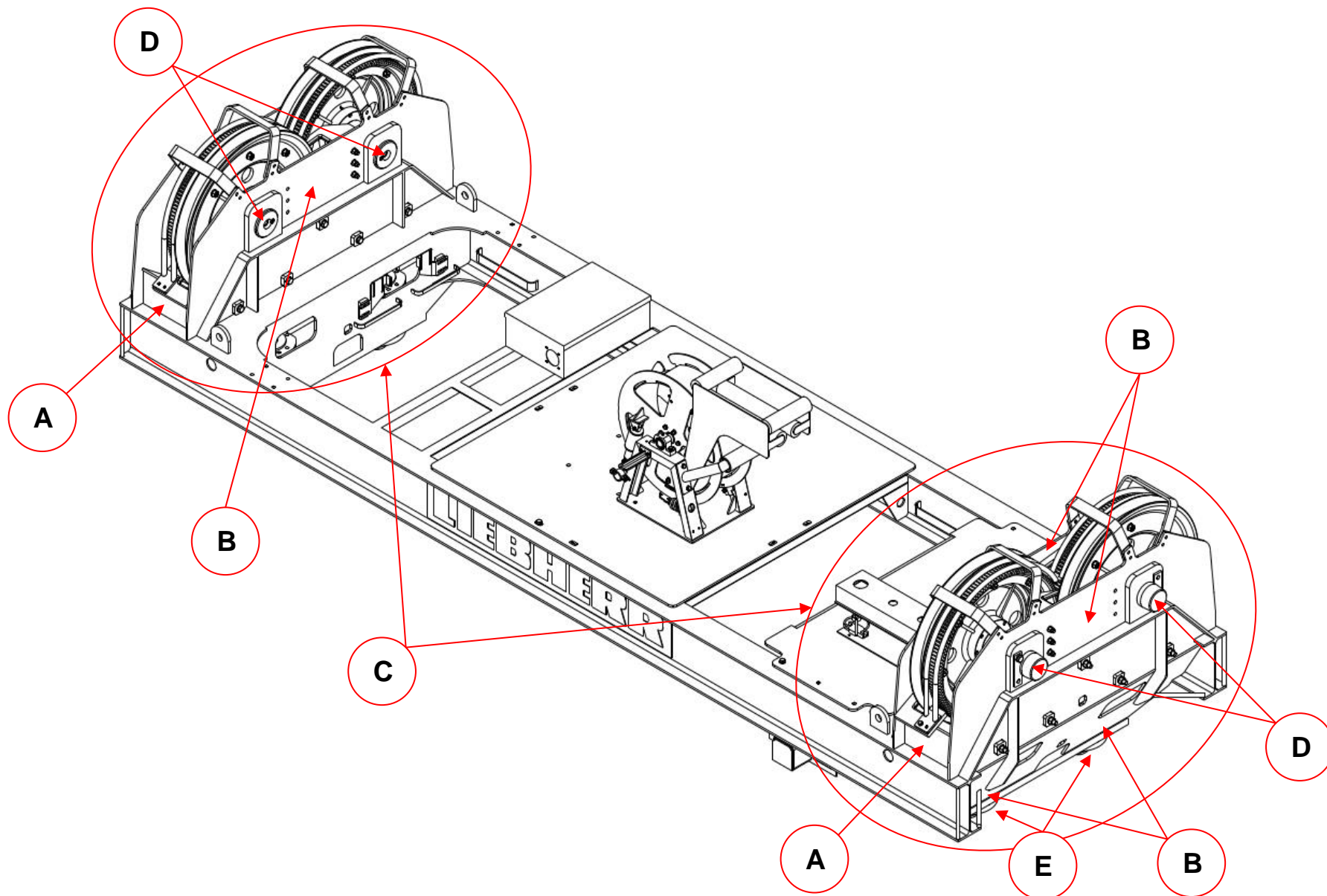
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

**Inspections**

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

## 27.1 Headblock – Inspection points



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## 28.0 Spreader - Instruction

See spreader manual for maintenance schedule.

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Examination of the spreader twistlocks	3 months	VT	Competent person	General examination	FCM
B	Examination of the spreader connection plates/twistlock pockets	3 months	VT	Competent person	General examination	FCM
C	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	FCM / NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

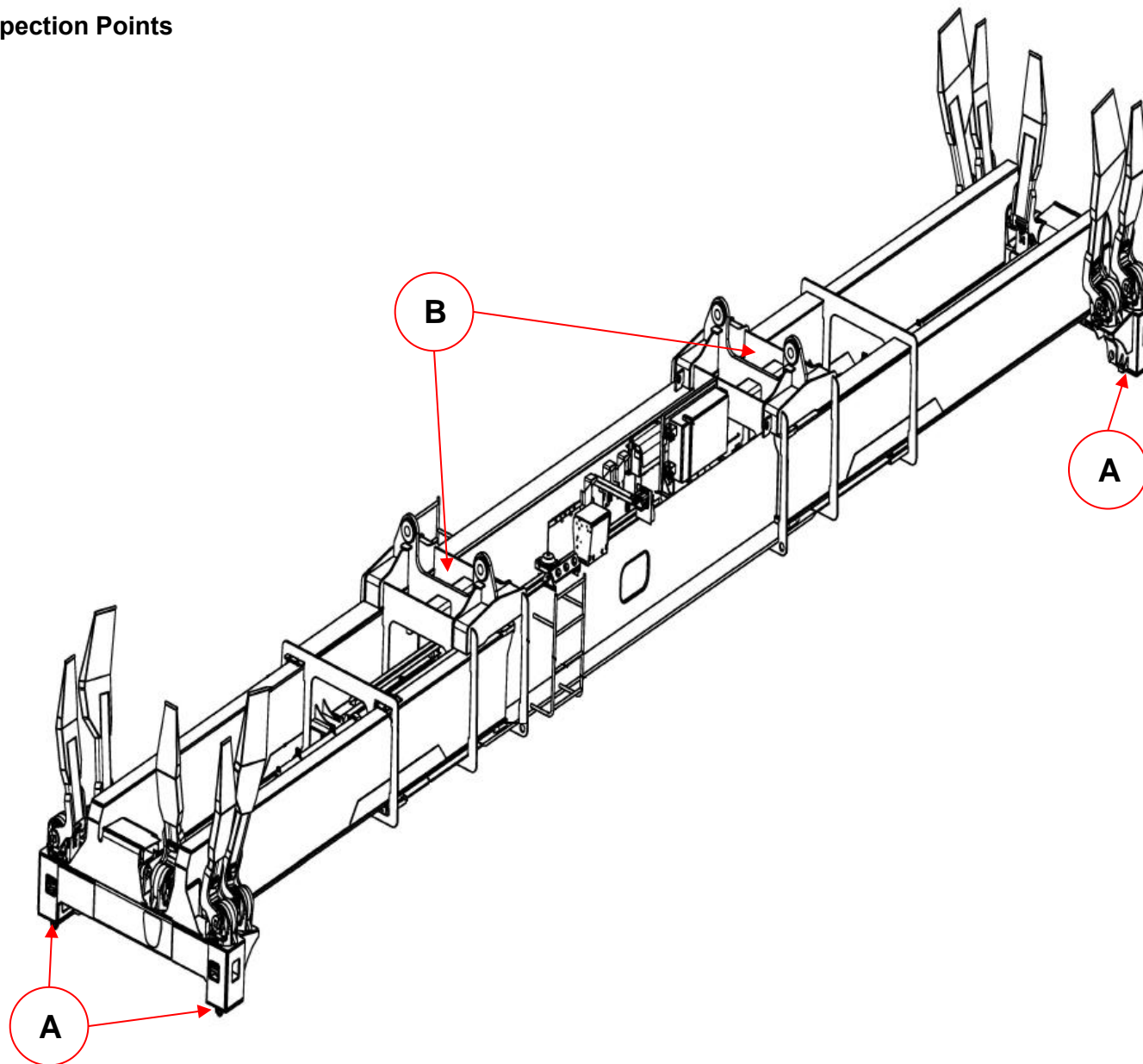
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

### Inspections

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

## 28.1 Spreader – Inspection Points



**29.0 Trim/list/skew - Instruction**

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Inspection of pulley arm pivot pins & bores, noting any gaps.	3 months	VT	Competent person	General examination	NFCM
B	Inspection of cylinder pins & bores, noting any gaps.	3 months	VT	Competent person	General examination	NFCM
C	Inspection of the pulley pins & bores, noting any gaps.	3 months	VT	Competent person	General examination	NFCM
D	Inspection of connection flanges to both platform and main beam.	Annual	VT	Competent person	General examination	NFCM
E	Inspection of supports, particular attention to be paid to welded joints.	Annual	VT	Competent person	General examination	NFCM
F	Inspection of the platform structure, particularly welded joints.	Annual	VT	Competent person	General examination	NFCM
G	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

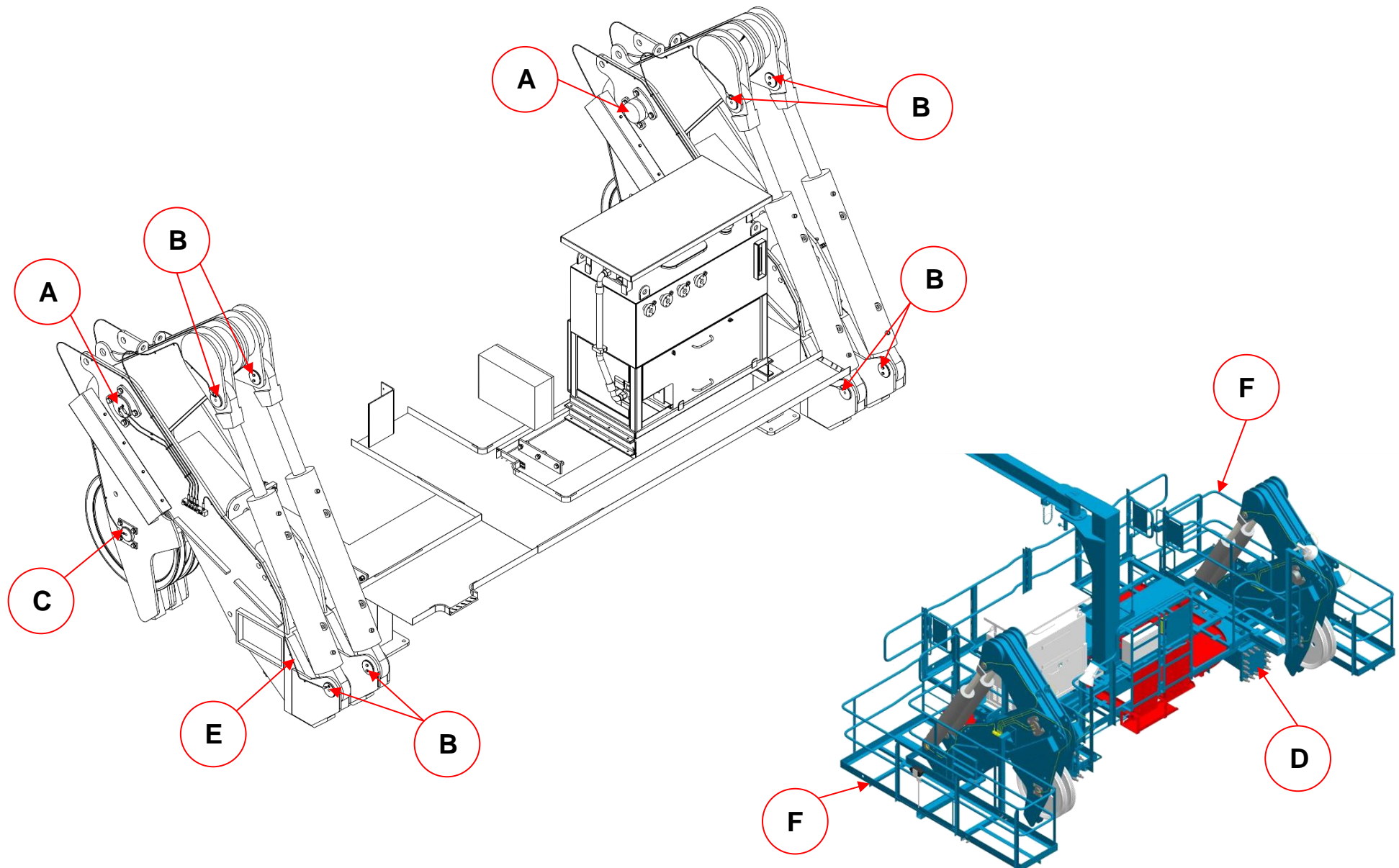
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

**Inspections**

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

## 29.1 Trim/list/skew – Inspection points (3D)



### 30.0 Hoist overload system - Instruction

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Visual inspection, concentration on any welded joints or attachments.	3 months	VT	Competent person	General examination	NFCM
B	Visual inspection for the full length, concentration on any welded joints or attachments.	Annual	VT	Competent person	General examination	NFCM
C	Inspection of the lever arm pins & bores, noting any gaps.	3 months	VT	Competent person	General examination	NFCM
D	Inspection of frame concentrating on platform connections.	Annual	VT	Competent person	General examination	NFCM
E	Complete visual inspection of all components	6 years	VT	Competent person	Thorough examination	NFCM

**Inspect all areas of member. Take particular care at indicated areas.**

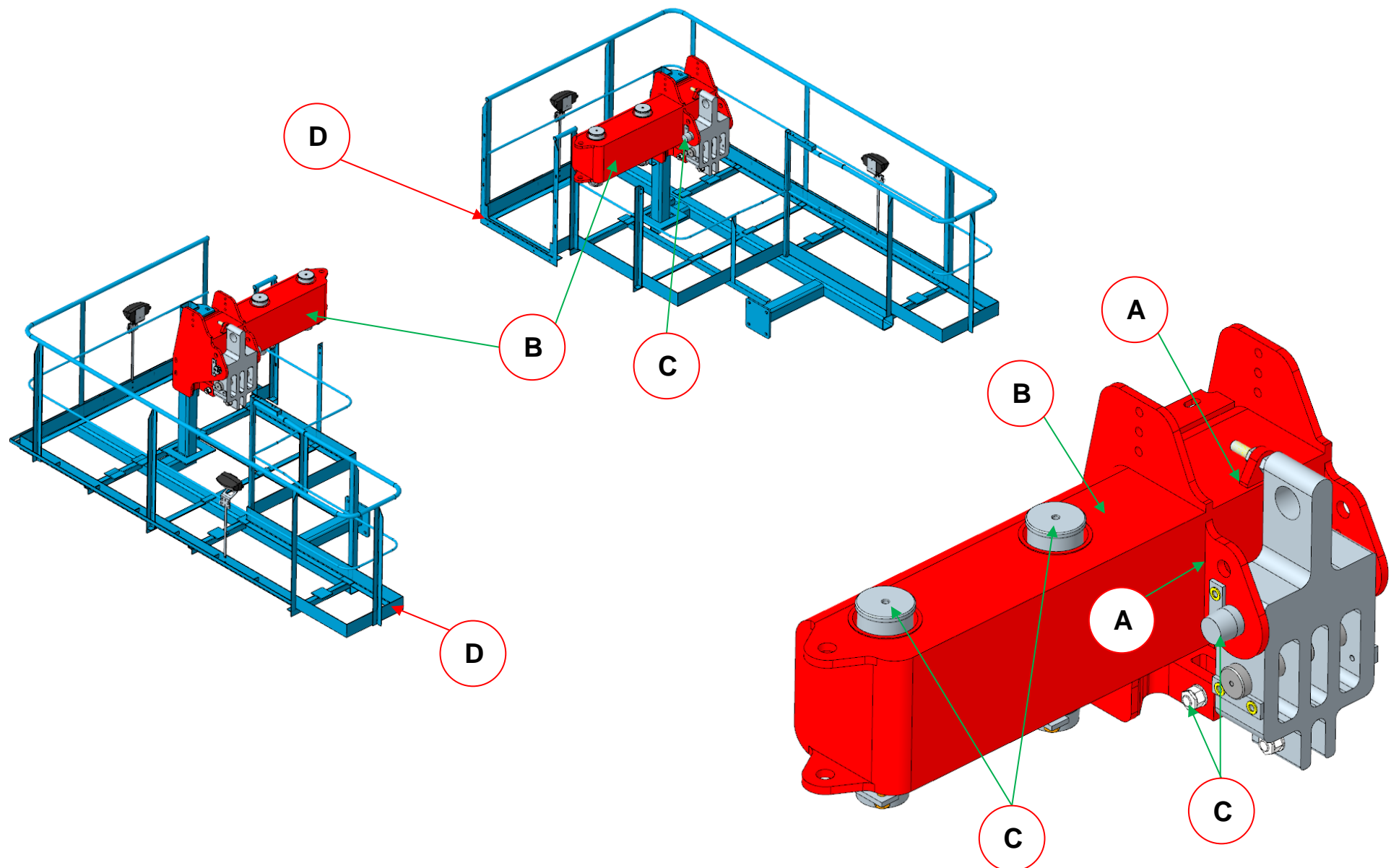
- Unless otherwise specified, inspections shall be visual only. NDT (predominantly PT/ MT/ UT/ EC) shall be used if any areas show potential defects.

#### Inspections

General Examination: Carry out inspection during routine maintenance; when maintenance person is in the region for maintenance duties. This general examination looks for any irregularities at the examination areas. This is a recommended inspection.

Thorough Examination: This is compulsory.

### 30.1 Hoist overload system – Inspection points (3D)



### 31.0 Bolted joints

A random sample of bolts are to be viewed. None are to be removed unless some suspicions or evidence of failure are seen or excessive corrosion.

Generally bolts individually can be considered as non-failure critical by virtue of the quantity of bolts in a particular joint. However if there are a significant number of damaged bolts in a group then the remainder can become substantially overloaded.

Item	Description	Inspection period	Inspection type	Carried out by	Carried out during	FCM / NFCM
A	Structure: Bolts will be inspected without dismantling any joints. Corrosion on bolts and nuts will be reviewed for example. (Viewed from suitable walkway, vantage point. Temporary access is also required for some joints.)	6 years	VT	Competent person	Thorough examination	NFCM
B	Machinery: Securing bolts shall be checked for security ("tap tested") and for movement during machinery operation. 100% of the bolts in a joint shall be checked by this means.	Annual	VT	Competent person	General examination	NFCM

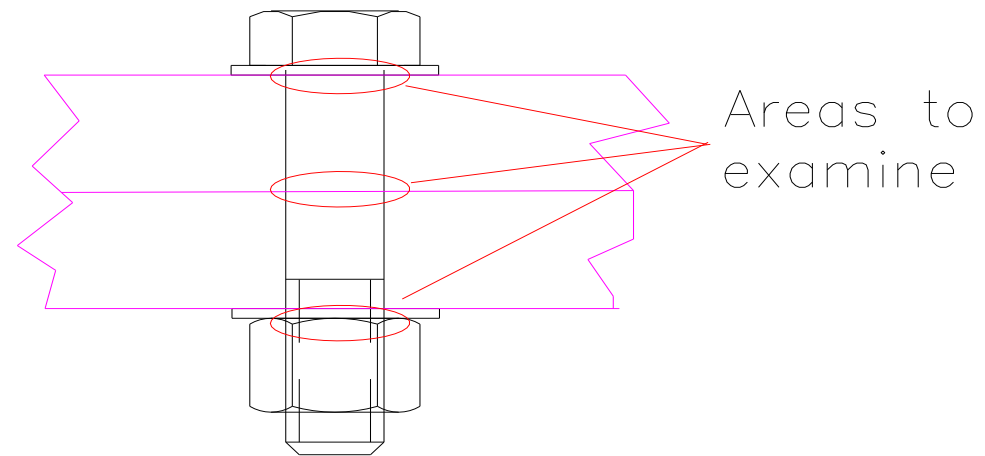
For the annual inspections, bolts will be externally examined only, from the closest and safest suitable platform. However if defects are suspected, for example lack of tension or corrosion, then the bolts shall be removed. If a defect is found then the adjacent bolts shall be progressively removed until satisfactory bolting is found.

Where bolts are to be removed, if only one bolt is to be taken from a group, i.e.: being a line of six or more bolts, then the remainder need not be disturbed. However if more than one are taken then the remainder will need attention.

If fractured bolts or bolts with surface cracks are identified at any crane component connection, ALL bolts at this connection must be replaced immediately.

Detailed examination shall include an assessment of the state of corrosion, particularly on the threads and the joint connection face region, and evidence of strain.

Any bolts removed shall be replaced by new bolts of equal strength and grade. The bolts shall be torque tightened to the original specification as defined by the bolt manufacturer and/or crane designer. In any event, advice shall be sought from a competent engineer. Adjacent bolts shall be checked for tightness after the replaced bolt is finish tightened.





## **32.0 Surface protection and corrosion**

Whilst examining the areas described in the preceding sections an assessment of the paint condition and corrosion shall be made.

Particular areas to inspect are close to welded connections, areas that have had welded attachments added during the crane life, in the vicinity of bolts, and areas where water is likely to collect.

Where the paint appears intact, or only the top coat has become damaged, then no further action is necessary.

Where there is light corrosion, less than 1 mm pitting, then the area shall be 'recorded' as needing treatment. This would generally be equivalent to Swedish Standard SS 05 59 00 SA 3.

Where the corrosion appears to be more than 1 mm then the record shall show that further investigation is necessary, including ultrasonic material thickness checks, adjacent paint thickness tests and localised material removal. The extent of the further work shall be at the discretion of the competent engineer.

Whenever repainting and/or 'touch up' painting is performed, whether by internal or external persons, the paint procedure specific to this crane shall be strictly adhered to.

**33.0 Inspection Reports**

Date	Item	Section / Description			Inspection Period	Inspection Type	Carried Out By: Name/Position	Carried Out During	FCM / NFCM
No. of Cycles		Hoist Hours	Trolley Hours	Gantry Travel Hours	Signature:				
Results / Notes									
Actions for Corrections									
Date	Item	Section / Description			Inspection Period	Inspection Type	Carried Out By: Name/Position	Carried Out During	FCM / NFCM
No. of Cycles		Hoist Hours	Trolley Hours	Gantry Travel Hours	Signature:				
Results / Notes									
Actions for Corrections									

Date	Item	Section / Description			Inspection Period	Inspection Type	Carried Out By: Name/Position	Carried Out During	FCM / NFCM
No. of Cycles		Hoist Hours	Trolley Hours	Gantry Travel Hours	Signature:				
Results / Notes									
Actions for Corrections									
Date	Item	Section / Description			Inspection Period	Inspection Type	Carried Out By: Name/Position	Carried Out During	FCM / NFCM
No. of Cycles		Hoist Hours	Trolley Hours	Gantry Travel Hours	Signature:				
Results / Notes									
Actions for Corrections									

Date	Item	Section / Description			Inspection Period	Inspection Type	Carried Out By: Name/Position	Carried Out During	FCM / NFCM
No. of Cycles		Hoist Hours	Trolley Hours	Gantry Travel Hours	Signature:				
Results / Notes									
Actions for Corrections									

Date	Item	Section / Description			Inspection Period	Inspection Type	Carried Out By: Name/Position	Carried Out During	FCM / NFCM
No. of Cycles		Hoist Hours	Trolley Hours	Gantry Travel Hours	Signature:				
Results / Notes									
Actions for Corrections									

Date	Item	Section / Description			Inspection Period	Inspection Type	Carried Out By: Name/Position	Carried Out During	FCM / NFCM
No. of Cycles		Hoist Hours	Trolley Hours	Gantry Travel Hours	Signature:				
Results / Notes									
Actions for Corrections									
Date	Item	Section / Description			Inspection Period	Inspection Type	Carried Out By: Name/Position	Carried Out During	FCM / NFCM
No. of Cycles		Hoist Hours	Trolley Hours	Gantry Travel Hours	Signature:				
Results / Notes									
Actions for Corrections									

END OF MANUAL