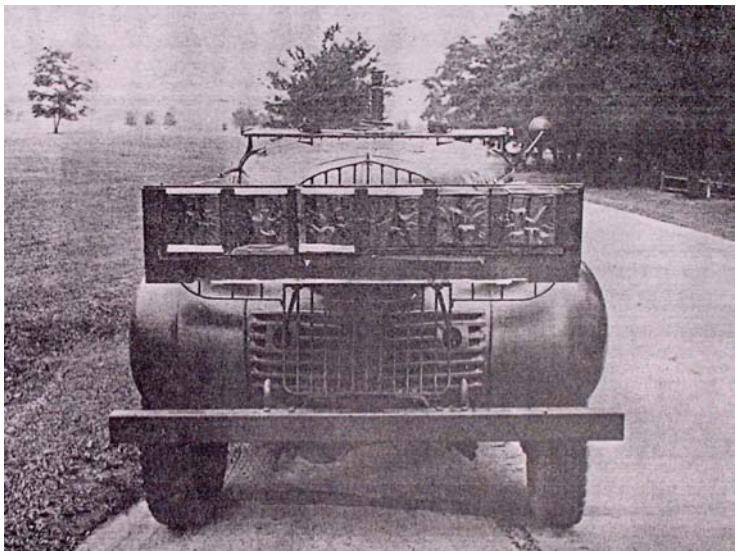
SNOOPERS, SNIPERS, PEEPING TOMS & TOM CATS

Clive Elliott continues the story of wartime night vision systems. The rather curious names in the title were code names for night vision systems developed by the Americans and Germans.

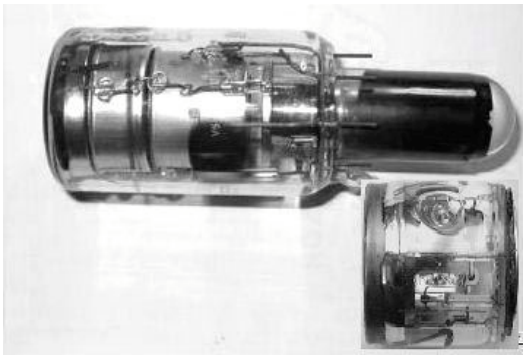
AMERICAN INFRA-RED

The first infra-red vision system was conceived by John Logie Baird during the 1920s. Although Baird devised his Noctovision apparatus, history gives him little credit for his efforts. It is generally claimed that the first night vision system was developed in the USA by Vladimir Kosma Zworykin, a Russian emigrant, who was employed by RCA. He found that television equipment could be developed to function into the infra-red spectrum, but in 1935 there was no interest from the military for such a facility. But with war in Europe attitudes changed and in 1940 a much improved RCA system was demonstrated at the Aberdeen Proving Ground. But the emphasis was on developing systems to be used by supply columns with trucks and DUKWs. Trials involved a vehicle fitted with seven 450-watt aircraft landing lights and in another experiment with two 3,000-watt lamps. Power was provided by large generators, but this noise in the still of the night would preclude use close at the front lines.



An early system of IR headlights fitted to a Dodge VC-5 pickup in August 1940.

Unlike the British image converter tube, which was small, and required a single voltage, the standard American IR converter tube required 15, 100, 600 and 4,000 volts. Suitable power supplies were large and complex. The converter tube and its optics were bulky, and to reduce length, a periscope arrangement had to be used. By 1942 RCA had produced a smaller image converter tube which was 6 inches long, but this was still much bigger than the British tube which was only 1¾ inches long. But a year later RCA had developed a tube 4½ inches long, this became the 1P25, which was used in a series of night viewing systems.

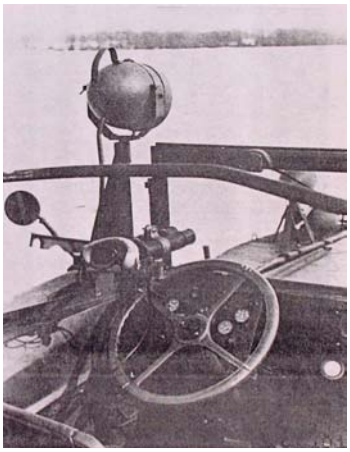


The IP25 converter tube with a British Tabby tube inset. To the right the viewing screen on the Tabby is flat, but the IP25 has a narrow domed screen, which required a special lens to produce a linear image. (IP25 image courtesy Brian Weber, USA.)

Infra-red viewer Type B

This was a binocular viewer intended not only for night driving, but could also be removed and used for reconnaissance. This was achieved by the development of a compact vibrator supply which could be powered by two torch batteries, or when in the vehicle by the vehicle battery. In May 1943 a comparison was made between Jeeps fitted with Type B and three infra-red spotlights, and a British Tabby Type E with four spotlights. The comparison showed that the British binoculars were heavier and longer than their American counterparts, and the definition of image was better with the American system. This was hardly a fair comparison as the American lighting system used a total of 1,350 watts, and the British system used only 144 watts! But it was conceded that the British system was tactically superior as it was merely powered by a 12-volt battery, whereas the American lights required a generator to be carried. It was noted at the time, that the American system was intended for supply column use, but the British also envisaged a system that could be used offensively.

Type B viewer, and three 450 watt infra-red spotlights. The generator to power the spotlight was carried in the back of the Jeep.



Type B viewer and infra-red spotlight fitted to a DUKW.

Ford GPA with periscope type viewer. Note IR spotlight & IR headlamps requiring 1.5kW onboard generator.

Infra-red viewer Type D
This was a monocular viewer, half of a Type B viewer. It was found that because the driver's binoculars were fixed to the vehicle, although he may be able to see the road ahead, it was difficult for him to retain an appreciation of the immediate surroundings, and was unable to see sharp left or right. But an assistant equipped with a Type D viewer could not only give guidance as the vehicle proceeded but also use it when out of the vehicle to investigate obstructions.

Infra-red viewer Type Z
In early 1944 a viewer was demonstrated that was fitted to a M1 steel helmet. Because the viewer was no longer fixed to the vehicle it gave the driver more flexibility in what he could see. Like the Type B and Type D, only small quantities of Type Z were produced.

Infra-red Snooperscope
This was a monocular viewer based on the 1P25 converter tube and intended for general observation and covert operations.

Infra-red Sniperscope M1
This was a modified Snooperscope fitted to a M3 carbine, which was a M2 carbine suitably modified. The Sniperscope and Snooperscope were the only American infra-red devices to see operational service. By the end of the war 6,000 of the devices had been manufactured, of which about 2,000 were Sniperscopes. The only time they were used in conflict was the capture of Okinawa from the Japanese. It was claimed that in the first week of the campaign 30% of Japanese casualties were attributable to the use of the Sniperscope. But the British view at the time was that, as there were less than 500 of these weapons actually used, they were really only undergoing field trials.

It is curious that having been the first to develop an infra-red system that such little use was made of the technology during the war. There seem to be a number of reasons for this:

1. The bulky nature of the earlier viewers and their large power supplies may have stifled thinking about developing more tactical systems.
2. Reliance of powerful infra-red spotlights requiring generators precluded frontline deployment.
3. Although the different trials were regarded as successful, there seems to have been ambivalence at various levels in placing firm orders for equipment and on occasions even providing vehicles for trials.
4. Apart from the later use of Snooperscope and Sniperscope, the purpose of night vision had always been seen in terms moving supplies by trucks, rather than front line use.
5. As the war proceeded the requirement for such secretive movements of supplies declined.
6. The US Navy made extensive use of infra-red signalling systems, and there may have been reluctance to permit infra-red technology to be used in land warfare, so as not to alert the Axis forces to the American infra-red capabilities.

AMERICAN NIGHT CONVOY DRIVING

Unlike the complexities of infra-red equipment, a simple system of lights allowed vehicles in night convoys to keep sensible distances apart. This widely used system relied on the limitations of the human eye, in that it becomes harder to differentiate between small lights close together with increasing distance from the lights. Vehicles were fitted with special rear lights on either side of the vehicle. The upper part enclosed a stoplight, and the lower part two pairs of red "cats eyes" which were illuminated by a single bulb.

At less than 60 feet from the vehicle in front all four “cats eyes” are distinguishable, beyond 60 feet the closest “cats eyes” appear as one so only two lights are visible. Beyond 180 feet then all the “cats eyes” appear as one light.

LESS THAN 60 FEET

BETWEEN 180 AND 60 FEET

MORE THAN 180 FEET

The lead vehicle could judge the distance of a vehicle behind from a simpler arrangement. At the front of the vehicle on either side was a lamp enclosing just a pair of “cats eyes”. At less than 60 feet the individual “cats eyes” are discernible, beyond 60 feet the “cats eyes” appear as a single light.

LESS THAN 60 FEET

MORE THAN 60 FEET

GERMAN NIGHT CONVOY DRIVING

Not to be outdone the Germans had also devised their own lighting system called "Nova Technik". The purpose was to speed up night-time convoy movement without increasing the risk of detection. The description that follows is based on an investigation by the RAC School of Tank Technology. The "Nova Technik" apparatus consisted of:

Tarnscheinwerfer, or "camouflaged headlight". A 35 watt bulb faced backwards to avoid the filament being seen directly, light was reflected forwards by a semi-oval mirror, passing through a glass diffuser under the overhanging hood. A diffuse-edged flat top beam of light was produced extending 30-40 metres forward with a width of about 25 metres. The strength of the beam was controlled by the **Stuffenschalter**, which was a three position dimming switch. The head lamp beam was claimed to be invisible both horizontally from the ground and vertically from the air according to the dimmer setting:

Setting LOW	invisible from 500 metres
Setting MEDIUM	invisible from 800 metres
Setting HIGH	invisible from 1500 metres

Abstanddrucklight, or rear "distance keeping light". This ingenious lighting unit comprised three chambers each fitted with festoon type bulbs.

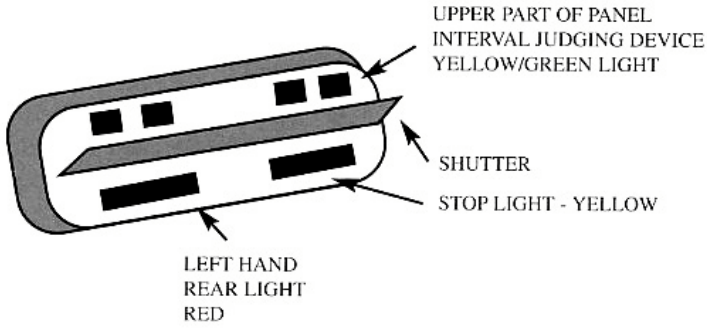
i) A yellow stop light.

ii) A red light defining the rear left side of the vehicle.

iii) Two pairs of square windows emitting a yellowish-green light to form the distance judging system. The principle relies on the limitations of the human eye which can only perceive adjacent light sources as being distinct at certain distances. So when:

All FOUR lights are distinguishable the gap between vehicles is 0 – 25 metres
FOUR points of light appear as TWO the gap between vehicles is 25 - 35 metres
FOUR points of light appear as ONE the gap between vehicles is 35 – 300 metres

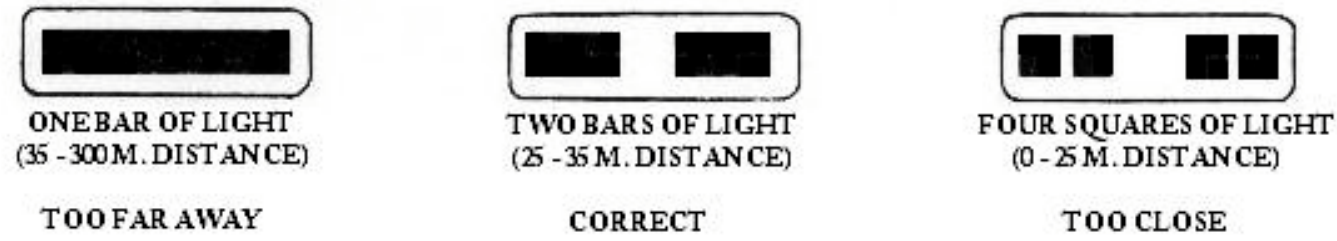
A horizontally hinged shutter was arranged to cover both the red and yellow lights, which are mounted in the lower half of the unit. These are covered over when in blackout convoy, during normal driving the shutter covers the upper part of the unit housing the four distance-judging lenses. The use of shutters may seem crude, but they are far more reliable than electrical switching. Note that should the latch on the hinged shutter fail, it is arranged so that it will fall down to give the dimmer display of lights.



Rear interval-judging panel and stop light fitted on left-hand rear of vehicle

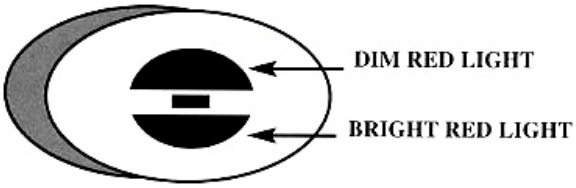
A post-war version of Abstanddrucklight, with shutter down for night driving.

Abstanddrucklight, with shutter up for normal driving.



Left hand rear light of vehicle with shutter down i.e. using the interval judging device

Zusatz-Schlusslight, or "additional rear light". German regulations required that the width of the vehicle be indicated rearwards as well as forwards. So as the rear left side was already illuminated by the distance judging light, the additional rear light was fitted to the rear right hand side. There was the option of either a bright red light or a dim red light when in blackout convoy. A rotatable shutter selected the appropriate brightness.



Rear right hand light with the option of dim or bright light

The normal distance observed for night convoys was 25 – 35 metres, with only the lead vehicle using headlights. It was felt that the system allowed good marching order in night convoys with safety to within 300 metres of the enemy.

GERMAN INFRA-RED

The British code named their infra-red night vision system Tabby, on the basis that a Tabby cat can see in the dark. But of course German cats also can see in the dark! One of the German night vision systems was called Kater Gerät, literally "the equipment of the tom-cat". They were clearly referring to its night vision capabilities as a number of other creatures that hunt by dark were used as code names for night vision systems. There is very little published information on wartime allied infra-red equipment, but there is quite a lot that has been published about German systems fitted to tanks. This seems to mirror the general obsession with German AFVs, over their allied counterparts. Unfortunately as far as infra-red goes there is some misinformation, this is in part due to the piece-meal way that Allied Intelligence had to work out what the Germans were up to.

The American claim of being the first have an infra-red night driving system is sometimes doubted on the basis that in the early 1930s AEG were also developing night vision technology. But this technology was not so much about night driving, but night fighting.

The early German system was initially fitted to artillery, but did not find favour with the army. This was because of the complexity of the equipment, and it could not offer the same accuracy as daytime firing. However the improved air power of the Allies in 1943 focussed minds on the need to be able to move under the cover of darkness, and a rapid development of infra-red equipment took place.

The description that follows is based on Allied intelligence reports produced during and immediately after the war. I shall cover some of the less known infra-red systems, rather than just AFVs, which have been described many times before. Much of this information filtered through in an unstructured way, dependant on intelligence reports, the availability of captured equipment, and the interrogation of POWs. The problem of questioning POWs was assuming that they were telling the truth, respondents may only have knowledge of a limited range of equipment. They may embellish stories in order to court favour from their captors so they would assume some importance, and, as often is the case, the higher the rank the less will be known about the detail of the equipment!

German infra-red systems were rather helpfully named after birds or animals, which gave a clue as to the role of the equipment. Sometimes this name was given to the type of infra-red lamp or searchlight used, sometimes the name referred to the viewing device, and sometimes to the complete system. Certain words were used in conjunction with the main title, but commonly omitted for brevity. The most common descriptions were:

Gerät meaning device or equipment.
Beobachtung Gerät meaning observation equipment. Refers to the general viewing system
Bildwandler or **BIWA** meaning picture converter. Refers to the converter tube and optics of a viewer.
Bildwandlerrohr refers to just the converter tube of a BIWA viewer.

In the early part of the war Allied Intelligence had only a limited appreciation of what infra-red equipment the enemy had developed. No infra-red equipment for AFVs had been recovered, but unconfirmed reports indicated such systems were available.

CAPTURED EQUIPMENT FROM FRANCE

By November 1944 several examples of infra-red detectors used Army Coastal Defence Units had been recovered from France. A detector called Kater Gerät, an electron telescope and a thermal detector called Donau Gerät.

Kater Gerät, meaning tom-cat device, was a simple infra-red detector probably intended to detect any Allied infra-red sources at close range. It could just detect an infra-red filtered torch at 100 yards, or a filtered headlight at 500 yards.

Electron Telescope, as the Allies called it, had greater range and sensitivity. It had a wide spectrum of sensitivity covering both “far” and “near” infra-red. “Near” is that part of the spectrum near visible red light; “far” infra-red is the opposite end in the thermal part of the spectrum. A captured document described how the electron telescope could detect the heat from the exhaust of aircraft engines, so this equipment was probably **Wärme Peil Gerät** (W.P.G.), meaning warm bearing device. The name clearly indicates its sensitivity into the far infra-red spectrum. Although it was as a “passive” detector, the captured document described how a searchlight of either 150 cm or 200 cm could make it into an “active” system working in the “near” infra-red part of the spectrum. An infra-red filter for a 150 cm searchlight was captured, it was thought that not only was this for use by anti-aircraft units, but also could be used as a navigational aid for shipping.

Donau Gerät, meaning Danube Device, indicates its coastal defence role. It worked by detecting heat in the “far” infra-red spectrum from ships by using thermocouples placed at the centre of focus of mirrors. Doneau 60 with receiving mirrors 60 cm in diameter could detect minesweepers and torpedo boats at about 15 km, but a fleet could be detected at 25 km. About 50 units were operational but were used only on land and were concentrated at important locations where triangulation could give an exact fix of naval targets for coastal artillery. When used individually only a bearing could be obtained, an infra-red searchlight was sometimes used

to augment detail at closer ranges. Donau Gerät was easily transportable and reliable in use so it could have been used if needed on ships or U-boats.

Donau Gerät was in fact more precise in obtaining a bearing than radar particularly at close range where radar could suffer from false echoes. But the two systems complemented each other.

POW INTERROGATIONS

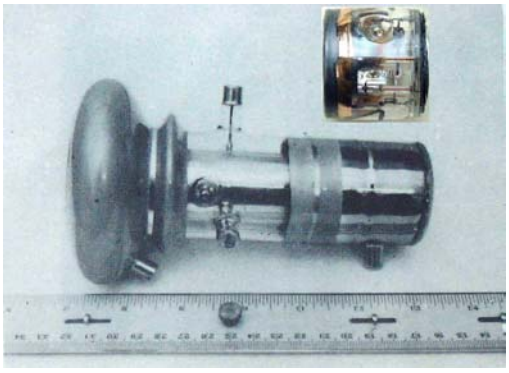
In November 1944 interrogation of POWs was producing some leads. 21 Army Group had been given a vague description of a night vision system called Uhu, and the Mobile Field Interrogation Unit No.1 revealed a more detailed description of a system called Uhu Gerät.

Uhu Gerät, meaning Great Horned Owl Device, confirmed to the allies how logical yet insecure was the German nomenclature for such devices. One of the POWs participated in trials at Pz Truppen Schule I at Fallingbostel; it was here later in the war that a comprehensive range of infra-red equipment was recovered. The POW claimed that since March 1944, Panther tanks had been fitted with Uhu. This included a filtered light as large as a bicycle lamp(!), which through the viewing device allowed a 40 metre diameter beam to extend 400-600 metres. The POW may have been confused, forgetful or devious, because the description was treated with some caution. There is no way that a small infra-red source could produce such a powerful beam. It was thought that the target for these experiments may have had its own infra-red beacon, or successful engagement of the target was as a result of detecting heat from the engine of the target, along the lines of a Donau Gerät. It seems likely, that for whatever reason, the POW failed to recount that a more powerful searchlight was used, although he did describe the engine of the tank racing, presumably to produce sufficient electrical power for the searchlight.

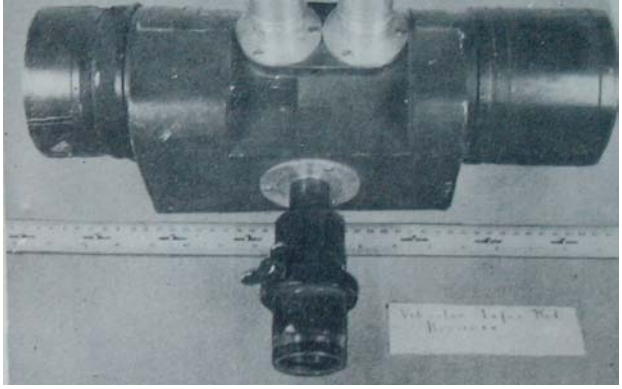
INTERROGATION OF RESEARCH TECHNICIAN

US Army Intelligence published a report in April 1945, which included material from Kurt Procknow who was a research technician at Forschungsanstalt des Reichs-Postministers. This research Institute of Reichs Postmaster had six sections; one devoted to television, which later changed to infra-red research.

Nachtfahrgerät, meaning night driving device, was researched not only by Reichs Postmaster, but also at AEG Laboratories in Berlin. From 1943 onwards production was carried out at Leitz, in Wetzlar. The Bildwandlerrohr (picture tube) required 14 kvolts and was 160 mm long, it was thus designated as Type 160. This made it about three times longer than the British tube, which required only just above 3 kvolts to function. The curvature of the glass contributed to distortion particularly at the periphery, whereas the smaller British tube had entirely flat surfaces at each end.

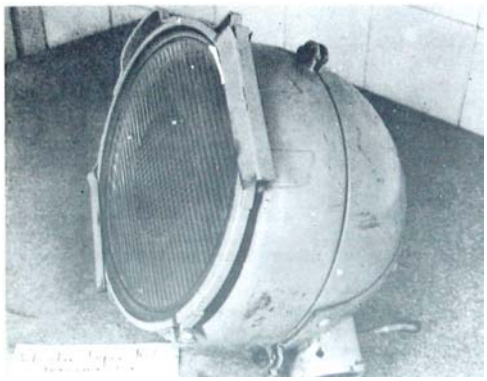


Tube Type 160, inset the British Tabby tube for comparison.

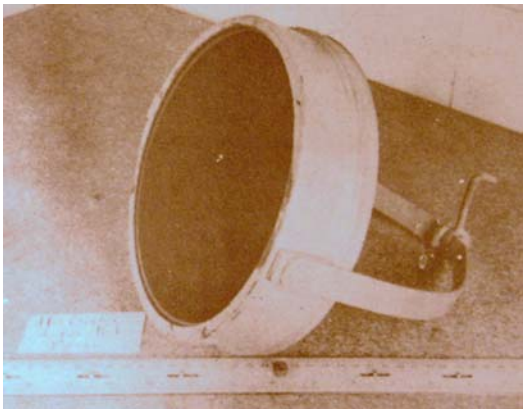


The bildwandler viewer containing the tube Type 160. The high voltage connectors are at the top.

All German infra-red systems used monocular vision as opposed to British and American systems that used a binocular system. With this Nachtfahrgerät it was found that with the eye 15 cm from the viewer that the image appears just as it would have been in daylight with no change in image size, giving a true interpretation of the surroundings. Moving closer or nearer to the screen would alter the image size. The infra-red source was provided by a 100 or 200 watt lamp fitted with a Fresnel lens to disperse the light across the road. This was supplemented by a pair of infra-red filters fitted over the vehicle headlights.



Nachtfahrgerät lamp with diffuser.

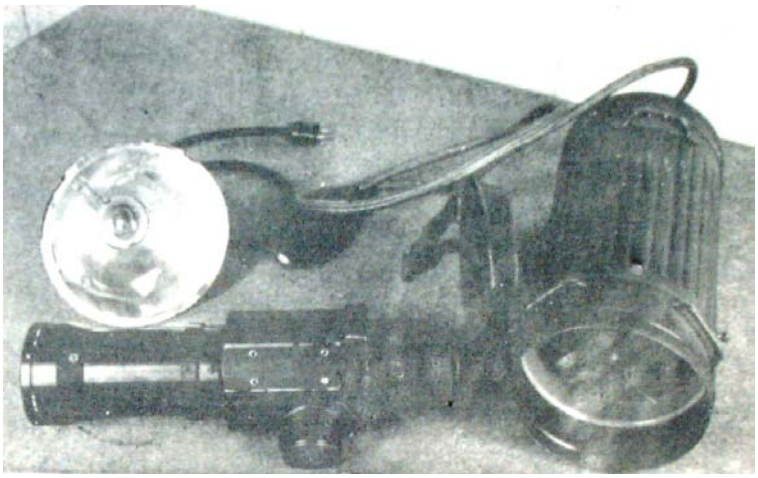


Nachtfahrgerät infra-red filter for the headlights.

It was claimed that this Nachtfahrgerät set-up could allow the roadway to be seen for 100 metres and most objects could be seen at 200 metres.

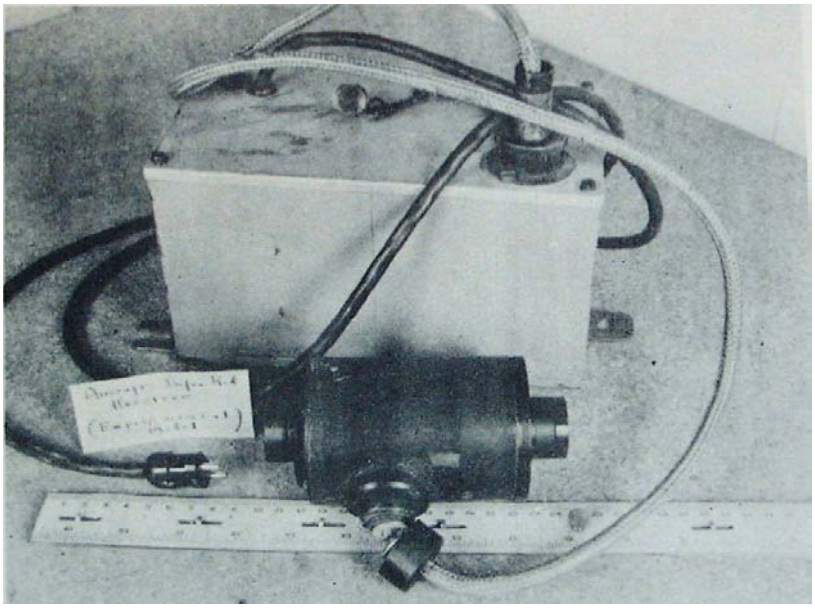
Zielgerät, meaning aiming device, was a general name for infra-red systems for guns of various sorts. The full designation of this captured example was not known other than the viewer could fit on a rifle in place of the telescopic sight. The bildwandler sight was 10½ inches long and the infra-red light source had a reflector about 4 inches diameter. The high voltage power supply was contained in a regular gas mask holder. A particular feature of the power supply was a large value capacitor.

As there was minimal current drain, the capacitor would continue to release its charge for about 15 seconds after switching off the device. In use the infra-red source would be kept on, whilst the sniper would press the "on" button to energise the screen and as it would fade press the button again. Although the high voltage was at minimal current, the battery still had to power the inverter for the transformer and this required 7 volts at 4 watts. This intermittent powering up represented considerable saving of battery power. Zielgerät was claimed to have produced good results when employed on the Russian front.



To the left is the bildwandler rifle sight, above that the lamp and reflector which has been dismantled from the lamp box and filter on the right.

Muecka probably should be **Mücke** meaning Mosquito. This suggests it was a lightweight system for aircraft use. Only a bildwandler viewer was captured with its 24-volt power supply. It was made in March 1945 and thought to be an experimental model, probably for identification of nearby planes. Although the viewer was small, it had a very narrow field of vision limiting its usefulness.



The small Mücke viewer with its power supply behind.

MORE CAPTURED EQUIPMENT

In May 1945 details were beginning to emerge of German infra-red fighting equipment. An infra-red gunsight was captured and assessed, there was no information about its use or the vehicle it was taken from. The sight was about 24 inches long and 5 inches in diameter; it contained an image converter tube, and optics. A knob was calibrated from 5 to 300, which corresponded to the distance in metres for correct focussing. Another knob was marked "Pz 39/42" and "Spr Gr 42" which was thought to indicate that it was the gun sight with the 7.5 cm Stu 42 or KwK 42. The eyepiece, which covered only 4º, was hinged which allowed a much wider field of vision either for target acquisition or night driving. A marking of "-17 kv" indicated the voltage for the converter tube, which was a considerably higher voltage than needed for the British Tabby systems which was only about 3 kvolts. An infra-red headlamp was also received for evaluation, but it was not known whether it was associated with the gunsight. The infra-red filter was 8 inches in diameter.

Confirmation was received from 21 Army Group that workshops at Fallingbostel had a centre for infra-red development. A wrecked Sd.Ffz.251 had been recovered, although no infra-red viewers were found, there was still an 8 kW generator fitted and 60 cm searchlight with infra-red filter. Better news was to come; a few weeks later an infra-red training unit complete with equipment had surrendered. The unit, known as Kamfgruppe Uhu, consisted of 11 officers and 246 other ranks, and was moved to the Tank Training School Area Fallingbostel. Interrogations revealed the range of equipment used at Fallingbostel, but for continuity I have included some details that only became apparent later.

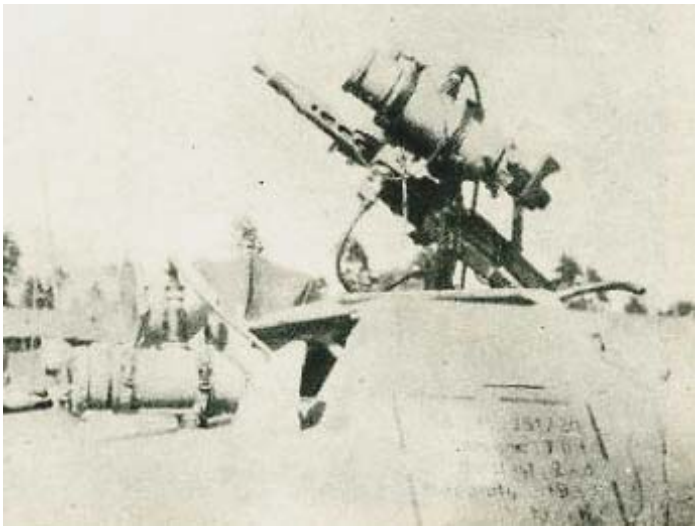
Vampir was a similar to the American Sniperscope. The earlier version was fitted to a rifle and the later version to a MP44 carbine (Sturmgewehr). It used a filtered 5-inch diameter lamp powered with a 35 watt bulb; the infra-red sight was about 14 inches long and with unity magnification. A backpack housed the battery and power unit, which supplied 11 kilovolts for the sight. The maximum range to identify a moving man was 80 yards, although the whole set up was rather heavy, it was claimed operationally good results had been obtained. Two men equipped with Vampir would be positioned at the rear of a vehicle to provide protection from infantry attack at night.

Posing with Vampir in daylight

F.G.12/50 this was a big brother version of Vampir fitted to an MG42 gun carried on a Sd.Kfz 251/20 half-track. The filtered lamp was of 200 watts of 8 inches diameter; the viewer was 20 inches long and 5 inches diameter. Although of unity magnification, there was an auxiliary lens to give enhanced vision. At 400 yards a standing man could be identified.

F.G.12/52 this was an F.G.12/50 modified as Nachtfargerät, i.e. a night driving device. The changes were a 100-watt bulb and a diffuser fitted over the lamp to give a wider spread of beam. Earlier versions of this were called Spanner.

Falke, meaning Falcon, was the term for a Sd.Kfz 251/20 fitted with F.G.12/50 and F.G.12/52.

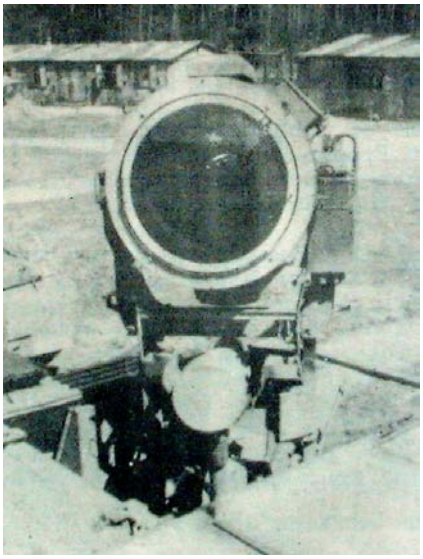


Falke for night fighting and night driving.

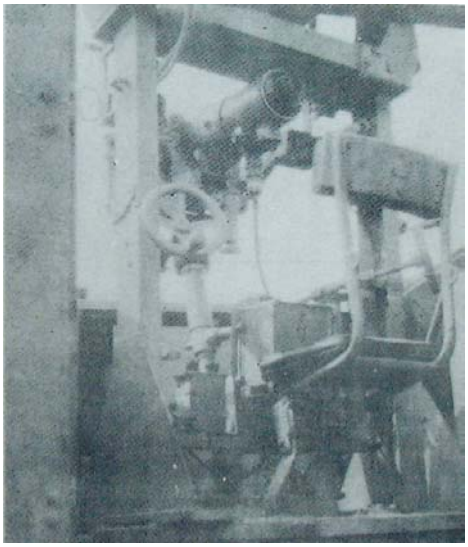
Puma was a Panther tank fitted with 7.5 cm gun KwK42l/71 with night vision system F.G.12/50. (Puma is probably incorrect, see later interrogations).

Uhu was the largest of the German infra-red systems; it used a 60 cm searchlight mounted on an unarmed Sd.Kfz 251/20 half-track. The searchlight was double filtered and had a 3º beamwidth, power was provided by an 8-kilowatt generator.

The bildwandler was 24 inches long and 10 inches in diameter, with a x10 magnification. The searchlight, viewer and operator's chairs were aligned together and could be traversed through 360º, with some degree of elevation.



The filtered 60-cm searchlight, the bildwandler beneath it is covered up.



Uhu operator's chair and viewer, the elevation control is on the left side

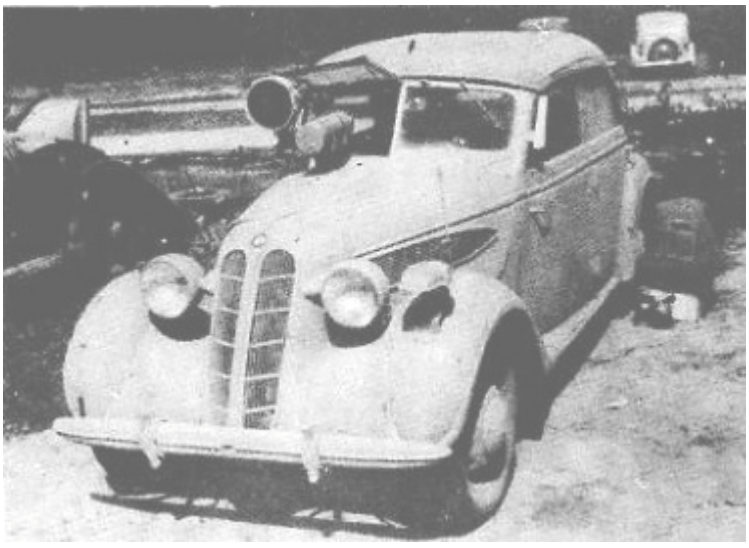
Tests showed that a target half-track could be identified at 1000 yards, but it was noted that the very narrow beamwidth made target acquisition difficult. Uhu was intended to be used for reconnaissance or to illuminate targets that could be engaged by Puma.

Kamfgruppe Uhu was a training unit, there seemed to be only two other units equipped with infra-red. One of these was employed with some success on the Eastern Front using Uhu and Puma in combination; it was claimed that 67 Russian tanks had been knocked out in one night. It was claimed that a lot more infra-red equipment was available but not actually deployed.

ZG.1221 this was a 36-cm searchlight produced experimentally in limited quantities. Part of this designation was probably short for Zielgerät, which is a term that crops up elsewhere, literally meaning aiming device. So the ZG.1221 searchlight was presumably for use with a gun. (See later)

Infra-red binoculars again experimentally produced, consisted of one half infra-red viewer, and the other half of normal optics. It was merely for passive observation, as no infra-red beam was produced. The power supply was carried in a standard type respirator haversack, but it was the smallest of the German infra-red viewers.

Amongst the captured equipment was a steel helmet with special fittings. Perhaps it was comparable to the American Type Z viewer fitted to a helmet for driving which allowed the driver the freedom to look around. There were also three personal cars fitted with systems including a BMW cabriolet.



Surprisingly a right hand drive BMW fitted with Spanner.

INTERROGATION OF INFRA-RED SCIENTIST

In June 1945 Halstead Exploiting Centre published a report on the interrogation of a senior scientist from the Optics Division of the Army Ordnance Office at Hillersleben. This organisation was responsible for drawing up specifications for infra-red equipment, developing training programmes for operators and the preparation of operating instructions. Interrogation of Dr Breunig, the assistant to the head of the department, yielded up some important details of a wide range of equipment.

Infra-red photography equipment used no clever code words. There were thirty or so of the more common models of camera, which were designated according to focal length. These cameras were made by Carl Zeiss and the special film by Agfa Wolfen, their main use was for aerial reconnaissance by detecting changes in building construction, attempts at camouflage, and convoys at sea.

Infra-red signalling was used by the navy and true to form was designated according to an appropriate animal:

Seehund meaning Common Seal, was merely an infra-red source derived from a filter fitted over a normal blinkered fixed searchlight. But portable versions were available:
Seehund II used 12cm optics, but was heavy and bulky.
Seehund III used 5cm optics, and was small and easily handled.
Bildwandler viewers for Seehund were developed by ABC Berlin.

Adler meaning Eagle, was a system of aircraft tracking using a filtered searchlight.

Adler I had a field of view about 12°, which was really too narrow for spotting and tracking aircraft.
Adler II had a field of view about 20°. Around 250 units were manufactured, but only a few deployed. The range for approaching aircraft was 20-25 km, but receding aircraft up to 35 km. It required great skill from the operator but poor weather only permitted usage for 40% of the time. It of course had still to be used with some type of bildwandler. Adler was cheaper than radar so more units could have been employed. It had the advantage that it could be operated when 'Window' radar jamming chaff was being used. This concept of a dual mode detection had been rejected by their British counterparts.

Spanner meaning peeping Tom, was a bildwandler (i.e. viewer) used by both the army and air force. The Luftewaffe used several hundred such viewers for experiments in:

Formation flying with infra-red lights on the fuselage and wings.
Blind landing with infra-red beacons on the ground.
Detecting enemy aircraft by detecting exhaust gases, which give high energy in the far infra-red spectrum.

Kiel meaning Quill, was an airborne bildwandler with a wide spectrum of sensitivity, and would have been better at detecting heat from enemy aircraft than Spanner. It would have been less affected by weather and had a longer range. Although it had some success, many pilots felt it was a complication that took up too much space for the results that it achieved.

Missiles with infra-red homing heads were under development by Plac and HBG laboratories.

Minefield marking was used so that individual troops could cross over at night without the need for a bildwandler. Troops could use a torch fitted with an infra-red filter to identify markers, which would fluoresce when hit by an infra-red beam. The markers were phosphor coated discs of 8 cm diameter placed at 15 metre intervals. Red or green fluorescence could be obtained according to the type of phosphor used. To cut down on the number of markers, an alternative method was to use a filtered searchlight aimed at a phosphor marker. It was then necessary to use a bildwandler in the form binoculars to the follow the beam.

Igle probably should be **Igel** meaning Hedgehog, in the military sense it might mean ‘all round defence' as in a fortified position. But the description given was for a bildwandler system used by the navy, so it probably was derived from **Seeigel** meaning sea-urchin. The lead boat in an assault or ferry convoy would be fitted with Igel Bildwandler, and a rotating infra-red beacon. The other boats had similar beacons, and used the simpler Kater Gerät detector. Even so the beacon could be detected at 1000 metres.

Kikinar seems to have no meaning. I can find no similar German words, which would have any significance. However the system was manufactured by Leitz in Wetzlar, and consisted of a bildwandler with a 40-cm focal length mounted on a tripod up to 100 metres in front of a fortification. A data transmission system gave a pointer display of the target direction within the safety of the fortification. Used with a 150 cm searchlight an impressive range was achieved, larger mirror lenses gave increased ranges:

Bildwandler focal length	Target type
40 cm	AFVs 2 km
60 cm	Ships 10 km
90 cm	Ships 15 km

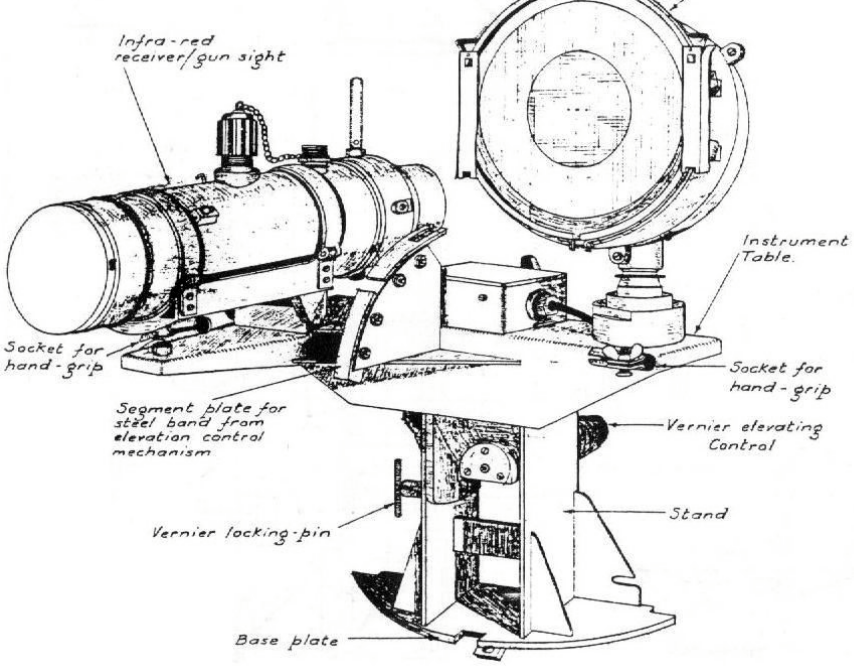
Kikinar was mainly used for coastal watching in conjunction with Donau Gerät. The system had a limited application and only about 30 systems were ordered for use by ground forces and the navy. In the event only about 10 units were delivered.

BG 1251, probably means Beobachtungerät 1251, described as a half-track with a 60 cm anti-aircraft searchlight but with a 40 cm infra-red filter, which rather sounds like Uhu. The bildwandler was of the Adler type. The interrogators were told how five Panther tanks, operating with one Uhu half-track, would be led close to their targets. The tanks could use their individual PG 1250 (=F.G.12/50?) bildwandlers which had a range of only 400 metres.
If this proximity was not feasible the Uhu searchlight could extend the range to 700 metres, when using the PG 1250 in the tank. The viewing range of the Uhu was 1500 metres, as it had the more sensitive BG 1251 bildwandler. The Uhu half-track was also fitted with an 8-cm gun to fire flares, once the target had been identified by infra-red. This meant that a wide range of firepower could be aimed on the enemy using their normal optics. About 600 Uhu systems were ordered, but only about 60 were actually used, and by the autumn of 1945 about 1000 Panthers were equipped with PG 1250.

PG 1252 and **PG 1253** were used only as night driving devices (Nachtfargerät). They were intended principally for supply convoys and could be easily mounted on most trucks. They were used with a 100 watt filtered searchlight fitted with a diffuser to spread the beam; this gave a range of 40 metres. PG 1252 was mounted horizontally, and PG 1253 vertically. Presumably the choice of model used was determined by the space available for a particular vehicle type.

Bildwandler devices for troops were considered in 1940 but at the time the smallest device had a range of only 30 metres. This was thought to be inadequate, but the range was very much related to the power of the infra-red source used. Although a small bildwandler of the ZG 1229 type was made for individual troops for observation and for sniper fire, and had a range of 50 – 60 metres.

ZG 1221, which was mentioned in earlier sources as experimental, was developed for use with the PAK 40 7.5 cm anti-tank gun, which gave a visual range of 400 metres. Although 1000 units were built, they were not used as most of the PAK 40 had been lost on the eastern front.



The Panther tank infra-red set-up, versions of this drawing have been used in a number of books, but this is the original by GSI (Tech) HQ 21 Army Group.

PANTHER TANK EQUIPMENT

21 Army Group had the opportunity to examine the infra-red installation in a Panther tank in July 1945. Early infra-red warfare techniques were developed at Fallingbostel by the Panzer Jager Lehr und Versuchskompanie (Tank Hunting, Training & Experimenting Company) their kit included four Panther Model G tanks fitted for infra-red. On the formation of the infra-red training unit Kampfgruppe Uhu, the soft skinned vehicles were moved with the new unit. However the four Panthers were sent into battle in a daylight role north east of Minden, as a result three were burnt out and the fourth was badly damaged. But sufficient remnants of equipment remained to assess its potential, and a bonus was a crewmember that was available for interrogation. He described Puma as the code word for a Panther tank fitted with infra-red equipment, but Puma was already used as the designation for the 8 wheeled armoured car Sd.Kfz.234/2 fitted with the 5 cm Kw.K.39 gun. But another POW described the Panther tank with infra-red equipment as Sperber, meaning Sparrow Hawk. Sperber is the term that is repeatedly used in post-war descriptions of Panthers.

Sperber kit consisted of a filtered headlamp with a 12 volt 200 watt bulb, bildwandler viewer for use with the 7.5 cm Kw.K.42 (L/70) gun, and a gun elevation control and power supply in the form of 12 volt accumulators, vibrator unit and transformer. In order to keep the accumulators fully charged a 400-watt portable generator was also part of the kit. The main features can be seen in the drawing, the segmental plate accommodated a steel band, which was linked to the gun. This permitted co-ordination of movement between the gun and the infra-red system.

The operation of Sperber was a little complicated. The bildwandler viewer was lined up on a light source at about 600 metres; the gun was lined up using its normal sight. On going into action the steel band indicator linkage was disconnected, the bildwandler viewer and its infra-red lamp were then free to move. Looking through this the commander would give orders to the driver who was driving totally blind. Once ready to engage the target, the tank was halted, the gunner was ordered to traverse the turret until it lined up to the original alignment settings, the steel tape was then reconnected to restore the linkage to infra-red sight and gun. The commander looking through his bildwandler viewer then ordered the gunner onto target. This was a very cumbersome way to engage in night warfare, it would clearly be far if better if the driver and gunner also had night vision equipment. (There are scattered accounts of such set ups in post-war tank books, often they refer to the original system as “Solution A” and a three viewer system as “Solution B”. But no photographs have yet been found to confirm that “Solution B” existed, although there was one photograph published it has since been exposed as a fake!)

In a post-war resume of activities, a veteran of the First Detachment of the Tank-Lehr Regt 130 described the operation of the unit when they were stationed at Fallingbostel from early summer 1944. He said that each of the four tank companies consisted of three platoons with five Panthers each. Each tank had a searchlight for viewing the immediate area, and it was claimed that drivers also had a smaller infra-red device for driving. Each platoon had an APC with a large searchlight for identifying targets for the Panthers. This presumably was Uhu on the half-tracks, but he referred to them as the "Schutzenpanzers", meaning, "tank marksmen". But a major problem was gun recoil and other vibrations, which caused the steel tapes linking the commander's bildwandler to the gun to misalign. In one mock battle, within a few shots being fired from each tank, the disorientation of the guns from their sights required that the exercise be abandoned.

ASSESSMENT OF SPANNER II

The Operational Research Group published their report into Spanner II in November 1946. This was purely a technical investigation, and despite the name of the organisation did not actually cover the operational use of the system.

> **Spanner**, meaning Peeping Tom, was a monocular viewer used in conjunction with visual binoculars.
> **Spanner I** comprised the Bildwandler viewer + infra-red searchlight.
> **Spanner II** was just the Bildwandler viewer i.e. was used for passive detection.

The monocular was 20 inches long and 6 inches diameter with a facemask incorporating a fixed eyepiece. The aperture of the viewer was 8 inches diameter and over that a 9-inch cowl, an internal graticule was illuminated by a 4-volt bulb. Spanner II and the binoculars were both mounted on the central pillar of an anti-aircraft gun. The fact that the power supply could operate on not only 28 volts DC but 220 volts AC as well tends to confirm its role in a fixed location such as an anti-aircraft battery. The bulky nature of the viewer was because a large image tube (bildwandlerrohr) was used; the AEG tube pattern B-102 required 16.4 Kvolts and a rheostat to permit electronic focussing. The overall magnification of the system was 0.8 with a field of vision of 30º, of which 17º was sharp and undistorted. The peripheral distortion was largely due to the curved periphery of tubes like B-102.

I apologise to those German experts who can see spelling mistakes or imprecise classifications, but I have used the names as they appear in the wartime documents. Some names have suffered a degree of dyslexia, such as Muecka (Mücke), Igle (Igel) and I wonder if Bildwandler should be Bildwandeln. Some uncertainty comes from documents that have been transcribed from indistinct microfilm. Particular victims of this uncertainty may be the designation PG.1250, BG.1251, PG 1252, and PG 1253. A post-war assessment mentions the systems F.G.12/50 and F.G.12/50, the letters P, B and F could easily get misread and 125* suggests a certain uniformity of nomenclature which the Germans seemed to like. As you will have seen some later reports add further detail, but some contradict earlier information. I have largely kept information from different reports separate, and if this is confusing then it must surely give the reader the feel of the problems of interpretation that was felt by Allied Intelligence at the time.

Photographs

A search engine will reveal an abundance of pictures of German AFVs fitted with IR equipment. I have not reproduced these here; I have tried to only rely on original material. I apologise for the poor quality of many of the photographs. Some have been taken from photocopies of newspaper articles or technical assessments published in the immediate post-war period. They were supplied by Bart Vanderveen to help me with an article published in *Wheels and Tracks* in 1995. I am unable to ascertain ownership as Bart died in 2001. However I note that many similar photographs are available in high quality from The Tank Museum, Bovington.