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| EE495/CME495 |
| EE495/CME495 System Requirement Matrix |
| Revision 3 |

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Contents

[1 Purpose 2](#_Toc23196114)

[1.1 Document Identifier 2](#_Toc23196115)

[1.2 Applicable Documents 2](#_Toc23196116)

[1.3 Revision History 2](#_Toc23196117)

[1.4 Abbreviations and Acronyms 2](#_Toc23196118)

[2 Requirements Matrix 3](#_Toc23196119)

[Table 2‑1 System Requirements Matrix 4](#_Toc23196120)

# Purpose

This document identifies the complete set of system requirements for the Doepker Industries Robot Rotator. It contains a matrix which identifies where the formal requirement is located, allocates each requirement to hardware or software or both, identifies one or more methods that will be used to verify each requirement, and identifies at which level of testing each requirement is verified.

As requirements are verified through analysis, inspection, demonstration or testing the documents containing the verification are identified in the matrix.

## Document Identifier

This document is identified as:

**CD3 – EE495/CME495 System Requirements Matrix**

## Applicable Documents

Applicable documents include:

**CD1 – EE495/CME495 Problem Definition**

## Revision History

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| --- | --- | --- |
| **Date** | **Revision** | **Changes** |
| October 27, 2019 | 1 | Initial Revision |
| October 28, 2019 | 2 | Formatting changes, added and edited requirements. |
| November 2, 2019 | 3 | Added new requirements for the user panel after meeting with client. |
|  |  |  |

## Abbreviations and Acronyms

The following is a list of abbreviations and acronyms used in this document:

FAT Factory Acceptance Test

HW Hardware

SRM System Requirement Matrix

SW Software

# Requirements Matrix

The matrix in this section identifies every system requirement. Its columns are described below:

1. **Requirement ID.** A unique identifier that can be used for purposes of traceability.
2. **Source.** An unambiguous reference to the origin of the requirement.
3. **Description.** The requirement text.
4. **Allocation.** The system object or objects to which the requirement is allocated.
5. **Verification Method.** This column indicates how the requirement will be verified:

* **Analysis.** Requirements are verified by applying indirect methods such as mathematical analysis, modeling, simulation, similarity assessments, review of design, and validation of records.
* **Inspection.** Requirements are verified by direct visual observation of passive characteristics, without the use of specialized equipment or services.
* **Test.** Requirements are verified by measurement of quantitative characteristics during or after the controlled application of stimuli under appropriately controlled conditions, or by direct visual observation of active qualitative characteristics.
* **Noted.** Noted, but no verification required, such as for an information only requirement containing a "will" statement.

1. **Test Level.** The level of testing at which the requirement will be verified. The column is subdivided into the three levels of testing at which the verification of the requirement will be shown.

* **Sub.** At the subsystem test level. Subsystem tests are generally performed to verify functionality on a unit level before the unit is integrated into the system. The tests are not witnessed by Doepker Industries, but the results of the test are available for review upon request.
* **FAT.** At the Factory Acceptance Test level. The factory acceptance is performed at Doepker Industries according to test procedures. The test procedures are submitted to Doepker Industries for approval before the start of testing. Doepker Industries is requested to witness FAT.

1. **Comments.** Used to clarify the group’s interpretation of a requirement, supplement any columnar information or to denote those rows in the table that are “Title Only”.
2. **Where Verified.** Identifies one or more documents that verify the requirement. Reference to a test procedure means the completed test procedure. This column is filled in before FAT.

| Table 2‑1 System Requirements Matrix |
| --- |

| **Requirement ID** | **Source** | **Description** | **Allocation** | | **Verification Method** | **Test Level** | | **Comments** | **Where Verified** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SW** | **HW** | **Sub** | **FAT** |
| **RD: Rotator Design Requirements** | | | | | | | | | |
| RD-1 | Client | The system shall continuously rotate a load 360° around a horizontal axis. |  | X | Test |  | X |  |  |
| RD-2 | Client | The system shall be able to recall and rotate to 4 different angle positions. | X | X | Test |  | X |  |  |
| RD-3 | Derived | The system shall support at minimum 1177 newton-meter (N m) of dynamic torque. |  | X | Test |  | X |  |  |
| RD-4 | Derived | The system shall support at minimum 941 N m of static torque. |  | X | Test |  | X |  |  |
| RD-5 | Derived | The system shall support a load of maximum 500 kilograms (kg) weight. |  | X | Test |  | X |  |  |
| RD-6 | Derived | The system shall support a load offset of maximum 0.15 meters. |  | X | Test |  | X | The offset distance is calculated from the center of the rotator to the center of gravity of the load. |  |
| RD-7 | Derived | The system shall rotate at a minimum speed of 1.0 rotations-per-minute (rpm). | X | X | Test |  | X |  |  |
| RD-8 | Derived | The system shall rotate at a maximum speed of 5.0 rpm. | X | X | Test |  | X |  |  |
| RD-9 | Derived | The load shall remain fixed along the rotational axis when the system is not rotating. |  | X | Test |  | X |  |  |
| RD-10 | Derived | The system shall rotate to angle positions with a resolution of maximum 1°. | X | X | Test |  | X |  |  |
| RD-11 | Client | The system shall be rotated using electrically powered means. |  | X | Analysis |  |  |  |  |
| **HD: Hardware Design Requirements** | | | | | | | | | |
| HD-1 | Derived | The system shall be built using two “A” frame supports provided by the client. |  | X | Inspection | X |  | Exact size of the supports is yet to be determined. |  |
| HD-2 | Derived | The system shall remain stationary during operation. |  | X | Test |  | X |  |  |
| HD-3 | Client | The total cost of system components shall not exceed $10,000 Canadian Dollars. |  | X | Analysis |  |  |  |  |
| **ED: Electrical Design Requirements** | | | | | | | | | |
| ED-1 | Derived | The system shall operate on the following electrical power voltages:   * 120 volts (V), single-phase * 575 V, three-phase |  | X | Analysis |  |  |  |  |
| ED-2 | Derived | The system shall be operated between 0°C to 35°C. |  | X | Analysis |  |  |  |  |
| **SRR: Standards and Regulations Requirements** | | | | | | | | | |
| SRR-1 | Derived | The system shall use only RoHS compliant components. |  | X | Analysis |  |  |  |  |
| SRR-2 | Derived | The system shall audibly alert the operator when rotating. | X | X | Test |  | X |  |  |
| **SR: Safety Requirements** | | | | | | | | | |
| SR-1 | Client | The system shall have an easy-to-access emergency stop button, which stops all system operations when pressed. | X | X | Test |  | X | The emergency stop button will stop power from going to the rotator but will keep the control panel powered to protect the microcontroller. |  |
| SR-2 | Derived | The system shall have a switch to disable/enable rotation operations. | X | X | Test |  | X |  |  |
| **UIR: User Interface Requirements** | | | | | | | | | |
| UIR-1 | Client | System operation shall only be performed using physical buttons. | X | X | Test | X |  |  |  |
| UIR-2 | Client | The system shall have a control panel with buttons to rotate the system in angular steps in the clockwise and counterclockwise direction. | X | X | Inspection |  | X | RD-10 specifies the amount by which the system shall rotate per step. |  |
| UIR-3 | Client | The system’s control panel shall be able to be moved up to 10 feet away from the rotating portion of the system. |  | X | Inspection |  | X |  |  |
| UIR-4 | Derived | The system’s control panel shall indicate if the system is rotation locked. | X | X | Test |  | X |  |  |
| UIR-5 | Derived | The system shall have an on/off button and indicator. | X | X | Test |  | X |  |  |
| UIR-6 | Client | The control panel shall have buttons to rotate 45˚ clockwise and counterclockwise from the current position. | X | X | Test |  | X |  |  |