ITIP

Universal station for testing image intensifier tubes



Fig. 1. ITIP test station

BASIC INFORMATION:

ITIP is a modular quasi universal station for expanded testing of image intensifier tubes. This station enables measurement of a long series imaging parameters, photometric parameters, electrical and temporal parameters of image intensifier tubes recommended in US MIL military standards. The station is generally designed for testing potted tubes (encapsulated II tubes powered from low voltage supply) but can be optionally delivered in versions capable to test bare tubes (modules before encapsulation powered from high voltage power supplies). Therefore ITIP stations can be used by manufacturers, test laboratories, repairing workshops at different stages of life of II tubes. The test procedures used by the ITIP station are based on recommendations of the US MIL series military standards.

From design point of view ITIP station is built from three main blocks: image projector, set of measuring tools, and computer system. The projector projects images of some standard targets to tube photocathode plane of precisely controlled light flux. The measuring tools enables capturing images of output images from tested II tubes and measurement of output light intensity at the tube screen. The computer system carries out processing of data from image projector block and the measuring tools and finally calculates parameters of tested II tubes.

TEST CAPABILITIES:

1. Image quality parameter: Resolution (center, peripheral, high level), Modulation Transfer Function (MTF), Signal To Noise Ratio (S/N), Halo, Useful cathode diameter, Dark and bright spots, Output Brightness Uniformity, Maximal output brightness, Alignment, Distortion, Multi-Multi Pattern Noise, Multi-Boundary Pattern Noise, Image Inversion, Magnification.
2. Photometric parameters: luminance gain, saturation level (maximal output brightness), EBI (optionally also photocathode luminous sensitivity and radiometric sensitivity).
3. Electrical parameters: current consumption, power consumption
4. Temporal parameters: rise time, decay time and phosphor decay time.

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Table 1. Test ranges of measured parameters

No	Parameter	Measurement range	Relative measurement expanded uncertaity
1	Resolution	16-81 lp/mm option: 4-114 lp/mm	6.00%
2	MTF	0-30 lp/mm range (0-50 lp/mm - option)	0.01 at 0-10lp/mm 0.02 at 10-20lp/mm 0.03 at 20-30lp/mm 0.04 at 30-40lp/mm 0.05 at 40-50lp/mm
3	SNR	15-40 at 0.108 mlx	8.00%
4	Dark spots	From 0.05 to 0.5 mm	15% for spots 75µm – 150µm 10% for spots 151µm – 500µm
5	Halo	0.2-1.5mm	10.00%
6	Useful cathode diameter	10-25 mm	2.00%
7	Gross Distortion	0-1 mm	15% or 15µm
8	Shear Distortion	0-0.3 mm	15% or 10 µm
9	Image alignment	0-1.5 mm	15% or 10 µm
10	Multi-Multi Pattern Noise	0-20%	10%
11	Multi-Boundary Pattern Noise	0-30%	10%
12	Image inversion	0.1º-5º	0.2º (absolute value)
13	Magnification	1 to 4	5.00%
14	Luminance gain	1000-100 000	10%
15	EBI	0.02-2 µlx	10%
16	Output brightness	0.3-20 cd/m^2	5.00%
17	Brightness non uniformity	1:1 to 5:1	7.00%
18	Luminous photocathode sensitivity Radiant photocathode sensitivity	400 to 3000 uA/lm 20 to 150 mA/W	8% 8%
19	Tube current consumption	1-100 mA	2% or 0.3mA
20	Operational stability	0-30%	3%

FEATURES:

- Computerized test station. Semi-automatic easy measurement of the above mentioned parameters.
- Testing II, III and IV generation tubes
- Both 18mm, 25mm and 16mm tubes can be tested.
- ITIP station can be offered in different versions offering different measurement capabilities

SPECIFICATIONS

Main modules	1) Base blocks, 2) Set of measuring tools 3)System for data processing Ad1) BM-IP base module, OS-1 stage, set of 3 adapters, set of cables for potted tubes, Ad 2) VMI2 video microscope, DCI2 digital camera, MI2 microscope, LUMIN light meter, CP current probe Ad 3)PC, TAS-IP program, ITIP Display program, Lumin Control program, MC Viewer program
1. BM I base module	The module projects on photocathode of II tube image of seven patterns at regulated illumination level.
1.1 Light source	
Light Source	Dual: 1)polychromatic 2850K color temperature halogen source 2)monochromatic 595nm LED light source
Spectral band of halogen source	400-1000nm
Illuminance range	1 10^{-7} lx to 20 lx (option 200lx)

Regulation resolution	0.05 μlux (at low intensity range)
Light regulation type	continuous
Regulation stability	better than 2% of the set value
Illuminance uncertainty	better than 5% of the set value
1.2 Projector of test patterns	
Type of macro projector	Custom designed refractive objective
Resolution of target projector	≥400 [1p/mm]
Target change mechanism	manual
Number of test patterns	7
Target plate	single multi-pattern target having the following patterns: USAF1951 pattern, edge/slit pattern, pinhole pattern, tube diameter pattern, gross/shear distortion pattern, uniform pattern
Resolution target	Typical: modified USAF 1951 target (all spatial frequencies of USAF1951 from 16lp/mm to 81lp/mm are the same but are added some new frequencies) Optional: ultra modified USAF 1951 target (all spatial frequencies of USAF1951 from 4lp/mm to 114 lp/mm are the same but are added some new frequencies) – see info below
Spatial frequencies of resolution target	Typical range: 16-81lp/mm (16, 17.95, 20.16, 22.62, 25.39, 28.5, 32, 36.0, 40.3, 45.3, 47.9, 50.8, 53.8, 57, 60.4, 64,0, 67,8, 71,8, 76,1, 80,6 lp/mm) Optional expanded range: 16-114lp/mm or 4-114 lp/mm
Maximal acceptable diameter of photocathode	25 mm
Tube holders	optimized for the following tubes: MX-10160, MX-10130, MX-11620, MX-9444 (other types are also possible – photocathode diameters up to 25mm)
LV power source	DC 2.7 V
Type of tube holders	exchangeable holders for 18 mm and 25 mm tubes
2. Set of measuring tools	Tools: VMI2 video microscope, DCI2 digital camera, MI2 microscope (option), Lumin light meter, CP current probe
2.1. VMI2 video microscope	For analysis of small parts of screen of II tubes. It enables measurement of the following parameters: resolution, MTF, SNR, halo, distortion, image non alignment
VMI2 video microscope type	high resolution, high sensitivity CCD camera integrated with custom macro objective, custom image processing electronics
Image resolution	1920 x 1080 px
Field of view	4,75 x 2,7 mm
Max magnification	200x
2.2 DCI2 digital camera	For analysis of images from entire area of screen of II tubes. It enables measurement blemishes, photocathode diameter, distortion, non uniformity
Type of DCI2 camera	High resolution digital camera with custom designed objectives
Image resolution	2748x2748 px [7,5 MPx]
Depth of focus	Over 3.9 mm (optimized for testing tubes with curved screens)
Field of view	Dual FOV (optimized for 18mm and 25 mm II tubes)
FOV at 18 mm mode	19,6 x 19,6 mm
FOV at 25 mm mode	27x 27 mm
PC communication	Yes. USB 2.0
2.3. Monocular microscope	To be used for resolution measurement, image quality evaluation, and photocathode diameter measurement (option on special demand)
M-I microscope type	custom designed high-res mono microscope
M-I microscope magnification	50x
Microscope resolution	At least 161 lp/mm
2.4 LUMIN light meter	
Spectral range	similar to human eye
Diameter of measuring circle	Step regulation: 14mm; 16mm, fi 18mm
Standard sensitivity mode	

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Measurement range	0.05 cd/m^2 – 5000 cd/m^2
Resolution	<0.005 cd/m^2
FOV	regulated
Measurement uncertainty	<5%
High sensitivity mode	
Measurement range:	10 ucd/m^2 – 100 mcd/m^2
Resolution:	<5 ucd/m^2
Measurement uncertainty:	<7%
2.6 CP current probe	
Current measurement range	10 pA - 100μA
Current resolution	5 pA
Other parameters	
Power	AC230/110 V 50/60 Hz (DC12V option)
Operating temperature	5°C to 40°C
Storage temperature	-5°C to 60°C
Humidity	Up to 98% (non condensing)
Mass	<85 kg (including PC set)
Dimensions	Overall dimensions: 1300x600x730mm

*specifications are subject to change without prior notice

VERSIONS:

ITIP test station can be delivered in different versions optimized for different customers. Both measurement capability and price depends significantly on version number.

Version	List of measured parameters	Blocks of test station
ITIP-A	Resolution, SNR	BM-IP/A base module, MI microscope , VMI2 video microscope, Vertical platform column (VPC), Movable hand block (MHB), set of adapters to power typical potted tubes, PC, TAS-IP/A computer program, ITIP Display computer program
ITIP-B	Resolution (center, peripheral, high level), MTF, SNR, blemishes (dark and bright spots), photocathode cathode diameter, gross distortion, output brightness non uniformity, image alignment, power consumption, current consumption	BM-IP/B base module, MI microscope, VMI2 video microscope, DCI2 camera, Vertical platform column (VPC), Movable hand block (MHB), set of adapters to power typical potted tubes, PC, TAS-IP/B computer program, ITIP Display computer program, MC Viewer program
ITIP-C	Resolution (center, peripheral, high level), MTF, SNR, Halo, current consumption, luminance gain, maximal output brightness	BM-IP/C base module, MI microscope, VMI2 video microscope, Vertical platform column (VPC), Movable hand block (MHB), set of adapters to power typical potted tubes, LUMIN light meter PC, TAS-IP/C computer program, ITIP Display computer program, MC Viewer program, LUMIN Control computer program
ITIP-D	Resolution (center, peripheral, high level), MTF, Blemishes (dark spots/fixed pattern noise), SNR, Output Brightness Uniformity, Halo, Useful cathode diameter, Image Alignment, Shear Distortion, Gross Distortion, Image inversion, Magnification, power consumption, luminance gain, maximal output brightness, EBI	BM-IP/D base module, MI microscope, VMI2 video microscope, DCI2 camera, Vertical platform column (VPC), Movable hand block (MHB), set of adapters to power typical potted tubes, LUMIN light meter, PC, TAS-IP/D computer program, ITIP Display computer program, MC Viewer program, LUMIN Control computer program
ITIP-E	As in ITIP-D but additionally luminous sensitivity and radiometric sensitivity (recommended for tube manufacturers or repairing workshops	As in ITIP-D but additionally: BM-IP/D base module converted to BM-IP/E version, additional CP current probe, HVP high voltage power supply, set of three bare tube holders optimized for powering photocathode

ITIP-F	As in ITIP-E but additionally temporal tests: rise time, decay time and phosphor decay time	As in ITIP-E but BM-IP/E base module converted to BM-IP/F version, and additionally TP temporal probe, ITIME computer program

Attention: Old test stations listed before 2018 year as ITS-I, ITS-P and ITS-IP can be delivered on special demand.

Options:

Each of the versions defined earlier can be delivered with some optional features:

HV) Typical test stations are optimized for testing potted image intensifier tubes or bare tubes but only photocathode is powered. Option HV enables to power and do testing of fully working bare tube (powering photocathode, MCP, screen).

X)Expanded range of resolution measurement up to 114 lp/mm. Inframet offers station having special optical image projector optimized for ultra high resolution tubes and modified target of spatial frequencies from 4 lp/mm to 114lp/mm instead of typical range from 16 lp/mm to 81lp/mm. It should be noted that tubes of resolution over 81lp/mm are market novelty. (code X)

Y)Maximal illumination of photocathode is increased from 20lx to 200lx (code Y) but illumination switch is manually operated and illumination changes are slow (up to 2 sec)
Attention: MIL standards recommends to carry out test of high level resolution at level of illuminance of photocathode equal to 200lx. However, such test of most non autogating tubes can be damaging for tested tubes. Therefore Inframet recommends to carry out tests of non autogating tubes high level resolution at 20lx illumination but offers optional increase of illumination to 200lx.

Z1)Testing tube reactions to fast change of illumination from low intensity mode to high intensity (200lx) day mode. In fact this feature is to check how well autogating electronics works.
Autogating electronic system of II tubes should enable work not only at night but under high illumination conditions (day or night but with military flares). Practically it means that if illuminance at photocathode changes from from typical night conditions (say 10 mlx) to day conditions (about 200lx) then the tube should generate output sharp image in very short time. The time delay should not be noticeable for humans (below 0.1 sec). Next, deterioration of image quality should be barely detectable (from typical resolution about 64 lp/mm to resolution not lower than about 45 lp/mm).
Most of non autogating tubes offer also ability to work under high illumination conditions (200 lx) but: a)there is often significant deterioration of image resolution (as low as 4 lp/mm), b)sometimes time interval at level of several seconds is needed to produce by tested tube an image of reasonable high quality.
In this option Inframet enables computerized control of internal light source, dynamic change of target illumination from night level to high illumination level (about 200lx), precision analysis of output image and determination of following functions/parameters: dynamic function of output brightness versus time, static low level resolution, time interval to achieve stable image and static high level resolution.

Z2)Measurement of design parameters of *autogating electronic system (pulse frequency, gating time width, time inertia) at different illumination levels. The measurement can be done on potted tubes without any danger to damage tube electronics.*

Comparison of ITIP and other test stations

ITIP test station represents a new generation of test stations for testing image quality of II tubes. It was developed by Inframet in 2017 year as the first commercially available single test station that enabled measurement of all image quality, photometric, electrical and temporal parameters of II tubes recommended by MIL standards. Several test stations offered by competitors have been needed to do the same task.

ITIP design is based on experience that Inframet has got working as a supplier of test equipment for top work manufacturers of image intensifiers and night vision devices since 2004 year. It should also be noted that a significant portion of these manufacturers use Inframet test stations (ITIP stations or its predecessor ITS stations).

Version 7.8

CONTACT: Tel: +48 226668780 Fax: +48 22 3987244 Email: info@inframet.com