

# SURFACE VEHICLE RECOMMENDED PRACTICE

**SAE** J159

REV.  
APR85

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## (R) LOAD MOMENT SYSTEM

### 1. PURPOSE:

The purpose of this recommended practice is to establish the minimum performance criteria of systems used to warn or indicate to the operator and/or other responsible persons when the load being lifted approaches and meets the rated load value on the applicable load rating chart of the crane.

### 2. SCOPE:

This SAE Recommended Practice applies to cranes when used in lifting crane service which are equipped with load moment devices.

### 3. DEFINITIONS:

- 3.1 **LOAD MOMENT SYSTEM:** A system consisting of devices which, when applied to a crane, sense crane loading, boom length (telescopic only), boom angle, or functions of these, and which automatically signal when the loading conditions approach, reach, and exceed the rated load values.
- 3.2 **CRANE CONFIGURATION:** The physical arrangement of the crane as prepared for a particular operation in conformance with the manufacturer's operating instructions and load rating chart.
- 3.3 **ACTUAL LOAD:** The weight of the load being lifted and all additional equipment such as blocks, slings, sensors, etc.; also referred to as working load.
- 3.4 **RATED LOAD:** The load value shown on the applicable load rating chart of the crane for the particular crane configuration, boom length, boom angle, or functions of these variables. For radii outside those shown on the load rating chart, the rated load is to be considered as zero.

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#### 4. PERFORMANCE CRITERIA:

- 4.1 Limit and Warning Signals: An audible and/or visual limit signal is to be activated at 100% of rated load and also whenever the radius shall fall outside the limits of the crane's load rating chart. The limit signal shall continue to function as long as the load is at, or in excess of, 100% of rated load, or as long as the radius is outside the limits of the crane's load rating chart.

An audible and/or visual warning signal, readily distinguishable from the limit signal, is to be activated as the rated load is approached. This warning signal is to be activated at not more than 90% of the load at which the 100% limit signal is activated.

Visual and/or audible signals are to have the visual signal clearly visible and the audible signal clearly distinguishable from engine and machinery noise. Their location shall not create an operational hazard.

- 4.2 System Capacity: The load moment system capacity is to be either compatible with the maximum capacity of the crane as specified by the crane manufacturer, or compatible with the maximum allowable lift for a specific crane configuration, less than maximum capacity.

#### 4.3 Accuracy:

- 4.3.1 Limit Signal Activation: The actual load which activates the limit signal is to be not less than 90% of the rated load nor more than 100% of the rated load for the corresponding actual load radius or boom angle.

- 4.3.2 Warning Signal Actuation: The actual load which activates the warning signal is to be no greater than 90% of the actual load which activates the limit signal.

- 4.4 Additional Functions: When load, radius, or angle are displayed as additional functions of the load moment system, the displayed function is to conform to the following:

- 4.4.1 Load: When load indication is displayed as an additional function of the load moment system, its performance criteria are to be in accordance with the current revision of SAE J376.

- 4.4.2 Radius: When radius indication is displayed as an additional function of the load moment system, its performance criteria are to be in accordance with the current revision of SAE J375.

- 4.4.3 Angle: When angle indication is displayed as an additional function of the load moment system, its performance criteria are to be in accordance with the current revision of SAE J375.

- 4.5 Temperature Effect: Specified accuracy is to be maintained over ambient temperature variations of -30 to +50°C (-22 to +122°F) without external adjustment.
- 4.6 Strength Margin: When any part of the load moment system is employed in the load supporting system so that its failure could cause the load to be dropped, its strength margin is not to be less than the minimum strength margin of the other load supporting members.
- 4.7 Operation Check: The system is to include a means for the operator or other responsible persons to determine that it is operative prior to crane use.
- 4.8 Testing: The system is to be performance tested by the installer initially, and by the user at intervals recommended by the manufacturer(s), or at any time there is an indication of inaccuracy. (See 4.3 and 4.4, and Section 6).

5. GENERAL REQUIREMENTS:

- 5.1 Installation and Maintenance: Installation and maintenance of the load moment device and maintenance of the crane are to be in accordance with the appropriate manufacturer's recommendations to attain system accuracy.
- 5.2 Identification: Labels are to be conspicuously placed on a system component(s) or in the operator's cab, or both, giving the following information:
  - (a) Identification of applicable load rating chart and rating conditions.
  - (b) Units of measure as applicable.
  - (c) Maximum capacity of the load moment system per 4.2.
  - (d) Operating range of the load moment system for which the performance criteria of 4.3 and 4.4 are met.
  - (e) Basic operating instructions and precautions, including recommended intervals for performance testing.
  - (f) Device manufacturer's name, address, and device model number.
- 5.3 Manual: Manual(s) containing installation, operation, test, and service information is (are) to be provided by the manufacturer and shall be available to the operator or other responsible persons at all times.

6. PERFORMANCE EVALUATION TESTS:

6.1 General Testing Requirements:

- 6.1.1 Test personnel are to be familiar with the system operation and the manufacturer's recommended test procedures, and are to check the system for all functions.

- 6.1.2 System tests are to be conducted using an appropriately configured crane and specified load rating chart.
- 6.1.3 For system calibration, two or more test loads are to be employed for each of the following configurations to establish compliance with 4.1, 4.3, and 4.4:
- (a) Maximum Boom Length and Maximum Radius (Min. Angle).
  - (b) Maximum Boom Length and Minimum Radius (Max. Angle).
  - (c) Minimum Boom Length and Maximum Radius (Min. Angle).
  - (d) Minimum Boom Length and Minimum Radius (Max. Angle).
- 6.1.4 For periodic calibration checks, two or more test loads are to be employed to activate alarms.
- 6.1.5 Test Data: Test forms are to include, but not be limited to, the following information:
- (a) Owner(s).
  - (b) Crane manufacturer, model, and serial number.
  - (c) Device manufacturer, model, and serial number.
  - (d) Crane configuration at time of test, method of test load application, location of load sensor, radius/angle sensor, and test readings.
  - (e) A statement that the system met (did not meet) the performance criteria of 4.3 and 4.4 or that recalibration was necessary in order to achieve the required accuracy. The system accuracy calculation is to be a part of such report.
- 6.1.6 All test records are to be signed and dated. A copy of the current test record is to be available at all times.
- 6.2 Test Procedures: One of the following test procedures or equivalent is to be used:
- 6.2.1 Known Weight:
- (a) Test load to be applied by suspending known weights accurate to  $\pm 1\%$ . If the weights of all additional equipment such as blocks, slings, sensors, etc., are included in the test load, the total load is to be known to an accuracy of  $\pm 1\%$ . Starting with load at a short radius (load within rating) lift load and increase radius slowly until the limit signal is activated. Measure and record radius. Two or more readings are to be taken with each test load. Similarly, check the warning signal.
  - (b) Determine the system accuracy in accordance with 6.3.

### 6.2.2 Fixed Anchor (Deadman):

- (a) Test load to be applied by hoisting against a fixed anchor (deadman) equipped with a means for measuring load (accurate to  $\pm 1\%$ ). If the weights of all additional equipment such as blocks, slings, sensors, etc., are included in the test load, the total load is to be known to an accuracy of  $\pm 1\%$ .

Referring to the crane's load rating chart, position the crane at the desired radius. Adjust the hoisting force, keeping the hoist line vertical within 0.5 deg. Measure and record radius and value of test load at which the limit signal is activated. Two or more readings are to be taken. Similarly, check the warning signal.

- (b) Determine the system accuracy in accordance with 6.3.

6.3 Computations: For each radius measured in the above tests, refer to the applicable load rating chart and determine the rated load. At radii intermediate to those on the load rating chart, rated load shall be determined by linear interpolation unless otherwise specified by the crane manufacturer.

The system accuracy is to be determined from the following formula:

$$\frac{\text{TEST LOAD}}{\text{RATED LOAD}} \times 100 = \% \text{ of RATED LOAD}$$

The (R) is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

RATIONALE:

J375b, Radius-of-Load or Boom Angle Indicating Systems

J376a, Load Indicating Systems in Lifting Crane Service

J159a, Load Moment System

The above documents establish minimum performance criteria for devices which indicate operating radius, boom angle, percent capacity, or actual load lifted by cranes in lifting crane service.

A five year review of SAE J375 has been initiated in 1980 and a proposed revision subsequently balloted by SC 17 and ORMTC members as an editorial revision. Significant editorial, and technical changes as well, have been implemented from suggestions and disapprovals resulting from these ballots.

Many of the changes were recommended by SAE legal counsel, the majority of which involve the following specific items:

1. Removal of accuracy tolerances from the unsafe side of operational performance specifications.
2. An improvement in accuracy specifications to be consistent with state-of-art advances and agreement with various existing requirements in European countries.
3. SAE legal counsel recommendation to delete the words "should" and "shall" and replace with the phrases "is to" and "are to".
4. Removal of the requirement for a statement of compliance by manufacturers.
5. More specific instructions on conduction of performance evaluation testing.

The structure of SAE J375b had been similar in format to that of SAE J376 and J159, and all three were complementary in their technical content and performance requirements. Since SAE legal counsel's objections to the previous J375 document were stressed quite significantly, it was the working group's decision to implement the same editorial changes to J376 and J159, and upgrade the accuracy specifications in the same manner as suggested in J375 even though a five year review for these other two documents was not pending at this time.

The three revised documents were reballoted by SC 17 members in March 1981, with all disapprovals and comments being satisfied with two exceptions. One member of SC 17 still maintains a disapproval on all three of these recommended practices primarily because of the proposed editorial change in the phrasing "should" and "shall" to the new acceptable phrasing "is to" and "are to" advised by SAE legal. It is also his conviction to impose tighter technical operating-accuracy requirements for all three systems.