INTERPLANT STANDARD - STEEL INDUSTRY		
IPSS	SPECIFICATION FOR NUCLEONIC THICKNESS GAUGES *(Third Revision)*	**IPSS:** 2-07-020-11
	NO CORRESPONDING IS	Formerly : IPSS: 2-07-020-97 (Second Revision)

0. FOREWORD

0.1 This Interplant Standard (second revision) was prepared by the Standards Committee on Computerization and Automation, IPSS 2:7. It was revised in March 2011.

0.2 Interplant Standards on design parameters primarily aim at achieving rationalization and unification of parts and assemblies of process and auxiliary equipment used in steel plants and these are intended to provide guidance to the steel plant engineers, consultants and manufacturers in their design activities.

0.3 The absorption of radiation from a radioisotope, while passing through a material, serves as a means for measurement of thickness of material, provided the measured material is homogeneous and its density is known.

0.3.1 In nucleonic thickness gauge the source holder, containing radioactive source, is located on one side of the material to be measured. The detector is located on the other side of the material. Part of the radiation is absorbed by measured material. The remaining radiation enters ionization chamber of the detector. The resulting ionizing current Ix, proportional to intensity of radiation, is amplified in detector itself and fed to microprocessor for linearisation, (as detector output does not vary linearly with respect to strip thickness), density correction and temperature compensation. Actual value of strip thickness thus computed is displayed.

1. SCOPE

1.1 This interplant standard covers the requirement for thickness gauges.

2. SPECIFICATION

2.1 Thickness gauges shall be non contact type nucleonic gauges and shall conform to following specifications.

2.2 Source - Type of radioisotope to be used shall depend on the measuring range of the gauge. Following radioisotopes shall be used for measurement of thickness ranges:

Radioisotope	Thickness Range for Steel	Activity
Sr 90 (rays)	0-0.5 mm	500 mCi
Am 241 (rays)	0.06 mm	1.2 Ci, 2.5 Ci, 4.8 Ci
Cs 137 (rays)	4-100 mm	20 Ci to 30 Ci

Source activity will depend on range of measurement and gap between source and detector and also on desired time constant of the gauge. In case strip thickness range is large, more than one isotopes may be used.

Radioactive source shall be housed in source holder and opening and closing of the source shall be pneumatic. Source shall close automatically in case of power failure. Micro-switches shall be installed in source holder to actuate status indication lamps.

2.3 Detector - Detector shall be ionization chamber with preamplifiers. Water cooling arrangement may be provided for hot application only. In this case temperature sensor should be installed in the detector which will give warning contacts in case temperature inside detector exceed limits.

2.4 C Frame - Source and detector assembly shall be installed on a movable C Bracket with source in bottom arm and detector in top arm. C frame shall be movable from off line position to measuring position either pneumatically or by means of an electric motor.

In case of hot applications C frame shall automatically move to off line position in case temperature of detector goes high.

Measuring gap - As specified by purchaser.

2.5 Source Status Warning Lamps- Source status warning lamps shall be installed at suitable locations to indicate status of source whether Open or Close. Lamp cover colours shall be GREEN for source close and RED for source open.

2.6 General specifications of the gauge shall be as under:

a)	Range	As required
b)	Time constant	50 mSec and 250 m Sec. Selectable
c)	Thickness	Setting of thickness range manually or automatic.
d)	Accuracy	$\pm$ 0.25% of gauge measured.
e)	Drift	Less than 0.05% for 8 hours period.

f)	Display	i)	Analog display of thickness deviation with varying sensitivities.
		ii)	Digital display of actual value.
		iii)	Sampling rate = 2 per second Sample time = 50 m sec.
g)	Sensitivity		Number of sensitivities will depend on range of the gauge. Typical sensitivity values are:

0-0.5 mm	± 50 Um
0.5-1 mm	± 100 Um
1-4 mm	± 250 Um
4-20 mm	± 500 Um

h)	Alloy compensation (Density correction)	Since measurement depends on density of material, correction is required for density variation. Gauge will be designed for particular alloy as specified during ordering. By varying alloy correction from 0 to 100% ±10%. Variation in thickness should be possible to take care of measurement of material of different densities.
i)	Temperature compensation	In case of hot applications measurement is done in hot condition but display required is that of thickness in cold condition. Two types of temperature compensation should be possible (i) Manual, and (ii) Automatic.

In automatic temperature compensation method, infrared pyrometer should be used to measure actual temperature of the strip. Signal from pyrometer should be used for temperature compensation.

In case of manual compensation method temperature should be set manually from 500^{o}C to 1300^{o}C in steps of 10^{o}C. Depending on this setting temperature compensation takes place.

2.7 Gauge should be divided into the following sub-assemblies:

a)	C Frame	For mounting source, detector, pyrometer, etc.
b)	Electronics	Linearization, of signal from detector. Alloy and temperature compensation calculations should be carried out. Micro-processor based electronics to carry out all these functions.
c)	Operator's panel	This consist of switches for thickness, alloy setting, C

frame movement, display of deviation and actual valve and lamp indications for source status, tolerance, etc. All contacts possible from operational panel should be available, that is, including electronics console.

d) Junction boxes (Pneumatic & electric)

e) Source status indication lamps

2.8 Output from the Gauge - A thickness gauge is generally used for two applications. One is in Rolling Mill where depending on actual thickness, corrective action has to be taken to get desired gauge. For this, output from thickness gauge will be given to automatic gauge control system. In other application thickness gauge is used in process lines when off gauge portion of strip is removed. For this thickness gauge shall have tolerance setting dials for setting tolerance limits of $\pm$ 10% from set thickness and external potential free contacts should be available whenever actual thickness crosses this limit.

2.9 Following outputs shall be available from thickness gauges:

a)	Actual thickness	0-10 V	
b)	Thickness deviation	$\pm$10 V for varying	used for recording sensitivity
c)	Thickness deviation	$\pm$10 V for fixed	For AGC sensitivity
d)	Potential free contacts	When tolerance limits are exceeded on positive and negative side.	

2.10 Services

2.10.1 Cooling Water - For ionization chamber and for other parts of the thickness gauge, drinking water should be adequate.

2.10.2 Compressed Air - Instrument quality air of the quality specified in IPSS:2-07-018-94 shall be supplied.

3. COATING THICKNESS GAUGE

3.1 Coating thickness measurement is based on X-Ray flourescenece (XRF) technique. This is based on characteristic X-Rays emitted by all elements of the periodic system. The energies range from 0.05 to 1.5 keV, each element having its own characteristic X-Ray energy by which it can be discriminated against other element. The X-Rays are excited by small isotope source of radiation in source-detector probe. The X-Rays of the element to be measured are detected by a suitable detector in probe (scintillation, proportional or solid state) and correct energy selected by an electronic window is registered by a scaler

and is a measure of the amount of the specific element present in the sample. It may be expressed as a concentration in the case of elemental analysis or as thickness in coating thickness measurement.

3.2 Two independent source detector assemblies, for measurement of top and bottom coating weights of coated strip, one fixed on a O shaped frame. Signals received from detectors are processed in electronics for computation and display of TOP, BOTTOM and TOTAL coating weights. Both source detector assemblies shall be movable across width of product to be measured. Following modes of movement shall be possible:

a)	Standby	Both heads shall move to off line position.
b)	Sample	Heads shall move to sample holder where sample plates will be kept one edge to other edge thus giving profiles of coating across width.
c)	Dwell	In this mode head will measure at three locations, Edge-Centre-Edge. The position of measurement from edge should be selectable.
d)	Manual	In this mode head can be kept any where, for fixed point measurement, across width of strip.

3.3 General specifications of the coating thickness gauge shall be as follows:

a)	Source	Radioisotope Am 241
b)	Detector	Scintillation or proportional counter
c)	Accuracy	$\pm$1% of coating weight measured
d)	Averaging time	4, 8, 16, 32 s. Selectable
e)	Range	As required
	i) Typical for zinc	0-450 gm^2/side
	ii) Typical for tin	0-30 gm^2/side
f)	Display	Digital display of TOP, BOTTOM and TOTAL coating weights
g)	Outputs	1) 0-10 V for TOP, BOTTOM coatings 2) Tolerance contacts for coatings higher than set 3) BCD output of coating weights for printer.
h)	Travelling speed of source detector assembly	25 mm/sec

3.4 Coating thickness gauge shall be aircoated type. Instrument quality air of the quality specified in IPSS:2-07-018-94 shall be supplied.

4. CALIBRATION PLATES

4.1 Two sets of standard plates of different thicknesses each in the range of measurement shall be supplied along with original equipment.

5. DOCUMENTATION

5.1 Every equipment shall accompany five sets of operating and maintenance manuals with complete details.

5.2 Two sets of relevant circuit diagrams and spares catalogue shall have to be supplied with each equipment.

6. Ambient (i) For field equipment 60^0C, RH 98%.

Condition (ii) For processing and measuring equipment - 50^0C, RH 98%.

7. SERVICES

7.1 Compressed Air - Instrument quality shall be supplied as specified in IPSS:2-07-018-94.

7.2 Cooling Water - Drinking water at a pressure of 1.5-2 kg/cm^2 shall be supplied.