



Bharat Heavy Electricals Limited
HIGH PRESSURE BOILER PLANT, TIRUCHIRAPPALLI 620 014.

TECHNICAL DELIVERY CONDITIONS

FOR SUB – DELIVERY COMPONENTS OF

CONTROLS & INSTRUMENTATION

TDC: TCI: 345 / REV 01

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TECHNICAL SPECIFICATION

FOR

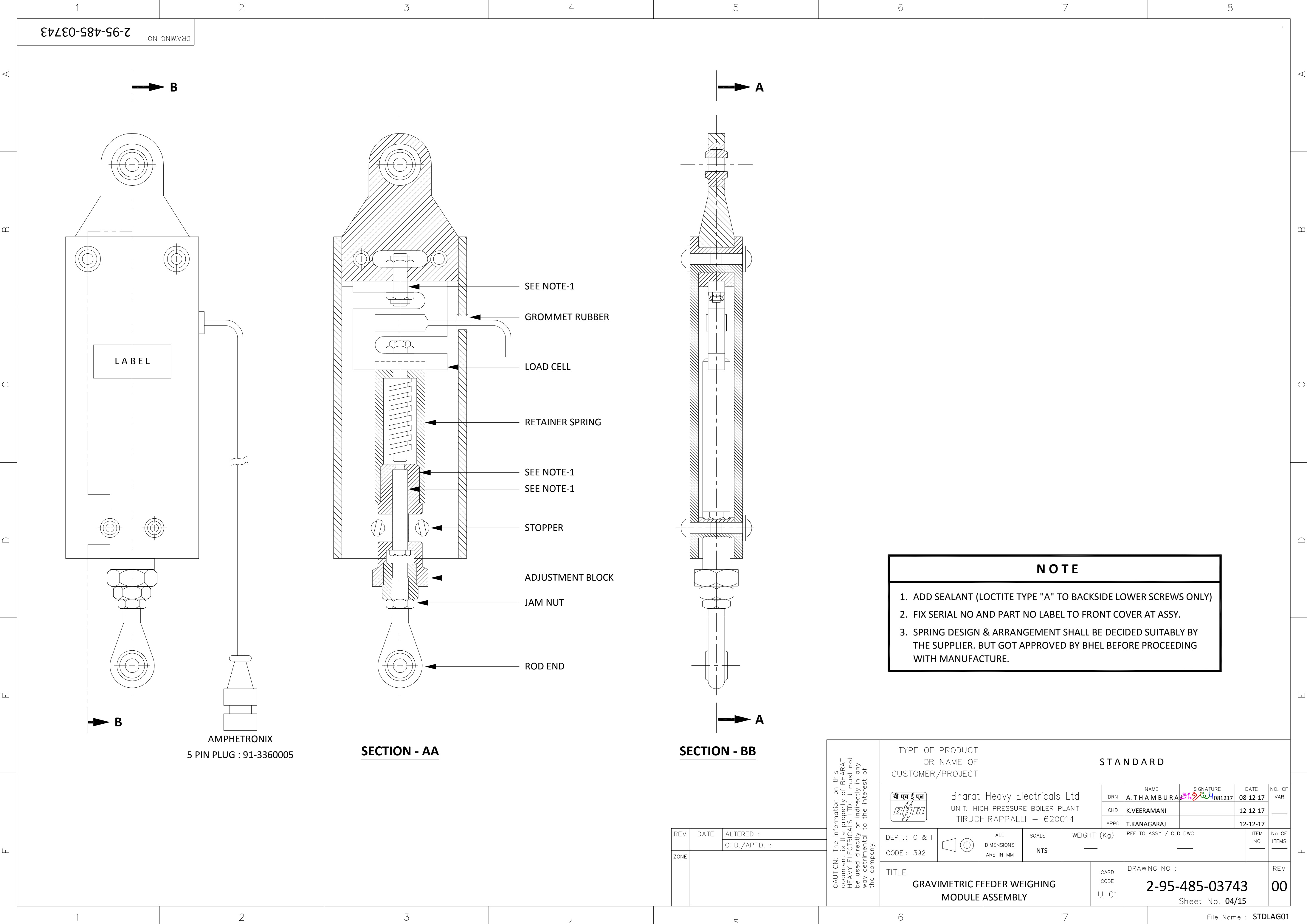
WEIGHING MODULE
(LOADCELL WITH ASSEMBLY)

OF
BHELFEED GRAVIMETRIC FEEDER CONTROLS

01	21/05/2018	Revised to update the load cell testing procedure	Sd./-	Sd./-	Sd./-	Sd./-
00	11/12/2017	Initial Release	[AB]	[KV]	[VA]	[TK]
Rev. No.	DATE	DESCRIPTION	PREPARED	ENGG	QAC	APPROVED
				REVIEWED		

1.	GENERAL	
1.1	Type of load cell	Strain gauge load cell. S type- Hermetically Sealed Tension Type
1.2	Connection of strain gauge elements	Wheatstone bridge configuration – Full bridge
1.3	Load cell capacity	150 lbs (68.04 Kg) OR 100 lbs (45.36 Kg) as per enquiry requirement.
1.4	Application	To produce millivolt signal proportional to the weight of coal passing over the belt in the weigh span of coal feeder.- Tension type measurement.
1.5	Mounting	As per drg. 2-95-485-03743
2.	ACCURACY – (MAX ERROR)	
2.1	Non-linearity (% FS)	±0.05
2.2	Hysteresis (% FS)	±0.03
2.3	Non-repeatability (% RO)	±0.02
2.4	Creep in 20 min (%)	±0.03
3.	TEMPERATURE	
3.1	Compensated Range (°C)	-20 to 150
3.2	Operating Range (°C)	-50 to 160
3.3	Effect on Output MAX (%/°C)	±0.0015
3.4	Effect on Zero MAX (% RO/°C)	±0.0015
4	ELECTRICAL	
4.1	Rated Output (mV/V)	3
4.2	Zero Balance (%RO)	±1
4.3	Bridge Resistance (Ohm)	350 ±1
4.4	Excitation Voltage MAX (VDC)	15
4.5	Insulation Resistance (Mega ohm)	>5000
5	MECHANICAL	
5.1	Calibration	Tension
5.2	Safe Overload (% CAPACITY)	150
5.3	Ultimate overload (% CAPACITY)	200
5.4	Cable Length (M)	4.5
5.5	Deflection	
	100 lbs	Vendor to specify
	150 lbs	Vendor to specify
5.6	End to end overall height of Weighing module adjustable using adjustable block between minimum and maximum height.	Minimum 244 mm Maximum 274 mm

5.7	Spring preload & bottoming load settings shall be done at vendor works for the following values		
		150 lbs load cell	100 lbs load cell
	Spring preload	170 lbs	80 lbs
	Bottoming load	200 lbs	100 lbs
6	NOTES		
6.1	The strain gauge load cell electrical connections are as per drg. 4-95-485-05867 and offered as a total weighing module as per 2-95-485-03743.		
6.2	Adequate protection shall be incorporated in the weighing module assembly to prevent the load cell damage from excess loading.		
6.3	Load cell shall be environmentally sealed, pressure insensitive and temperature compensated.		
6.4	Free end of the shielded cable shall be provided with a 5 pin round adopter as shown in the drg. 2-95-485-03743		
6.5	During offer stage vendor shall furnish test reports of offered weighing module as per BHEL procedure No. QA:CI:STD:PR: 20 /REV 00 for evaluation.		
6.6	Inspection & Testing shall be as per BHEL procedure No. QA:CI:STD:PR:20/Rev.01		
6.7	Vendor to furnish VQP for review/approval.		
6.8	The insulation of load cell cable shall be PTFE and shall be suitable for temperature rating of 200°C.		



2-95-485-03743
DRAWING NO.:

L A B E L

AMPHETRONIX
5 PIN PLUG : 91-3360005

SECTION - AA

SECTION - BB

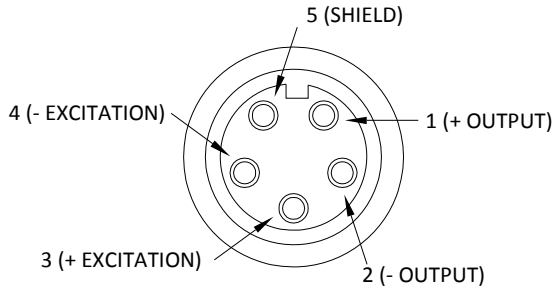
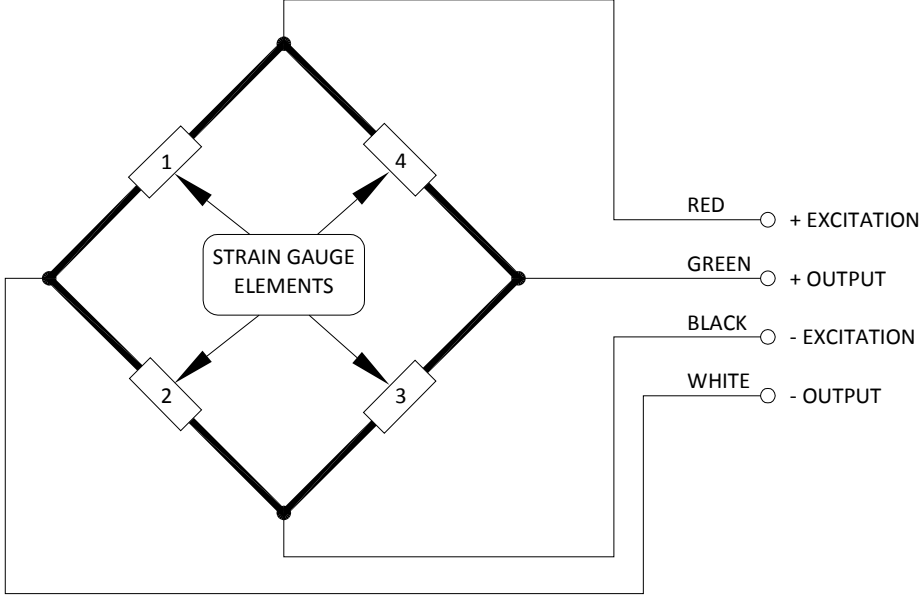
NOTE

1. ADD SEALANT (LOCTITE TYPE "A" TO BACKSIDE LOWER SCREWS ONLY)
2. FIX SERIAL NO AND PART NO LABEL TO FRONT COVER AT ASSY.
3. SPRING DESIGN & ARRANGEMENT SHALL BE DECIDED SUITABLY BY THE SUPPLIER. BUT GOT APPROVED BY BHEL BEFORE PROCEEDING WITH MANUFACTURE.

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TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT		STANDARD					
बी एच ई एल BHEL	Bharat Heavy Electricals Ltd		DRN	NAME A. THAMBURAI	SIGNATURE  081217	DATE 08-12-17	NO. OF VAR
	UNIT: HIGH PRESSURE BOILER PLANT TIRUCHIRAPPALLI - 620014		CHD	K.VEERAMANI		12-12-17	---
			APPD	T.KANAGARAJ		12-12-17	---
DEPT.: C & I		ALL DIMENSIONS ARE IN MM	SCALE NTS	WEIGHT (Kg) ---	REF TO ASSY / OLD DWG ---		ITEM NO ---
CODE : 392						No OF ITEMS	
TITLE				CARD CODE U 01	DRAWING NO : 2-95-485-03743 Sheet No. 04/15		REV 00

REV	DATE	ALTERED :
		CHD./APPD. :



**TOP VIEW OF
AMPHETRONIX 5 PIN PLUG
FEMALE SOCKETS 91-3363006 AVAILABLE
ON THE FEEDER INTEGRAL CABINET
CARD RACK ASSY.
(NOT IN SCOPE OF LOADCELL VENDOR)**

NOTE

1. LOADCELL TERMINATION SHALL BE BY 4 CONDUCTOR 28 AWG 15 FEET LONG SHIELDED CABLE, TEMPERATURE 200°C (INTEGRAL TO LOADCELL)
2. FOR TERMINATION OF LOADCELL CABLES, FEMALE SOCKETS ARE AVAILABLE ON THE FEEDER INTEGRAL CABINET CARDRACK ASSEMBLY AND LOADCELL CABLES SHALL BE SUPPLIED WITH MALE SOCKETS.

TYPE OF PRODUCT
OR NAME OF
CUSTOMER / PROJECT

STANDARD

बी एच ई एल  Bharat Heavy Electricals Ltd UNIT : HIGH PRESSURE BOILER PLANT TIRUCHIRAPPALLI - 620014		DR N	NAME A.Thamburaj	SIGNATURE  091217	DATE 09-12-17	NO. OF VAR		
		CH D	K.Veeramani		12-12-17	_ _		
		APP D	T.Kanagaraj		12-12-17			
DEPT. : C & I		ALL DIMENSIONS ARE IN MM	SCALE NTS	WEIGHT (Kg) _ _	REF TO ASSY / OLD DWG _ _		ITEM NO _ _	No OF ITEMS _ _
TITLE: LOADCELL ELECTRICAL CONNECTION OF STRAIN GAUGE ELEMENTS				CARD CODE U 01	DRAWING NO : 4-95-485-05867 Sheet 01 of 01			REV 00

Sheet 01 of 01

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI
CONTROLS AND INSTRUMENTATION / FB
QUALITY ASSURANCE

PROCEDURE FOR PERFORMANCE TESTING

OF

WEIGHING MODULE
(LOAD CELL)

REV	DATE	PREPARED		REVIEWED	APPROVED	Revision History
01	19/03/2018	[KV] 	[VA] 	[TK] 	[RMV] 	Revised to Correct Quantum of Inspection
00	11/12/2016	[KV] SD/-	[VA] SD/-	[RMV] SD/-	[SDM] SD/-	Initial Release

Load Cell Performance Testing Guidelines

This guideline provides general-purpose test procedures for testing load cells.

1. Tests

1.1 Test Methods and parameters specified in this guideline are in accordance with IS: 9281.

1.2 Tests

I. Routine Test (Inspection - 10% of offered lot shall be performed)

1. Calibration (Following parameters are inferred from Calibration curve): -

- a) Non-Linearity
- b) Hysteresis
- c) Repeatability

2. Zero balance

II. Type Test (Inspection - 1 No. per PO shall be performed)

- 1. Temperature effect
- 2. Creep test

NOTE:

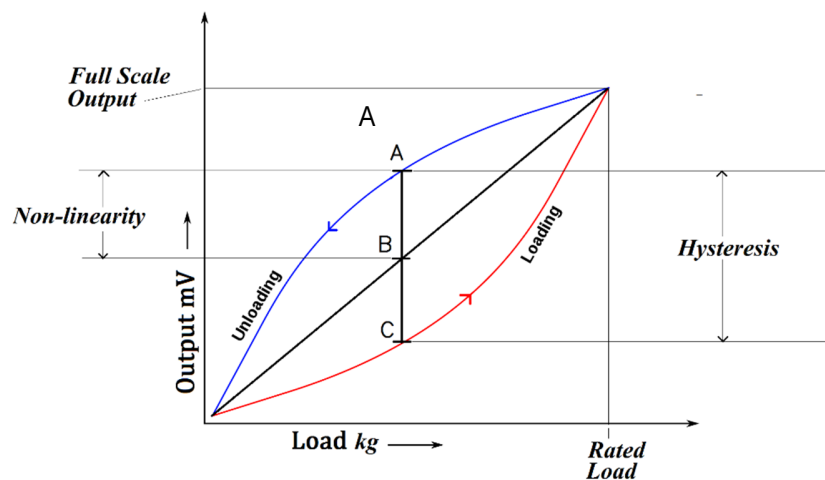
- If there is no test load equivalent to rated load, employ a test load which is as close to rated load. The output shall extrapolated to the maximum load in the curve.
- Application of load shall be done using force calibrator/Universal Testing Machine (UTM)/ standard weights (Calibrated in any national accredited labs).
- Inspection shall be in presence of BHEL inspectors at vendor works or any NABL accredited labs.
- The excitation voltage for the load cell is 10V DC.
- The measurement of output signal from load cell (mV) shall be done using digital multimeter having error $\pm 0.01\%$ of accuracy.

2. Calibration

- a) Apply the maximum load (68 kg) then remove the load. (0 kg). Repeat this step for three times (warming up process).
- b) Wait for the output to stabilize.
- c) Measure the initial output without load.
- d) Apply loads in ascending order to maximum load as per table 1.1. Take readings after a stabilization period for each load increment.
- e) Remove the same test loads in a descending order as per Table 1.1. Take readings after a stabilization period for each load decrement.
- f) Upon removal of the last test load, record the output at minimum load (0 kg).
- g) Repeat (a) through (f) two more times.
- h) Corresponding readings (average readings from 3 runs) of the output at the various loads are taken (refer table 1.1). Plot a graph showing output versus load as shown in Figure 1.1.
- i) Note: Number of load points can be increased to obtain smooth graph.

Table 1.1

SL. NO.	Load (kg)	Output (mV) (Ascending)				Output (mV) (Descending)			
		a ₁	a ₂	a ₃	a _{avg}	d ₁	d ₂	d ₃	d _{avg}
1.	0								
2.	15								
3.	30								
4.	45								
5.	68								

Figure 1.1
Typical Graph for illustration**3. Calculations:****a. Non-linearity**

The calibration data (refer table 1.1) is used to determine non-linearity. The curve joining the various points is drawn (refer Figure 1.1). The maximum deviation of the curve from the straight-line joining the end points (Terminal linearity) is then interpreted as the nonlinearity factor.

$$\% \text{ NonLinearity} = \frac{A - B}{S} * 100$$

S = Full scale (FS) output at rated load

Acceptable Limits: $\pm 0.05 \% \text{FS}$

b. Hysteresis

The calibration data (refer table 1.1) is used to determine hysteresis. The curve joining the various points is drawn (refer Figure 1.1). The maximum deviation (nominally occurring at 50% load) from the line joining the end points shall give the hysteresis value.

$$\% \text{ Hysteresis} = \frac{A - C}{S} * 100$$

S = Full scale output at rated load

Acceptable Limits: $\pm 0.03 \% \text{FS}$

C. Repeatability

The calibration data (refer table 1.1) is used to determine non-repeatability. For each set of the three data points (refer table 1.2), taken at the same temperature, non-repeatability is the maximum deviation between any two readings expressed as percentage of rated output.

Table 1.2

SL. NO.	Load (kgs)	Output (mV) (Ascending)			Max.Difference Δ $\Delta (a_1, a_2, a_3)$	Repeatability $= \frac{\Delta}{E} * 100 \%$
		a ₁	a ₂	a ₃		
1.	0					
2.	15					
3.	30					
4.	45					
5.	68					
Average =						

Data for Table 1.2 is taken from Table 1.1 (Calibration data).

E = Rated output RO in mV

Acceptable Limits: $\pm 0.02 \%RO$

d. Zero Balance

Zero balance is the load cell's zero load output which will likely read some value slightly off true zero.

$$\text{Zero Balance} = \frac{e0}{E} * 100 \%$$

e0 = mV output at No Load

E = Rated output RO in mV

Acceptable Limits: $\pm 1 \%RO$

e. Temperature Effect

$$\text{Temperature effect on No Load Output} = \frac{Z2 - Z1}{(T2 - T1) * E} * 100 \frac{\%}{C}$$

$$\text{Temperature effect on Rated Output} = \frac{S2 - S1}{(T2 - T1) * S} * 100 \frac{\%}{C}$$

Z1 = mV output at T1 (T1 = -15°C) at No load.

Z2 = mV output at T2 (T2 = 65°C) at No load.

E = Rated output

S = Full scale output (Output at rated load)

S1 = mV output at T1 (T1 = -15°C) at 68kgs.

S2 = mV output at T2 (T2 = 65°C) at 68kgs.

Acceptable Limits:-Effect on Zero: $\pm 0.0027\% \text{ RO}/^{\circ}\text{C}$ Effect on Rated Output: $\pm 0.0015\% / ^{\circ}\text{C}$ **f. Creep**

The change in LOAD CELL SIGNAL occurring with time under constant load and with all environmental conditions and other variables also remaining constant.

Apply the full rated load and read the output immediately after the load has been applied after a short stabilization period (t1) and after at 20 minutes (t2).

t2-t1 = creep measurement period (20 min)

$$\text{Creep \% of Rated output} = \frac{e2 - e1}{E} * 100$$

e1 = mV output at t1

e2 = mV output at t2

E = Rated output RO in mV

Acceptable Limits: $\pm 0.025\% \text{ RO}$

Test Results:

Sl.No	Tests	Acceptable Limit	Results
a.	Non-linearity	$\pm 0.05\% \text{ FS}$ (FS-Full Scale)	
b.	Hysteresis	$\pm 0.03\% \text{ FS}$	
c.	Repeatability	$\pm 0.02\% \text{ RO}$ (RO-Rated Output)	
d.	Zero Balance	$\pm 1\% \text{ RO}$	
e.	Temperature Effect	Effect on Zero: $\pm 0.0027\% \text{ RO}/^{\circ}\text{C}$ Effect on Rated Output: $\pm 0.0015\% / ^{\circ}\text{C}$	
f.	Creep	$\pm 0.025\% \text{ RO}$	