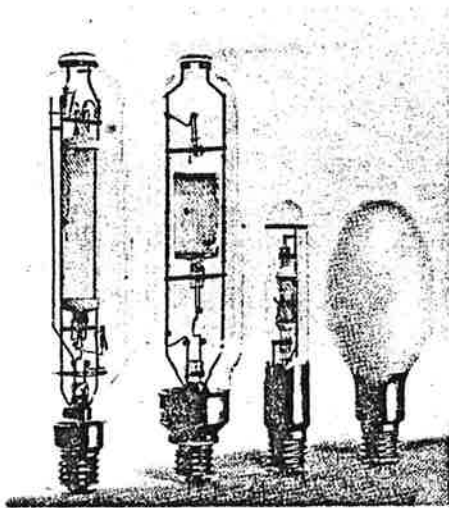


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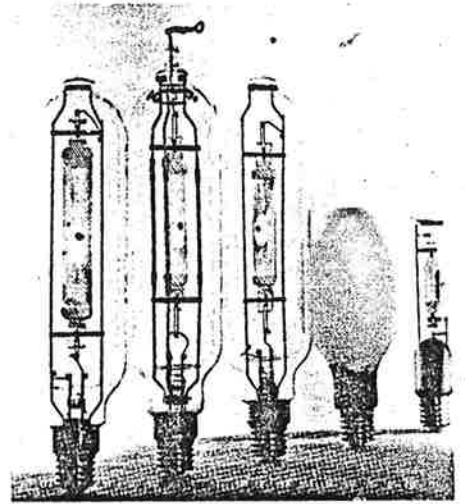
TUNGSRAM METAL HALIDE LAMPS

combine advantages of several light sources



*TUNGSRAM HgMI three-additive
Metal Halide Lamps
Extremely high luminous efficacy,
good colour rendering*

*TUNGSRAM HgMI/D Metal Halide Lamps
with rare earth metal additives
high fidelity colour rendering,
high-luminous efficacy*



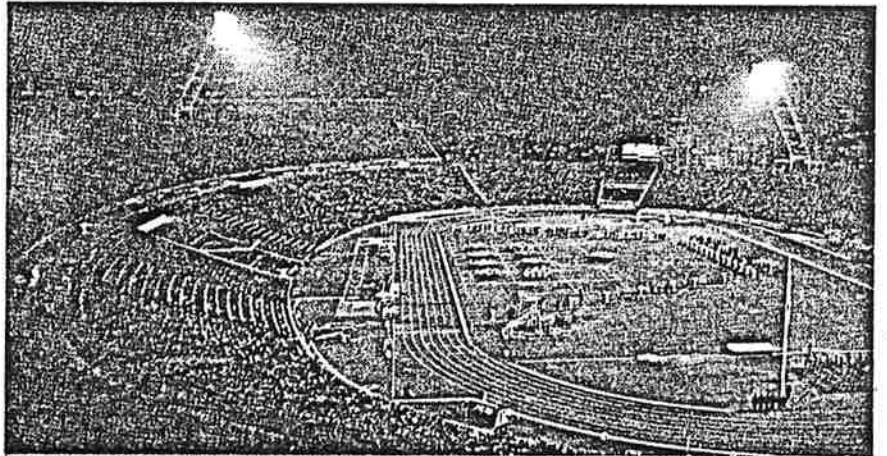
Long Life

These lamps fitted with dear bulbs are compact light sources in white tone which permit designers to produce high efficiency luminaires

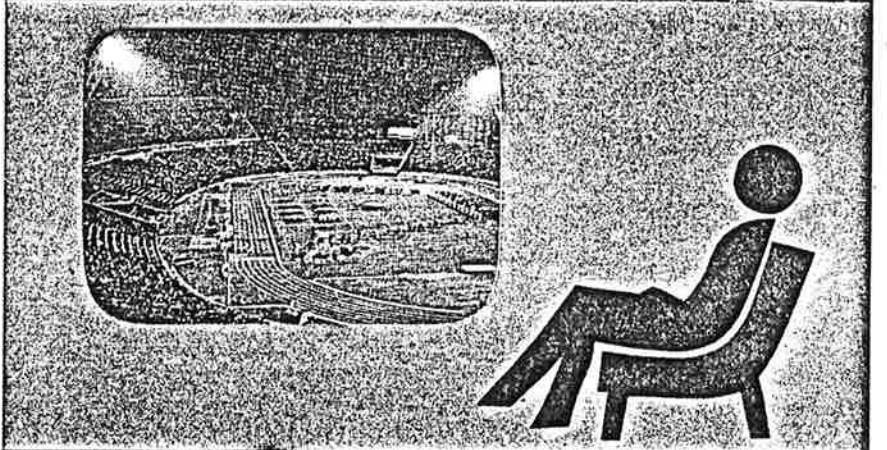
The most modern requirements of sports grounds and sports-halls illumination are ensured by TUNGSRAM Metal Halide Lamps

As a result of modern light sources and advanced telecommunications systems, sport-fans throughout the world can watch sport programmes either

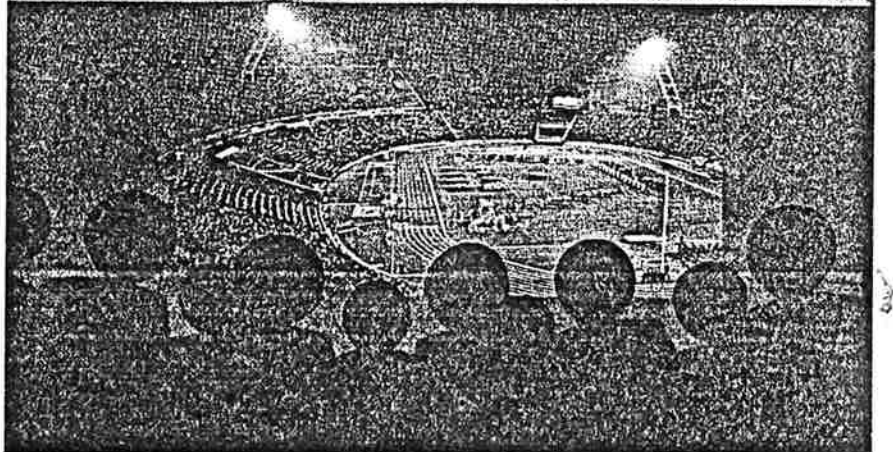
in the stadium

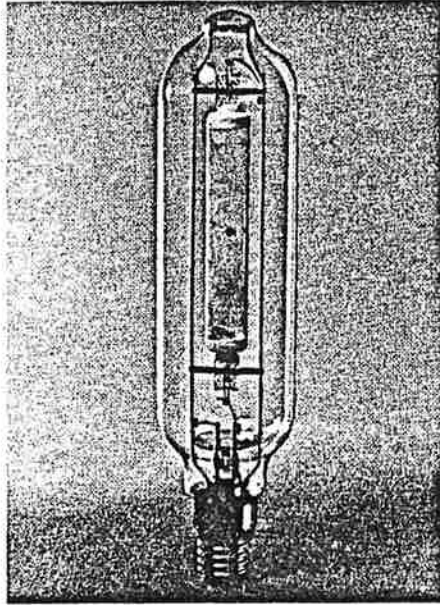
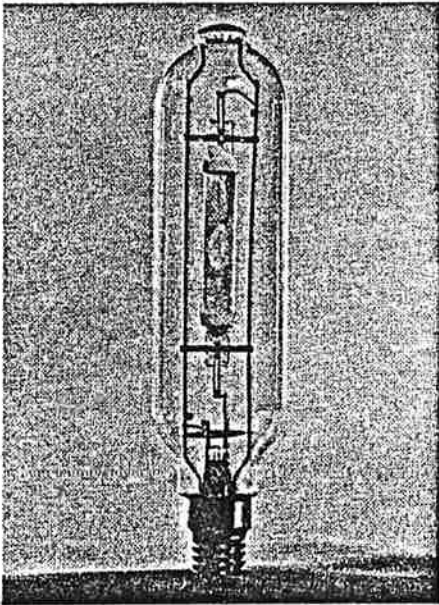


or at home viewing the TV



or at the cinema.

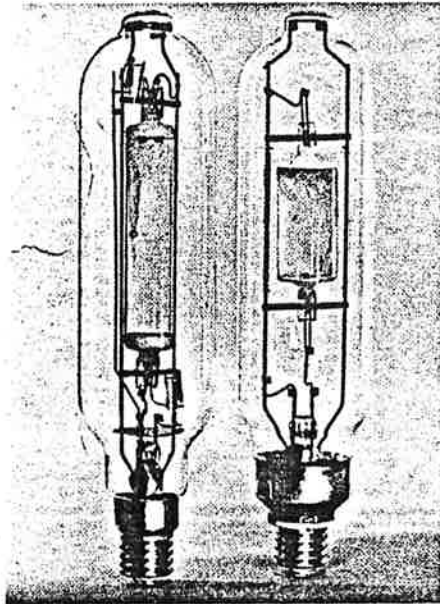
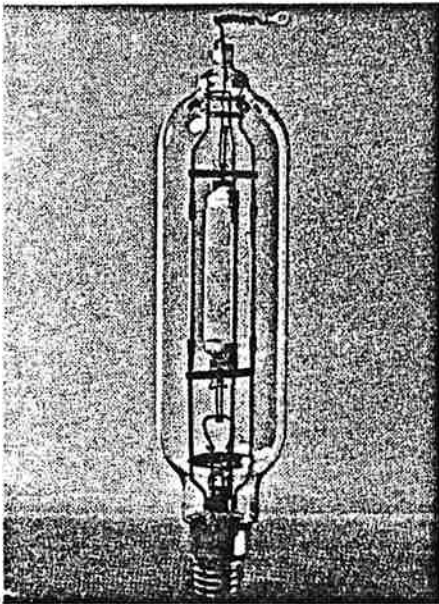




TUNGSRAM 2000/D1 and 3500/D1 Metal Halide Lamps with rare earth metal additives, ensure bright daylight illumination of stadiums; in addition, colour television broadcasts can be made as well as colour films shot on location rendering matches and competitions in their original natural colours.

HgMI 2000/D2 and HgMI 3500/D2 Metal Halide Lamps with rare earth metal additives are especially suitable for security lighting since they ensure the instant starting and fast re-ignition of the hot lamp.

The advantages of HgMI 2000 W lamps with three additives are simple installation, easy servicing and high light output. No starter units are required for the 380 V version of this type.



Tungsrham Metal Halide Lamps are especially suitable for the illumination of streets and squares.

No modern metropolis would be complete without high standard artificial illumination in the evening.

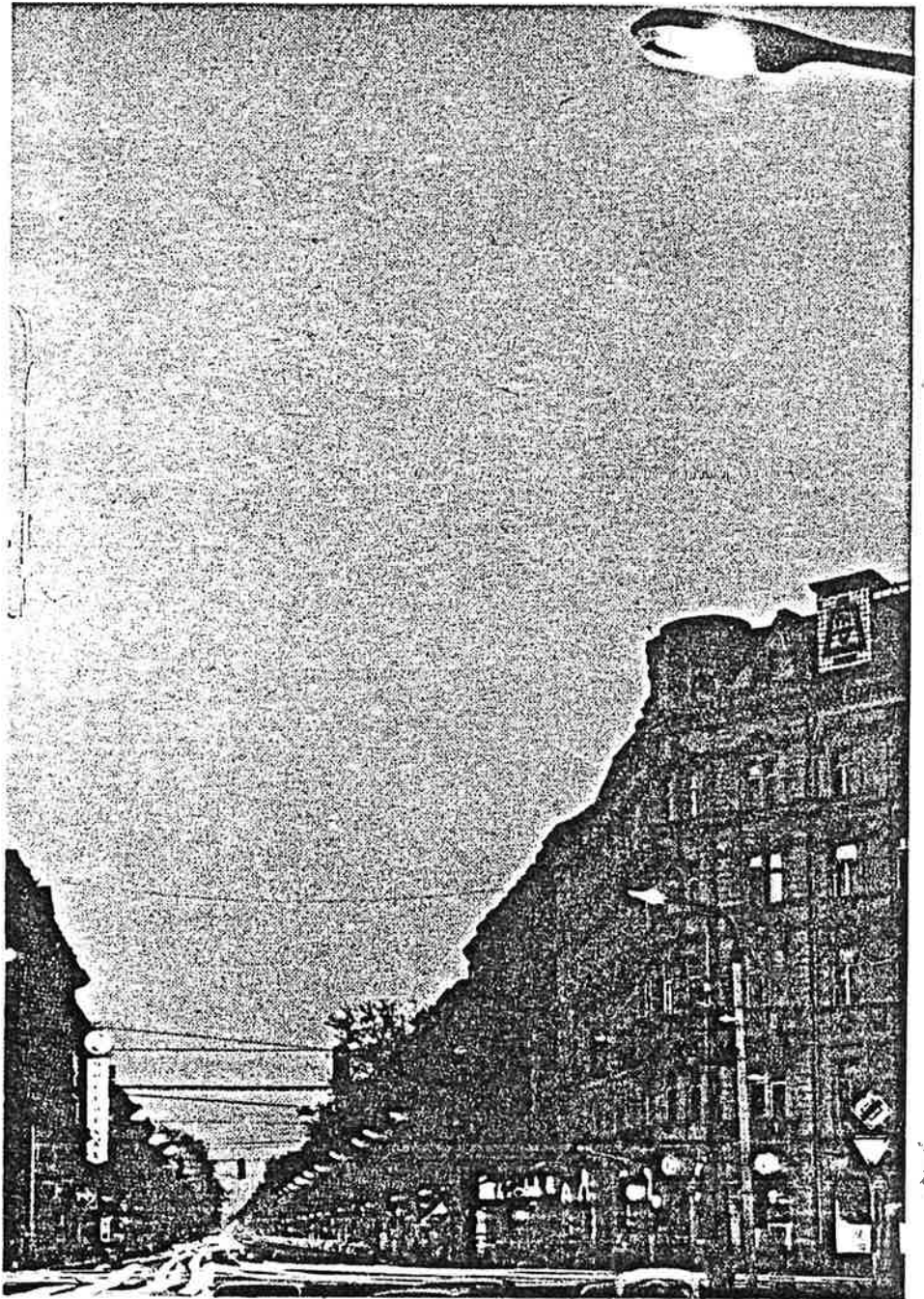
TUNGSRAM lamps illuminate cities in many aesthetic ways and ensure safe city traffic.

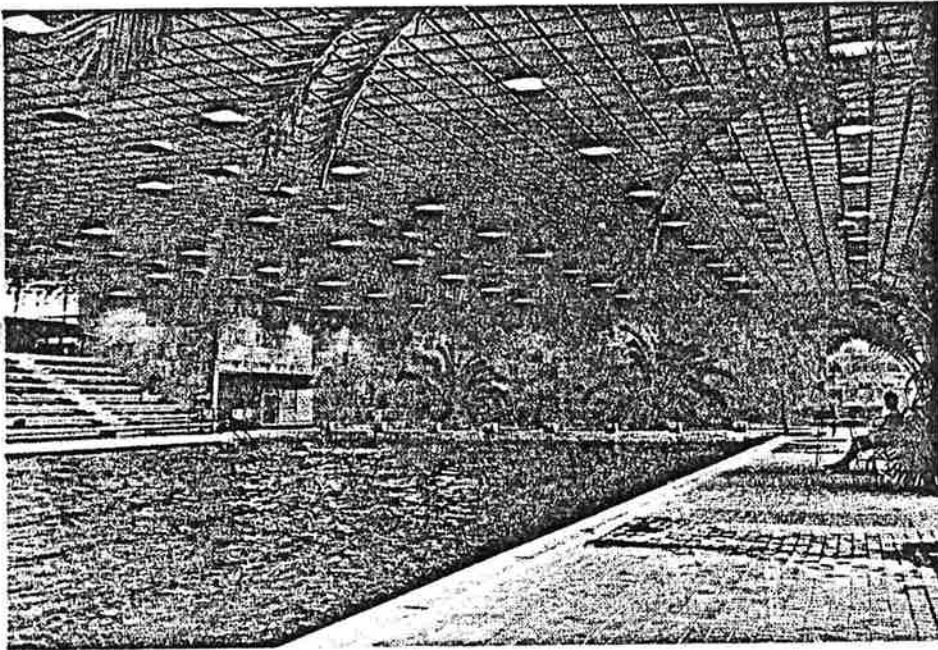
Using TUNGSRAM Metal Halide Lamps, **OUTDOOR LIGHTING PROBLEMS** can be solved the most conveniently because:

— compared to mercury vapour lamps, they produce **30 PERCENT MORE LIGHT** and of a satisfying colour:

— with the 400 W type, **THE BALLAST OF 400 W MERCURY VAPOUR LAMPS CAN BE USED**

— and in case of the phosphor-coated 400 W type using the luminaires designed for the mercury vapour lamps, **THE LIGHT DISTRIBUTION REMAINS UNCHANGED**





Due to their excellent colour rendition, high luminous efficacy and long life, TUNGSRAM METAL HALIDE LAMPS OFFER A WIDE RANGE OF APPLICATIONS FOR **INDOOR LIGHTING** too, such as the illumination of **SWIMMING-POOLS AND SPORT HALLS**



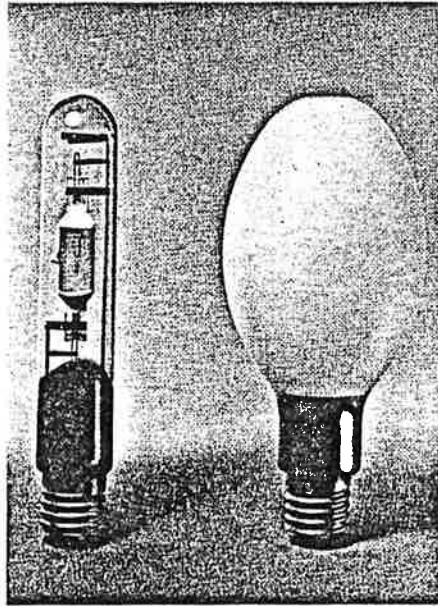
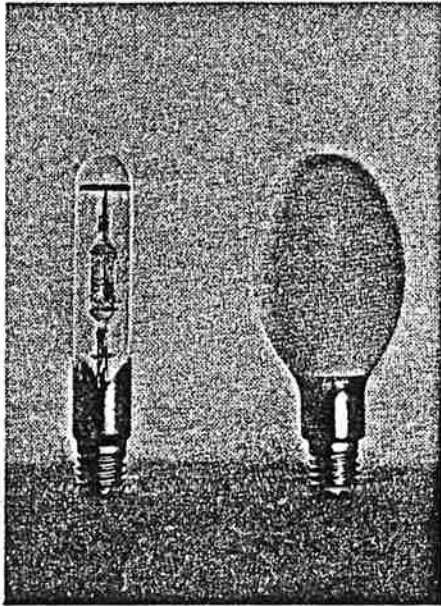
OPERATION AND LAMP DESIGN

TYPE ASSORTMENT

Tungsrham Metal Halide Lamps are designed with two different additive systems, respectively, one lamp series with iodides of sodium, thallium and indium and the other one with iodides of one or more rare earth metals and thallium. Low and high wattage lamps are produced using both additive systems, respectively.

Lamps with iodides of sodium, thallium and indium

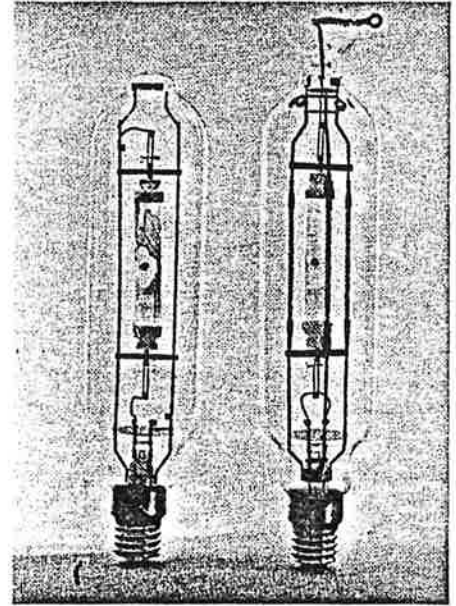
have somewhat better luminous efficacies, but their colour rendition is inferior to that of lamps with rare earth metal additives.



made both with tubular clear bulbs and with phosphor-coated bulbs, respectively. The rare earth metal is indicated by the better "D" in the type designation, e. g. the designation of the 400 W tubular bulb lamp type is: HgMI 400/D.

The shape of HgMI 2000/D1 and HgMI 3500/D1 lamps is identical to those of the 2000 W types mentioned above, there are differences only in the dimensions of the discharge tubes in the metal additives.

The discharge tubes of the HgMI 2000/D2 and HgMI 3500/D2 lamps are similar to



Metal Halide Lamps are high pressure gas discharge lamps. Like the High Pressure Mercury Vapour Lamps, they consist essentially of a discharge tube made of silica glass with tungsten electrodes at each end. The discharge tube has a small amount of argon gas in it, as well as mercury and halide compounds of different metals. When the tube is cold, these substances are condensed on the sides and when the supply is switched on, a discharge occurs in the argon gas. The whole tube warms up, evaporating the mercury and the metal iodides. The halide compounds, that do not damage the silica wall, dissociate and radiate light at the arc temperature. As soon as the pressure has risen to its steady value, and the full lumen output is attained, the light radiated by the lamp will be emitted predominantly by the metal atoms giving spectral lines that fall in the spectrum of Mercury Vapour Lamps.

The discharge tube is surrounded by an outer glass envelope, evacuated or having an inert gas atmosphere to protect the inner tube from sudden changes in temperature. The lamps are fitted with E 40 caps.

Low power lamps are provided with hard-glass bulbs of two different types; one is clear and tubular in form, the other is phosphor-coated and identical in shape with the bulbs used for mercury vapour lamps of the same power consumption. Phosphor-coated lamps are distinguished from those without coating by "L" in their type designation; e. g. for a phosphor-coated lamp 400 W, HgMIL 400. As the mains voltage for type HgMI 2000/220 is but 220 V, these lamps have a very short arc gap of 70 mm and, consequently, a high brightness.

The type HgMI 2000/380 is provided with internal starting electrodes allowing these lamps to operate without any external starter unit on 380 V mains voltage.

Lamps made with iodides of rare earth metals and thallium have luminous efficacies somewhat lower than those mentioned above, but they have an excellent colour rendition closest to natural daylight.

Like the three-additive types, the low-wattage rare earth additive lamps are also

those of the D1 lamps with the same power. Only the support and lead-in wires in the hard glass bulb are differently arranged, permitting an instant re-ignition of the hot lamps.

Using special additive metals,

Tungsrham also produces various lamps for decorative lighting purposes.

HgMI 400/A, HgMI 400/B and HgMI 400/C lamps have designs, dimensions and electrical characteristics similar to those of the HgMI 400.

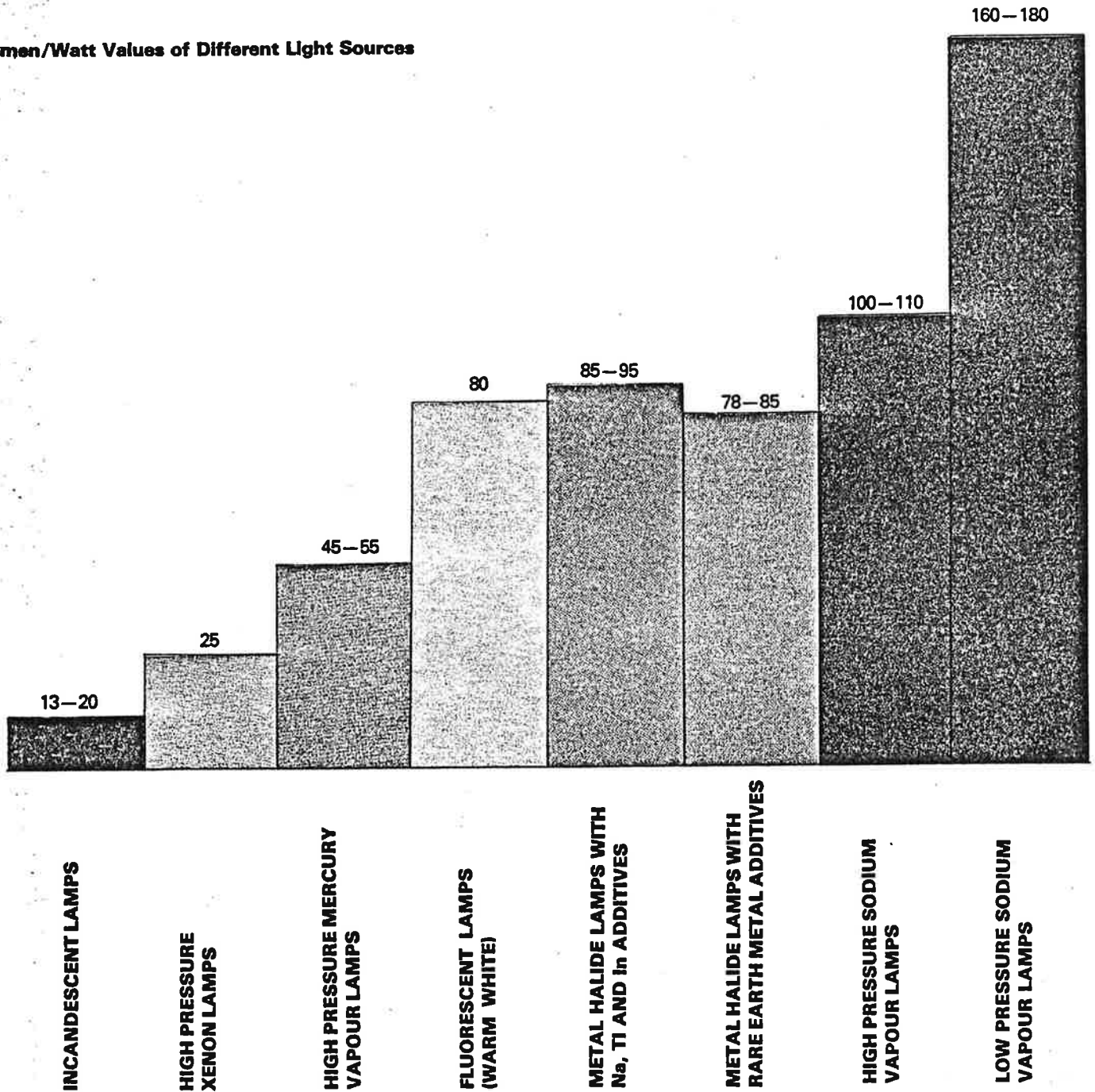
Their colour effects are as follows: bright green for type "A", purple for type "B" and azure blue for type "C".

CHARACTERISTIC FEATURES

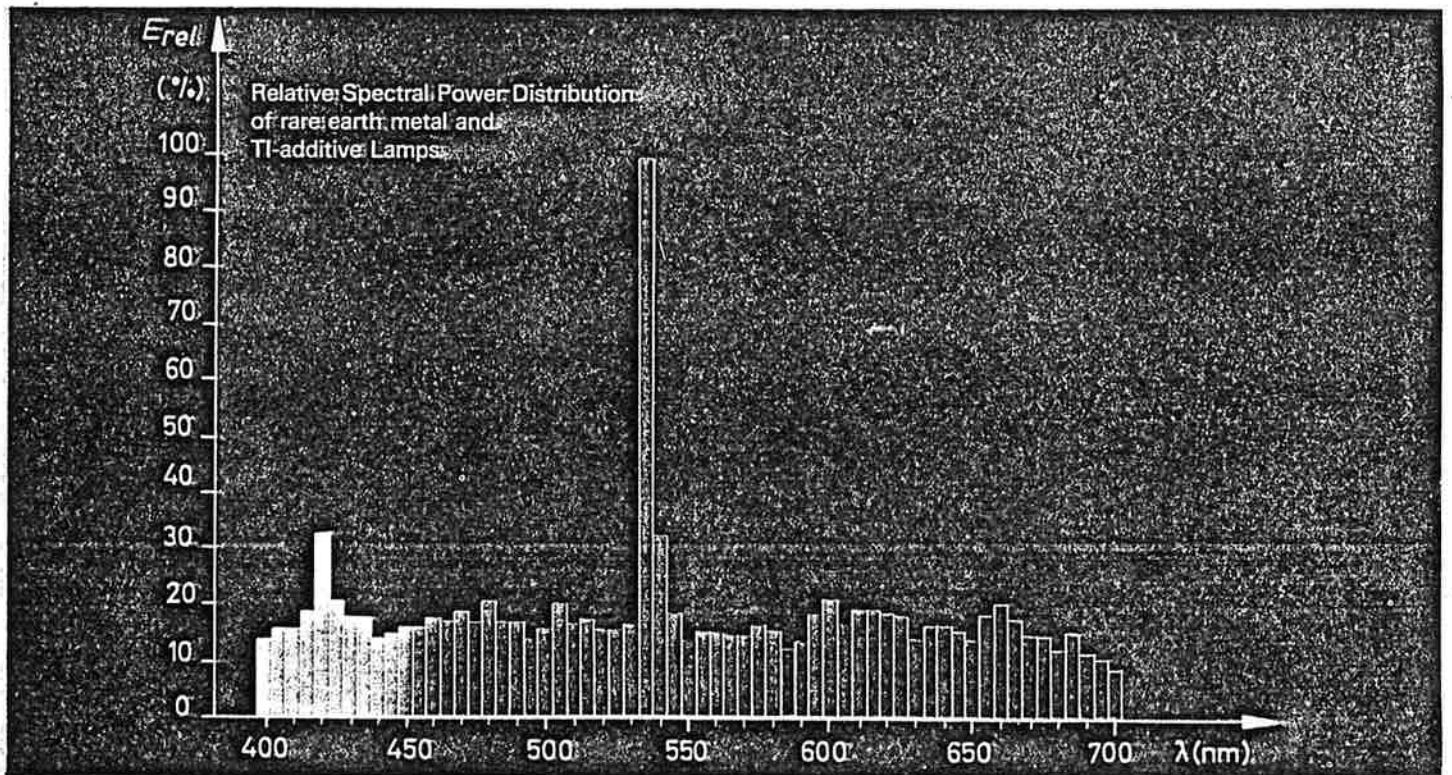
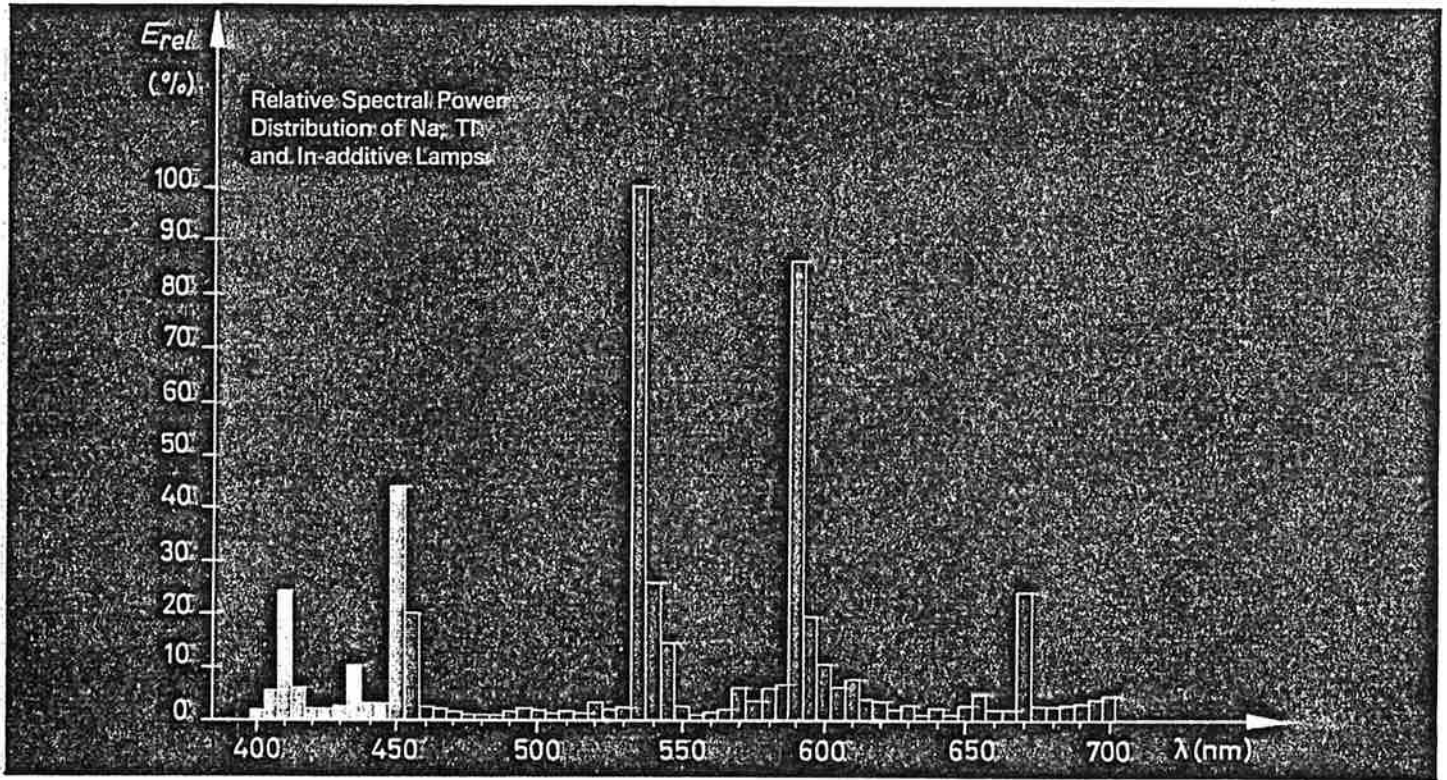
Luminous Efficacy

With the exception of sodium vapour lamps, Metal Halide Lamps surpass all other light sources in their luminous efficacy.

Lumen/Watt Values of Different Light Sources



Spectral Power Distribution



Colour Temperature

The colour temperature of Metal Halide Lamps is correlated with the Metal additives. Lamps with iodides of Na, Tl and In have a colour temperature of approx. 4000 K, however, the spectral power distribution shows that the resulting hue is a composite of some discrete colours. Therefore, three-additive lamps are subject to slight variations in colour temperature according to altering physical

conditions of the additives, that depend on the burning position, mains voltage and individual differences. Consequently, these lamps are recommended for use in locations, where lamp-to-lamp colour variations are negligible. The colour temperature of rare earth metal thallium iodide additive lamps is 6000 K and this value is closer to the desired stability.

Colour Rendering



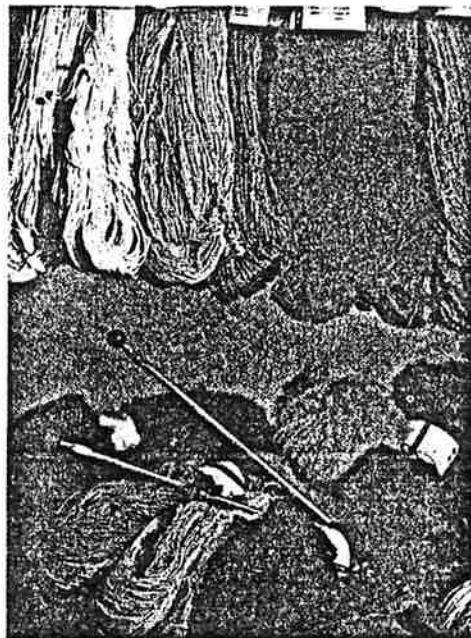
1



2



3



4

The light emitted by Metal Halide Lamps is made up of more colour components than that of Mercury or Sodium Vapour Lamps. Lamps with iodides of sodium, thallium and indium also radiate the spectral lines of these metals. The light of the lamps with rare earth metal and thallium iodide additives produces a practically continuous spectrum and these lamps have outstanding colour rendering properties.

Four examples of colour rendering under various light sources:

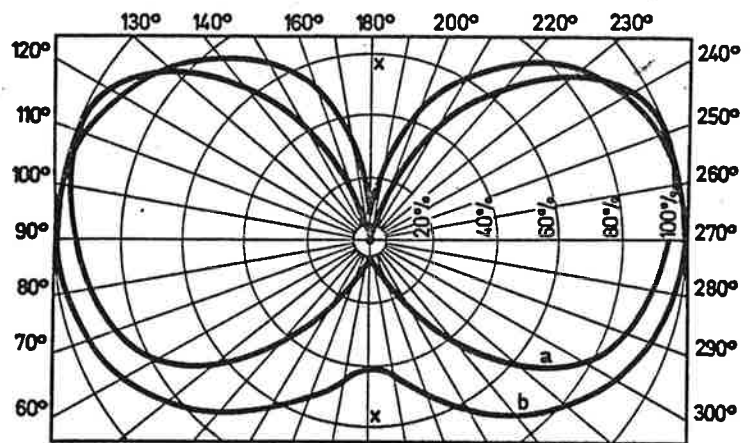
- 1— High Pressure Mercury Vapour Lamp
- 2— Metal Halide Lamp with Na, Tl and In
- 3— Metal Halide Lamp with rare earth metals and
- 4— High Pressure Sodium Lamp

Polar Curves

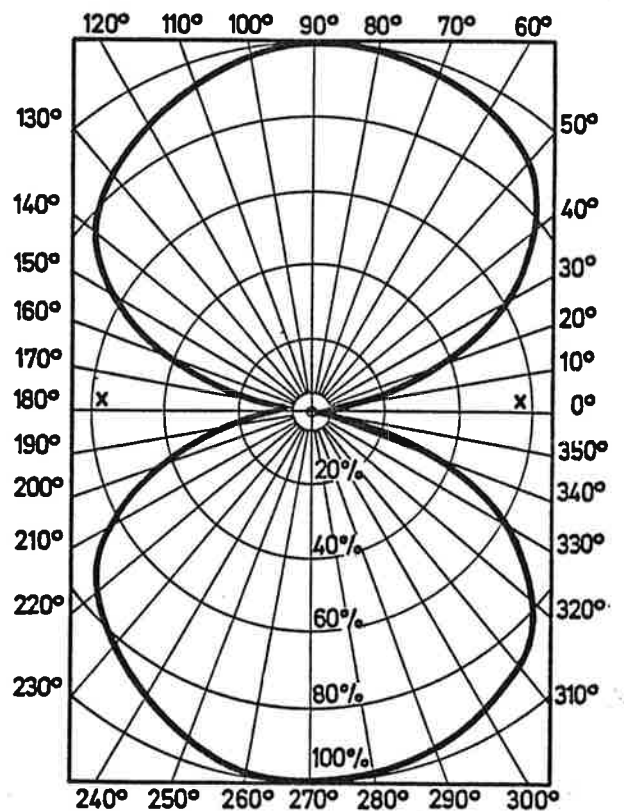
x-x indicates the lamp axis

The following table includes luminous efficacies and colour rendering indices of different light sources. It is evident that the luminous efficacy and the colour rendering properties of the Metal Halide Lamps are superior to those of any other light source.

Type	Luminous Efficacy lm/W	Colour Rendering Index R_a (%)
Incandescent Lamps	13–20	100
High Pressure Xenon Lamps	25	90
High Pressure Mercury Vapour Lamps	45–55	40
Fluorescent Lamps (warm white)	80	52
Metal Halide Lamps with Na, Tl and In additives	85–95	65
Metal Halide Lamps with rare earth metal additives	78–85	90
High Pressure Sodium Lamps	100–110	21
Low Pressure Sodium Lamps	160	21

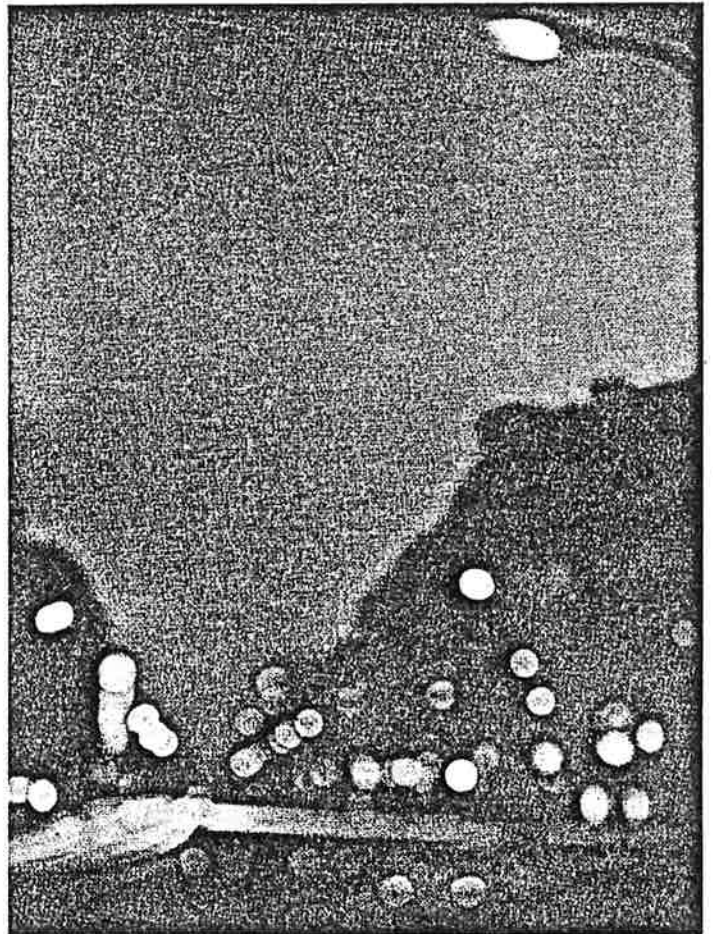
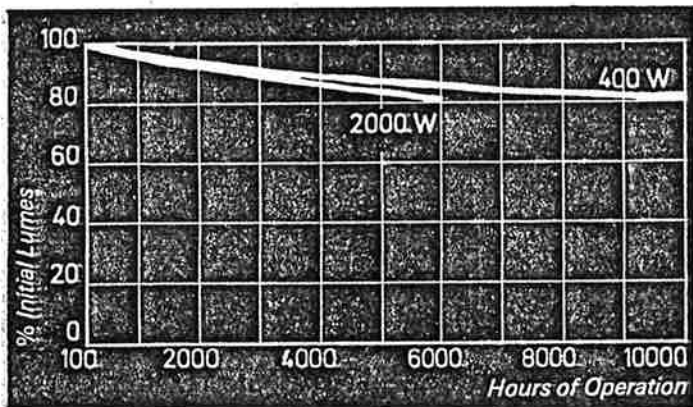
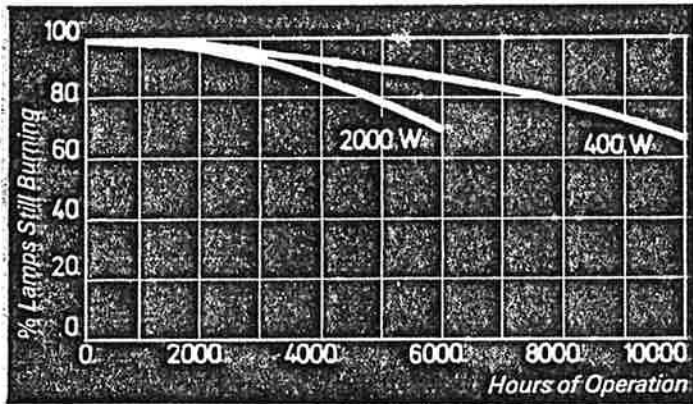


400 W Metal Halide Lamps burning vertically in cap up position
a) tubular bulb, b) phosphor-coated bulb

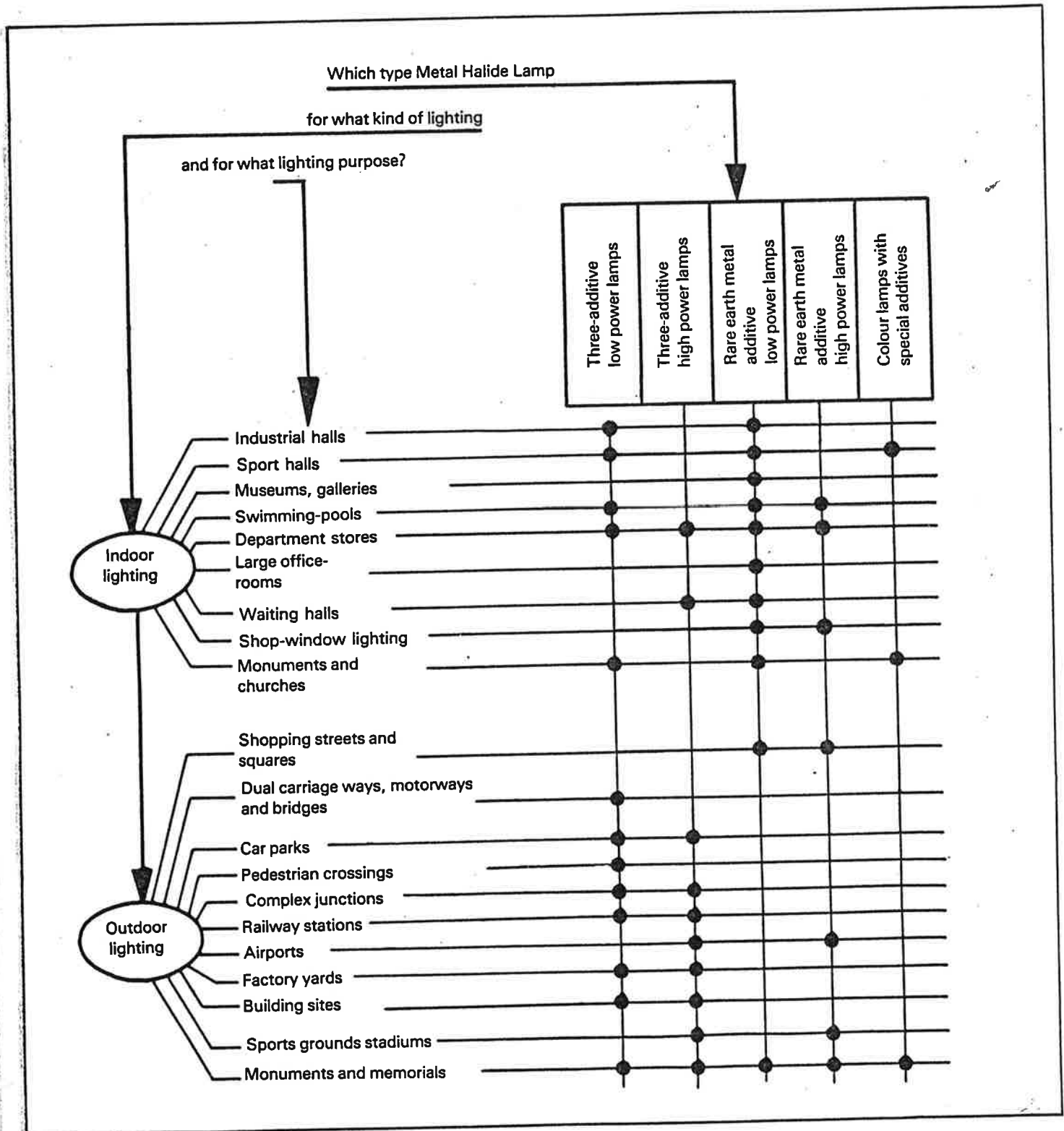


2000 and 3000 W Metal Halide Lamps
burning horizontally

Life, Lumen Maintenance



HOW TO CHOOSE YOUR METAL HALIDE LAMP FOR VARIOUS LIGHTING PURPOSES



TECHNICAL DATA

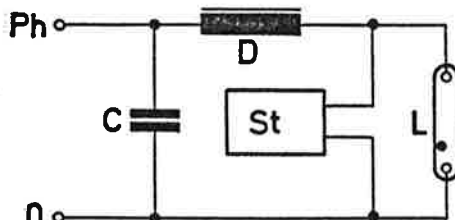
Type		HgMI 400 83410	HgMIL 400 83420	HgMI 2000/220 83710	HgMI 2000/380 83740
Additive System		Iodides of sodium, thallium and indium			
Power Consumption	W	380		1900	2000
Power consumption Ballast Included	W	405		1980	2070
Supply Voltage	V	220 + 5%			380 + 5%
Lamp Current	A	3.8		16.5	8.8
Luminous Flux	lm	32	28	180	190
Luminous Efficacy	lm/w	85	75	95	
Bulb Diameter, max.	mm	48	120	100	
Total Length, max.	mm	285	292	425	430
Light Centre Length (a)	mm	175	—	287	260
Colour Temperature	°K	4000			
Colour Rendering Index, R_a		65			
Capacitor for Power Factor Correction	μF	25		120	37
Starter		S 400			not needed
Burning Position		optional		horizontal ± 75°	
Cap		E 40/45		E 40/88 × 70	E 40/65 × 47
Standard Packing Quantity	St.	12	4		
Figure		2	1	4	5

HgMI 250/D 83310	HgMIL 250/D 83320	HgMI 400/D 83430	HgMIL		HgMI 2000/D1 83720	HgMI 2000/D2 83730	HgMI 3500/D1 83820	HgMI 3500/D2 83830	HgMI 400/A 83450 HgMI 400/B 83460 HgMI 400/C 83470
			400/DH 83440	400/DV 83480					
Iodides of rare earth metals and thallium									
250		360			2000		3500		380
275		385			2080		3650		405
220 ± 5%		220 ± 5%			380 ± 5%				220 ± 5%
3.0		3.5			10.3		18.0		3.8
20	17	28	23.4	26	170		300		—
80	68	78	65	72	85		86		—
48	92	48	120		100				48
220	226	285	292		430	490	430	490	285
150		175	—		260				175
6000									
90									
32		35			60		100		25
manufactured by the electrotechnical industry		S 400			manufactured by the electrotechnical industry				S 400
horizontal ± 45°	optional	horizontal ± 45°	verti- cal ± 45°	horizontal ± 60°				optional	
E 40/45		E 40/45			E 40/65 × 47				E 40/45
12	9	12	4						12
3	1	3	1	6	7	6	7	2	

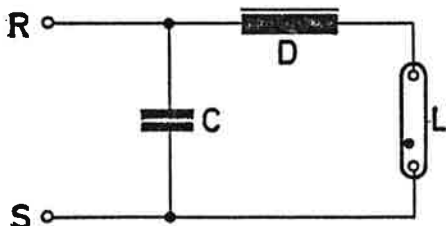
ELECTRICAL CIRCUIT DIAGRAMS

PRINCIPAL CIRCUIT ELEMENTS REQUIRED FOR THE OPERATION OF THE LAMPS

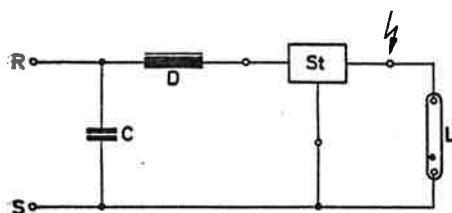
All the Lamps should be operated on AC mains using an inductive current limiting ballast and a capacitor for power factor correction. Except HgMI 2000/380 V Lamps require the use of separate starter units.



HgMI types operating on 220 V

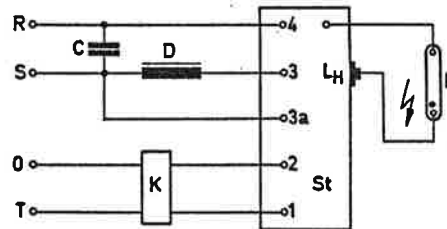


HgMI 2000/380 V Lamp



HgMI types operating on 380 V except
HgMI 2000/380, HgMI 2000/D2 and
HgMI 3500/D2

- Ph, O = 220 V AC mains
- R, S = 380 V AC mains
- C = capacitor for power correction
- D = ballast
- L = lamp
- St = starter unit



HgMI 2000/D2 and HgMI 3500/D2 Lamps

- R, S, T, O = three-phase mains
- C = capacitor for power factor correction
- D = ballast
- L = lamp
- K = short-time switch
- St = starter unit
- 1, 2, 3a, 3, 4, LH = terminals of the instant starter

When applying more than one instant starter, the phase sequence must be considered. The combinations to be applied are listed below:

Instant starter terminals			
1	2	3	4
T or S	O	S	R
R or T	O	T	S
S or R	O	R	T

BALLAST

Some Types of TUNGSRAM Metal Halide Lamps can be operated with ballasts standardized for Mercury Vapour Lamps while other types use special ballasts.

All 400 W Metal Halide Lamps operate on 220 V mains and with ballasts standardized for 400 W Mercury Vapour Lamps as specified in IEC Publ. No. 262. In case the rated mains voltage differs from 220 V, special ballasts or leakage transformers are required, ensuring lamp currents indicated in this catalogue, as well as providing no-load of at least 220 V.

To operate HgMI 2000/220 V Lamps on 220 V mains, two parallelly connected 1000 W Mercury Vapour Lamp ballasts are required. (For ballast specifications see IEC Publ. No. 262).

To the operating of HgMI 2000/380 V Lamps on 380 V mains, ballasts standardized for 2000 W Mercury Vapour Lamps (see IEC Publ. No. 262) can be applied. For the other type Lamps special ballasts are required, ensuring lamp currents indicated in the Technical Data, operating at the relevant supply voltages.

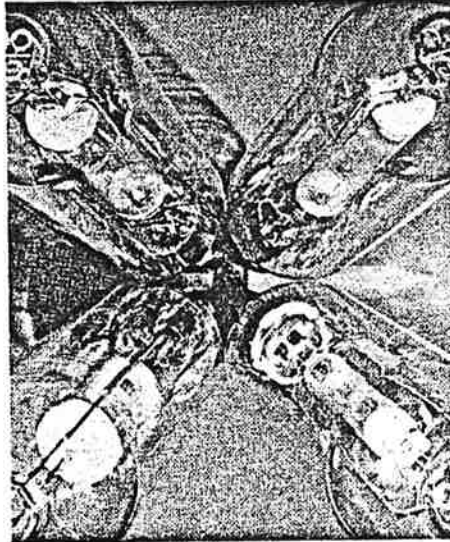
Any other type Metal Halide Lamp can be operated with the ballast suitable for the corresponding lamp type of other manufacture, according to the recommendations of the Interchangeability List of this catalogue.

STARTER UNIT

Metal Halide Lamps do not start on mains voltage so that they require separate starters (except the "Self-starting" type HgMI 2000/380 V). When switching-on the Lamp (see electrical circuit shown in the diagrams on page 16), the starter unit applies a high-voltage starting pulse to the lamp terminals. These starters have not yet been standardized and therefore several starter types based on different principles and made by different manufactures are available. TUNGSRAM Lamps will start by using any starter suitable for corresponding lamps of other manufacture, according to the recommendations of the Interchangeability List of this catalogue.

TUNGSRAM Starter S 400

- glow-starter appropriate for starting Metal Halide Lamps operating on 220 V
- simple design and reliability
- low price
- in case of lamp failure it must be replaced together with the lamp



Technical Data of Starters S 400		
Type designation		S 400
Mains voltage	V	220 ± 10%
Non-reclosure voltage	V	160
Minimum peak value of starting pulse	V	min. 1600
Max. ambient temperature	°C	max. 50
Max. capacitive load permissible on the interconnecting wires of the starter	pF	max. 500
Weight	g	50
Figure		8

Life. The starter is designed to start 6000 times, however in the event of lamp failure it will no longer produce pulses, and so the starter must be replaced together with the lamp

INSTRUCTIONS FOR STARTING AND OPERATION OF TUNGSRAM METAL HALIDE LAMPS

For the starting of HgMI Lamps an electrical circuit according to the diagrams on page 22 should be realized as follows:

- The outer conductor is to be connected to the ballast, and the neutral or the other outer conductor to the screw shell of cap E 40;
- The lead wire between lamp and ballast must have a load capacity not exceeding the value prescribed for the starter, and the lead wire must be designed so that the voltage pulses produced by the starter should not cause a breakdown.
- When switching-on the lamp the short-circuit current of the ballast flows through the circuit which, depending on the ballast, has a load capacity 1.5 . . . 2 times higher than the operating lamp current. The circuit should be designed for this short-circuit load.

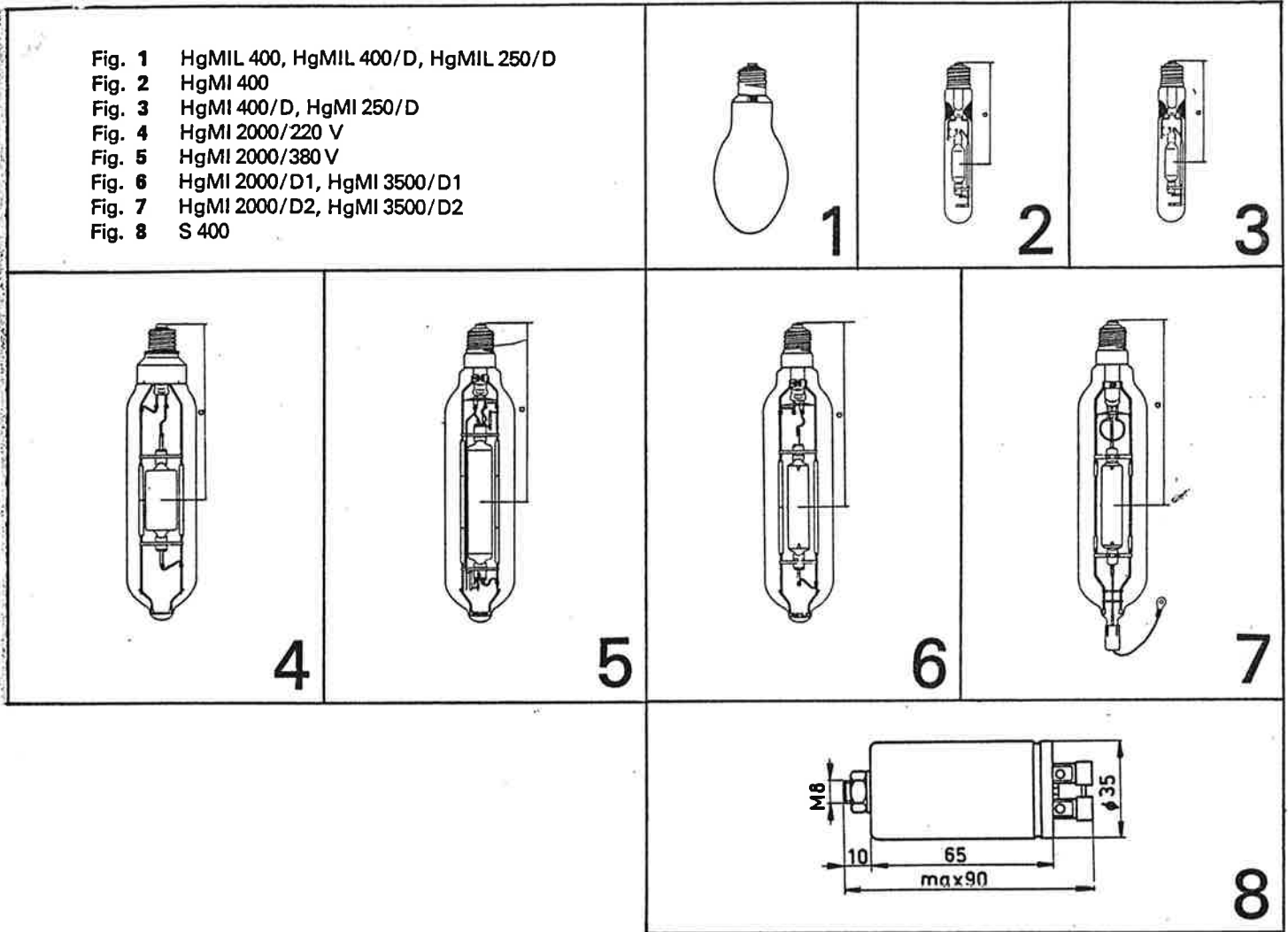
For the operation of the Lamps consider the following:

- The lamps must start within 3 minutes after switching-on;
- The stabilized photometrical conditions have to set in within 7–10 minutes after starting;
- After switching-off a lamp it should not be reignited for about 20 minutes, except the D2 types, which can be reignited immediately, provided that the appropriate instant starter is used.

BALLASTS, STARTERS AND LUMINAIRES SUITABLE FOR TUNGSRAM METAL HALIDE LAMPS

Lamp Type	Ballast	Starter	Luminaire
HgMIL 250/D	Special ballast designed for 3.0 A lamp current	Series glow-switch or thyristor starter of any manufacture providing pulses peaking at 3—4.5 kV _s and designed for the lamp current	Luminaires and projectors designed for mercury vapour lamps for indoor and outdoor lighting, shopwindow illumination, indoor lighting with special fitted or built-in luminaires
HgMI 250/D			Special fitted or built-in indoor and shopwindow luminaires
HgMIL 400 HgMIL 400/D	400 W Mercury Vapour Lamp ballast of any manufacture. For specification see IEC Publ. 262	Parallel starter (e. g. Tungfram S 400) or a series glow-switch or thyristor starter of any manufacture providing pulses peaking at 3—4.5 kV _s and designed for the lamp current	Mercury Vapour Lamp luminaires or projector for indoor or outdoor lighting
HgMI 400 HgMI 400/D			Special luminaires for indoor and outdoor lighting, special symmetrical or asymmetrical floodlights
HgMI 2000/220	2 parallelly connected 1000 W Mercury Vapour ballasts of any manufacture. For specifications see IEC Publ. 262	not required	Special, symmetrical or asymmetrical floodlights
HgMI 2000/380	2000 W Mercury Vapour Lamp ballasts of any manufacture. For Specifications see IEC Publ. 262		
HgMI 2000/D1	Special ballast designed for 10.3 A lamp current	Series glow-switch or thyristor starter of any manufacture providing pulses peaking at 4—5 kV _s and designed for the lamp current	Special, symmetrical or asymmetrical floodlights
HgMI 3500/D1	Special ballast designed for 18.0 A lamp current		
HgMI 2000/D2	Special ballast designed for 10.3 A lamp current	Special instant starters designed for the lamp current and providing pulses peaking at 60 kV _s	Special, symmetrical or asymmetrical floodlights allowing instant re-starting
HgMI 3500/D2	Special ballast designed for 18.0 A lamp current		

FIGURES



INTERCHANGEABILITY LIST FOR METAL HALIDE LAMPS OF OTHER MANUFACTURERS

Lamp designation	TUNGSRAM	PHILIPS	OSRAM
Lamps with sodium iodide additives			
Tubular lamps	HgMI 400 — HgMI 2000/220 V HgMI 2000/380 V	HPI/T 400 HPI/T 1000 HPI/T 2000/220 V HPI/T 2000/380 V	— — — HQI 2000 W*
Ellipsoidal bulb lamps with phosphor coating	HgMIL 400	HPI 400	—
Lamps with rare earth metal iodide additives			
Tubular lamps	HgMI 400/D — HgMI 2000/D1 HgMI 2000/D2 HgMI 3500/D1 HgMI 3500/D2	— — — — —	/HQI 400W-70 /HQI 400 W-71 HQI 1000 W/D1 HQI 2000 W/D1 HQI 2000 W/D2 HQI 3500 W/D1 HQI 3500 W/D2
Ellipsoidal bulb lamp with phosphor coating	HgMIL 400/D	—	/HQIL 400 W-70 /HQIL 400 W-71

* No starter required