



FM APPROVAL: HAZARDOUS LOCATION EQUIPMENT CLASSIFICATION

Equipment listed in this guide for Hazardous (Classified) Locations is also suitable for installations in areas that are unclassified locations and, unless referenced in the listing to another part of the Approval Guide, has been examined only for its hazardous location suitability.

The equipment is listed alphabetically. The addition of the temperature class and enclosure type/ingress protection, along with the reorganization according to model number, is a "work-in-progress". Where a temperature class or enclosure type/ingress protection is not shown, the manufacturer or FM Approvals should be consulted to obtain the applicable ratings.

Installation and maintenance of equipment listed in this chapter shall be according to the National Electrical Code ® (NEC) or other applicable code. Two different Hazardous Location rating systems are defined by Articles 500 and 505 of the National Electrical Code ® . The following are explanations of the two systems:

Hazardous Location Coding System — NEC 500

Class I / II / III, Division 1 / 2

Type of Protection

XP	=	Explosion proof
IS	=	Intrinsically Safe Apparatus
AIS	=	Associated Apparatus with Intrinsically Safe Connections
ANI	=	Associated Non-incendive Field Wiring Circuit
PX,PY,PZ	=	Pressurized
APX,APY,APZ	=	Associated Pressurization Systems/Components
NI	=	Non-incendive apparatus and non-incendive field wiring apparatus
DIP	=	Dust-Ignition proof
S	=	Special Protection

Equipment utilizing more than one type of protection is shown by joining the applicable types of protection with hyphens, see Example 2.

Class

I	=	Class I
II	=	Class II
III	=	Class III

Division

1	=	Division 1
2	=	Division 2

Group

A	=	Group A
B	=	Group B
C	=	Group C
D	=	Group D

The chemical formula of a specific gas or vapor for which the apparatus is Approved may be shown alone or concatenated with an apparatus group.

E	=	Group E
F	=	Group F
G	=	Group G

Temperature Class

T1	=	T1 (450°C)
T2	=	T2 (300°C)
T2A	=	T2A (280°C)
T2B	=	T2B (260°C)
T2C	=	T2C (230°C)
T2D	=	T2D (215°C)
T3	=	T3 (200°C)
T3A	=	T3A (180°C)
T3B	=	T3B (165°C)
T3C	=	T3C (160°C)
T4	=	T4 (135°C)
T4A	=	T4A (120°C)
T5	=	T5 (100°C)
T6	=	T6 (85°C)
XXX°C	=	XXX°C

The temperature class is based on a 40°C ambient unless a higher ambient is shown, e.g. “T4 Ta =60°C”. A temperature class is not shown for associated apparatus designed to be located in an unclassified location.

Control Documentation

When critical details for the installation are specified in a control drawing, instruction manual, installation diagram, etc. – the document number will be specified.

Entity

Intrinsically Safe apparatus Approved under the Entity concept shows the word “Entity” and may include the entity parameters in the Listing.

FISCO

Intrinsically Safe apparatus Approved under the Fieldbus Intrinsically Safe Concept shows the word “FISCO” and may include the FISCO parameters in the Listing.

Nonincendive Field Wiring

Apparatus Approved under the Nonincendive Field Wiring concept will include a control drawing reference and may include the nonincendive field wiring parameters in the listing.

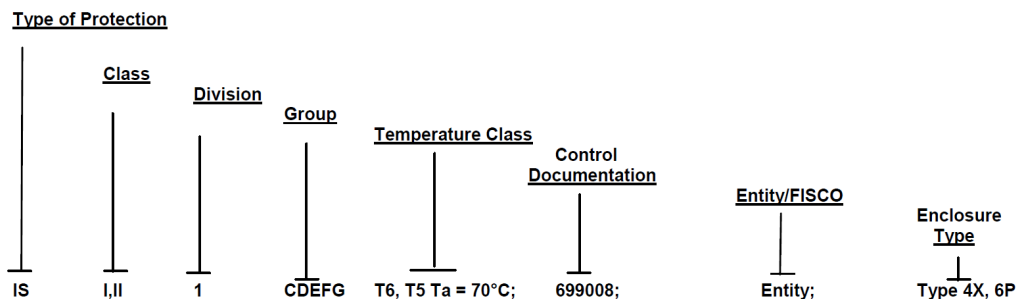
Enclosure Type

Enclosure type/ingress protection designation per ANSI/NEMA 250 and/or IEC 60529.

Special Conditions of Use

Some products, typically components, include Special Conditions of Use that must be observed when installing and using the product. The conditions are shown following each applicable Listing.

APPROVAL DESIGNATION



Example 1 123-abc. Temperature Transmitter.
 IS /I,II /1 /CDEFG / T4 — 699007; Entity; Type 4X
 Entity Parameters: V_{oc} = 18.4 V, I_{sc} = 33 mA, C_a = 0.9 μF, L_a = 110 mH

Example 2 456-def. Temperature Transmitter.
 XP-AIS /I /1 /CD /T4— 699008; Type 4X, IP66
 XP-AIS /I /1 /IIB /T4— 699008; Type 4X, IP66

Example 3 789-ghi. Temperature Transmitter.
 AIS / I,II,III /1 /CDEFG — 699008; Type 12

Example 4 a1b34-c Temperature Transmitter.
 NI /I /2 /ABCD / T4 98123; Type 4X
 Nonincendive Field Wiring Parameters: V_{oc} =24 V C_a = 650 nF

HAZARDOUS LOCATION CODING SYSTEM - NEC 505

Class I, Zone 0 /1 /2

<u>Class</u>			
I	=	Class I	
[I]	=	Located in an unclassified nonhazardous location with connections for Class I	
 <u>Zone</u>			
0	=	Zone 0	
1	=	Zone 1	
2	=	Zone 2	
[0/1/2]	=	Located in an unclassified nonhazardous location with connections for Zone 0/1/2	
 <u>Explosion Protection</u>			
AEx	=	Explosion Protected for North America	

'Division' apparatus with supplemental "Zone" marking as permitted by Section 505-10 (b) (1) of the NEC does NOT show the "AEx" designation, see Example 2.

Type of Protection

d	=	Flameproof
e	=	Increased safety
ia	=	Intrinsic safety (Zone 0)
ib	=	Intrinsic safety (Zone 1)
[ia]	=	Associated apparatus with I.S. connections for Zone 0
[ib]	=	Associated apparatus with I.S. connections for Zone 1
m	=	Encapsulation
nA	=	Non-sparking apparatus
nC	=	Protected contacts
nR	=	Restricted breathing
o	=	Oil immersion
p	=	Pressurization
q	=	Powder filled

Equipment utilizing more than one type of protection is shown by adjacent codes for types of protection, see Examples 5 and 6.

“Division” apparatus with supplemental “Zone” marking as permitted by Section 505.9 (c) (2) of the NEC does NOT show an AEx “Type of Protection” designation, but does show the same “Type of Protection” prefix as the “Division” apparatus, see Example 2.

Group

IIA	=	Group IIA
IIB	=	Group IIB Apparatus marked with Group IIB is also suitable for use in Group IIA.
IIC	=	Group IIC Apparatus marked with Group IIC is also suitable for use in Group IIB or IIA.

The chemical formula of a specific gas or vapor for which the apparatus is Approved may be shown alone or concatenated with an apparatus group – e.g. “H2 ” or “IIB +H2 ”, see Example 6.

Temperature Class

T1	=	T1 (450°C)
T2	=	T2 (300°C)
T3	=	T3 (200°C)
T4	=	T4 (135°C)
T5	=	T5 (100°C)
T6	=	T6 (85°C)
XXX°C	=	XXX°C

The temperature class is based on a 40°C ambient unless a higher ambient is shown, e.g. “T4Ta =60°C”. A temperature class is not shown for associated apparatus designed to be located in an unclassified location.

Control Documentation

When critical details for the installation are specified in a control drawing, instruction manual, installation diagram, etc – the document number will be specified.

Entity

Intrinsically Safe apparatus Approved under the Entity concept shows the word “Entity” and may include the entity parameters in the Listing.

FISCO

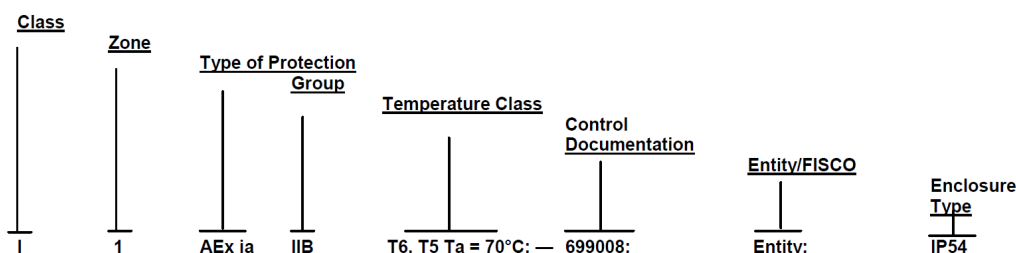
Intrinsically Safe apparatus Approved under the Fieldbus Intrinsically Safe Concept shows the word “FISCO” and may include the FISCO parameters in the Listing.

Enclosure Type

Enclosure type / ingress protection designation per ANSI/NEMA 250 and/or IEC 60529.

Special Conditions of Use

Some products, typically components, include Special Conditions of Use that must be observed when installing and using the product. The conditions are shown following each applicable Listing.



- Example 5 123-abc. Temperature Transmitter.
I /1 /AEx ia /IIB/T4— 699007; Entity; Type 4X
Entity Parameters: V oc = 18.4 V, I sc = 33 mA, C a = 0.9 μF, L a = 110 mH
- Example 6 456-def. Temperature Transmitter.
I /1 /AExd[ia] / IIB / T4 — 699008; Type 4X, IP66
- Example 7 789-ghi. Temperature Transmitter.
I /1 /AExdIIB /+H 2 / T6; IP54
- Example 8 1001-abc. Temperature Transmitter.
[I/O] AEx [ia] / IIB — 699008; Type 12

Class I, Division 1, Groups A, B,C & D

Class I, Division 1 locations are those in which hazardous concentrations of flammable gases or vapors exist continuously, intermittently or periodically under normal operating conditions. Electrical equipment for use in such locations may be “explosionproof,” “intrinsically safe,” “purged” or otherwise protected to meet the intent of Articles 500 of the National Electrical Code ® . Explosionproof protection consists of equipment designed to be capable of containing an internal explosion of a specified flammable vapor-air mixture. In addition, the equipment must operate at a safe temperature with respect to the surrounding atmosphere. Intrinsically safe electrical equipment and associated wiring are incapable of releasing sufficient electrical or thermal energy to cause ignition of a specific hazardous material under “normal” or “fault” operating conditions.

Normal operation assumes maximum supply voltage and rated environmental extremes; fault conditions assume any single or dual independent electrical faults plus field wiring open, shorts or connections to ground. Equipment rated as intrinsically safe is recognized by Article 500 as safe for use in hazardous locations without special enclosures or physical protection that would otherwise be required.

Purged systems have fresh air or an inert gas under positive pressure to exclude ignitable quantities of flammables from the electrical equipment enclosure.

Equipment Approved for Division 1 locations shall be permitted in Division 2 locations of the same class, group and temperature class.

Class I, Division 2, Groups A, B, C & D

Class I, Division 2 locations are those in which hazardous concentrations of flammables exist only under unlikely conditions of operation. As such, equipment and associated wiring which are incapable of releasing sufficient electrical and thermal energy to ignite flammable gases or vapors under “normal” operation and environmental conditions are safe to use in Class I, Division 2 locations.

Class I, Zone 0, Groups IIC, IIB & IIA

A Class I, Zone 0 location is a location (1) in which ignitable concentrations of flammable gases or vapors are present continuously; or (2) in which ignitable concentrations of flammable gases or vapors are present for long periods of time. Electrical apparatus for use in such locations may be type of protection “ia” Intrinsic Safety.

Class I, Zone 1, Groups IIC, IIB & IIA

A Class I, Zone 1 location is a location (1) in which ignitable concentrations of flammable gases or vapors are likely to exist under normal operating conditions; or (2) in which ignitable concentrations of flammable gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or (3) in which equipment is operated or processes are carried on, of such a nature that equipment breakdown or faulty operations could result in the release of ignitable concentrations of flammable gases or vapors and also cause simultaneous failure of electrical equipment in a mode to cause the electrical equipment to become a source of ignition; or (4) that is adjacent to a Class I, Zone 0 location from which ignitable concentrations of vapors could be communicated, unless communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided. Electrical apparatus for use in such locations may be type of protection “d” Flameproof, “e” Increased Safety, “ib” Intrinsic Safety, “m” Encapsulation, “o” Oil Immersion, “p” Pressurized or “q” Powder-Filled.

Note: Electrical apparatus Approved for use in Class I, Zone 0 locations shall be permitted in Class I, Zone 1 locations of the same gas group and temperature class.

Class I, Zone 2, Groups IIC, IIB & IIA

A Class I, Zone 2 location is a location (1) in which ignitable concentrations of flammable gases or vapors are not likely to occur in normal operation and if they do occur will exist only for a short period; or (2) in which volatile flammable liquids, flammable gases or flammable vapors are handled, processed or used, but in which the liquids, gases or vapors normally are confined within closed containers or closed systems from which they can escape only as a result of accidental rupture or breakdown of the containers or system or as the result of the abnormal operation of the equipment with which the liquids or gases are handled, processed or used; or (3) in which ignitable concentrations of flammable gases or vapors normally are prevented by positive mechanical ventilation, but which may become hazardous as the result of failure or abnormal operation of the ventilation equipment; or (4) that is adjacent to a Class I, Zone 1 location, from which ignitable concentrations of flammable gases or vapors could be communicated, unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided. Electrical apparatus for use in such locations may be type of protection “nA” Non-Sparking, “nC” Protected contacts, “nR” Restricted Breathing or “p” Pressurized.

Note: Electrical apparatus Approved for use in Class I, Zone 0 or Zone 1 locations shall be permitted in Class I, Zone 2 locations of the same gas group and temperature class.

Class II, Divisions 1 & 2, Groups E, F & G

Electrical equipment suitable for use in Class II locations, as defined by the National Electrical Code ®, is constructed to exclude ignitable amounts of dust from the equipment enclosure. Approved equipment of this type has also been evaluated to assure that hazardous surface temperatures do not exist. Equipment listed as suitable for Class II locations is “dust-ignitionproof” or otherwise designed to meet the intent of Articles 500 and 502 of the National Electrical Code ®.

Class III, Divisions 1 & 2

Class III locations are those which are hazardous because of the presence of ignitable fibers or flyings. Equipment listed for installation in Class III locations is designed to exclude the fibers and flyings from the equipment enclosure and to function without developing excessive surface temperatures.

Entity Concept

Under entity requirements, the concept allows interconnection of intrinsically safe apparatus to associated apparatus, not specifically examined in such combination. The criteria for interconnection is that the maximum input voltage and current, which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal to or greater than the maximum output voltage and current levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum internal capacitance and inductance of the intrinsically safe apparatus, including interconnecting wiring, must be less than or equal to the maximum allowed capacitance and inductance which can be safely connected to the associated apparatus. If these criteria are met, then the combination may be connected and remain intrinsically safe.

FM Approvals defines the entity parameters as follows:

Electrical Parameter	“Division” Apparatus (Traditional U.S. Format)	“Zone” Apparatus (IEC Format)
<i>For Associated Apparatus</i>		
Maximum output voltage	Voc	Uo
Maximum output voltage – Multiple Channel Apparatus	Vt	Uo
Maximum output current	Isc	Io
Maximum output current – Multiple Channel Apparatus	It	Io
Maximum allowed capacitance	Ca	Co
Maximum allowed inductance	La	Lo
Maximum output power	Po	Po
External inductance-to-resistance ratio	La/Ra	Lo/Ro
<i>For Intrinsically safe apparatus</i>		
Maximum input voltage	Vmax	Ui
Maximum input current	I _{max}	Ii
Maximum internal capacitance	Ci	Ci
Maximum internal inductance	Li	Li
Maximum input power	Pi	Pi
Internal inductance-to-resistance ratio	Li /Ri	Li /Ri

FISCO Concept

Under the FISCO concept the interconnection of Fieldbus Intrinsically Safe Apparatus to Associated Apparatus not specifically examined in such combination is allowed. The FISCO concept eliminates the need to consider the cable parameters of the circuit. This is an alternative to the Entity Concept.

Nonincendive Field Wiring

Under the Nonincendive Field wiring concept, normal operation includes opening, shorting and grounding the field wiring. Apparatus Approved under this concept allows the installer to use wiring methods permitted for unclassified locations.

Enclosure Types

I. The following enclosure types are defined by ANSI/NEMA 250, Enclosures for Electrical Equipment.

Type 1 – Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection against falling dirt.

Type 2 – Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment, to provide a degree of protection against falling dirt and to provide a degree of protection against dripping and light splashing of liquids.

Type 3 – Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow and windblown dust; and that will be undamaged by the external formation of ice on the enclosure.

Type 3R – Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet and snow; and that will be undamaged by the external formation of ice on the enclosure.

Type 3S – Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow and windblown dust; and in which the external mechanism(s) remain operable when ice laden.

Type 4 – Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water and hose-directed water; and that will be undamaged by the external formation of ice on the enclosure.

Type 4X – Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, hose-directed water and corrosion; and that will be undamaged by the external formation of ice on the enclosure.

Type 5 – Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against settling airborne dust, lint, fibers and flyings; and to provide a degree of protection against dripping and light splashing of liquids.

Type 6 – Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against hose-directed water and the entry of water during occasional temporary submersion at a limited depth; and that will be undamaged by the external formation of ice on the enclosure.

Type 6P – Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against hose-directed water and the entry of water during prolonged submersion at a limited depth; and that will be undamaged by the external formation of ice on the enclosure.

Type 12 – Enclosures constructed (without knockouts) for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against circulating dust, lint, fibers and flyings; and against dripping and light splashing of liquids.

Type 12K – Enclosures constructed (with knockouts) for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against circulating dust, lint, fibers and flyings; and against dripping and light splashing of liquids.

Type 13 – Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt; against circulating dust, lint, fibers and flyings; and against the spraying, splashing and seepage of water, oil and noncorrosive coolants.

II. The following “Ingress Protection” designations for enclosures are defined by IEC 60529, Degrees of Protection Provided by Enclosures.

The ingress protection (IP) of an enclosure is designated by the letters “IP” followed by two arabic numerals.

First numeral (protection against solid bodies):

0	=	No protection.
1	=	Objects greater than 50 mm
2	=	Objects greater than 12 mm
3	=	Objects greater than 2.5 mm
4	=	Objects greater than 1 mm
5	=	Dust-protected
6	=	Dust-tight

Second numeral (protection against liquid):

0	=	No protection
1	=	Vertically dripping water
2	=	75° to 90° dripping water
3	=	Sprayed water
4	=	Splashed water
5	=	Water jets
6	=	Heavy seas
7	=	Effects of immersion
8	=	Indefinite immersion



Approved SENTRAN Products

VC-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity lbs (50, 100, 150 or 250).

WA-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity lbs (1,000, 1,500, 2,000, 2,500, 3,000, 5,000, 10,000, 15,000, 20,000, 25,000, 50,000 or 75,000).

WB-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity lbs (20,000, 25,000, 40,000, 50,000, 60,000, 75,000, 100,000, 125,000).

WC-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity lbs (50,000, 65,000 or 100,000).

WD-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity lbs (25,000, 40,000, 50,000, 60,000, 75,000, 100,000 or 125,000).

WE-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity lbs (5,000, 10,000, 20,000, 30,000, 40,000, 50,000, 60,000, 100,000 or 150,000).

XA-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity lbs (500, 1,000, 2,000, 2,500, 3,000, 4,000, 5,000, 10,000, 15,000 or 20,000) or Capacity kg (250 kg, 500 kg, 1000 kg, 1500 kg, 2000 kg, 2500 kg or 5000 kg).

YB-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity kg (0.6 kg, 1 kg, 2 kg, 3 kg, 6 kg, 10 kg, 15 kg, 20 kg, 30 kg, 35 kg, 60 kg, 100 kg, 200 kg).

YD-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity kg (5 kg, 7 kg, 10 kg, 15 kg, 20 kg, 30 kg, 50 kg, 100 kg, 150 kg, 250 kg, 300 kg, 500 kg, 635 kg, 800 kg or 1000 kg).

YG-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity kg (5 kg, 7 kg, 10 kg, 15 kg, 20 kg, 30 kg, 50 kg, 100 kg, 150 kg, 250 kg, 300 kg, 500 kg, 635 kg, 800 kg or 1000 kg).

ZA-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity lbs (25, 50, 75, 100, 150, 200, 250, 300, 500, 750, 1,000, 1,500, 2,000, 2,500, 3,000, 5,000, 10,000, 15,000 or 20,000).

ZB-a. Load Cell

IS / I,II,II /1 /ABCDEFG / T5 — 14001; NI /I /2 /ABCD /T5;S /II /2 /FG /T5;S /III /2 /T5
a = Capacity lbs (200, 250, 500, 750, 1,000, 1,500, 2,000, 2,500, 3,000, 5,000, 7,500, 10,000, 15,000, 20,000 or 40,000) or Capacity kg (25 kg, 50 kg, 75 kg, 100 kg, 250 kg, 500 kg, 750 kg, 1000 kg, 1500 kg, 2000 kg, 2500 kg or 5000 kg).

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