

Sheet Key

Each worksheet in the 1939–41 file, unlike other data presented on this CD-ROM, is based on a single documentary source that could not be cross-checked against another. Thus, the information in the three worksheets that make up the 1939 and 1941.xls workbook does not match the criteria and specificity of worksheets for 1942–45. The following lists of documents are the sources of the worksheet in file 1939–41.xls:

1. Sir Charles Kingsley Webster and Noble Frankland, *The Strategic Air Offensive against Germany, 1939–1945*, vol. 4, *Annexes and Appendices* (London: Her Majesty's Stationery Office, 1961), app. 40 and 41, which include Bomber Command (BC) losses and tonnage by month, September 1939 to May 1941, worksheet 1, BC 1939–41
2. RAF Air Historical Branch Monograph, *The RAF in the Bombing Offensive against Germany*, vol. 2, app. U 15, May 1940 to 31 May 1941, worksheet 2, BC 1940–41
3. RAF Air Historical Branch Monograph, *The RAF in the Bombing Offensive against Germany*, vol. 3, app. L1 through L16, *Bomber Command operations by day, June 1941 to December 1941*, worksheet 3, BC June–December 1941.

An explanation for the content of each worksheet's abbreviation; codes, and other designations follows.

Worksheet Columns

The following list of abbreviations spells out the names of countries abbreviated in column A of the worksheets:

Column **A**: countries struck by Anglo-American strategic bombers

Au = Austria
Be = Belgium
Bu = Bulgaria
Cz = Czechoslovakia
De = Denmark
Fr = France
Ge = Germany
Gr = Greece
Hu = Hungary
It = Italy
Li = Libya
Lu = Luxembourg
NL = Netherlands
No = Norway
Po = Poland
Ru = Rumania
Sa = Sardinia
Si = Sicily
Sw = Switzerland
Tu = Tunisia
Yu = Yugoslavia

Column **B**: Air Force codes (numbered air forces or commands employing strategic bombers)

- 8 = US Eighth Air Force (United Kingdom)
- 9 = US Ninth Air Force (North Africa only)
- 12 = US Twelfth Air Force (November 1942–October 1943)
- 15 = US Fifteenth Air Force (Italy)
- BC = RAF Bomber Command (United Kingdom)
- 205 = RAF 205 Group (North Africa and Italy)

Column **C**: City

When a slash (/) follows city name, the information after the slash refers to a specific industrial firm, rail yard, airfield, or refinery targeted by bombers.

Hamburg/Blohm & Voss:	U-boat builders in Hamburg
Münich/BMW:	engine manufacturer in Munich
Sindelfingen/Daimler-Benz:	aero engine manufacturer in Sindelfingen
Leipzig/east:	Leipzig east rail yard
Cologne/Ford Motors:	Ford Motors of Europe; plant in Cologne
Münster/Handorf:	airfield near Münster
Rostock/Heinkle:	aircraft manufacturer in Rostock
Nürnberg/Henschel:	armored fighting vehicle plant in Nürnberg
Leverkusen/I.G. Farben:	German chemical combine facility in Leverkusen
Essen/Krupps:	steel and armaments manufacturer in Essen
Augsburg/Maybach:	tank engine plant in Augsburg
Rüsselheim/Opel:	General Motors of Europe plant in Rüsselheim
Endhoven/Philips:	Philips Electronics Corp. plant in Endhoven
Harburg/Rhenania:	major oil firm refinery in Harburg
Frankfurt/Siemens:	electrical equipment manufacturer in Frankfurt
Berlin/Tempelhof:	airfield in Berlin

This work uses the spellings for European cities designated in American mission and targeting reports. British and contemporary European spellings are ignored, hence Nürnberg, not Nuremburg.

Column **D**: (Date): The day the attack took place. In the case of night raids, the date refers to the evening of the attack and not to the early morning of the next day. For example, an operation taking place on the night of 29 February and 1 March 1944 would be recorded under the date of 29 February 1944 (February 29/1). All dates are given in American style (month/day/year: 2/29/44 or February 29, 1944).

Column **E**: Target Struck (see “General Information” at end of key)

The Target Struck column divides, and usually subdivides, the European target base into one of the following strategic categories:

- AAA: antiaircraft artillery
- A/F: all airfields, seaplane bases, airdromes, landing strips, etc.
- A/I: aircraft industry
- A/Iasy: aircraft assembly plant
- A/Icomp: aircraft component plant
- A/Ieng: aero engine plant
- A/Irep: centralized repair and maintenance facility

When a specific aircraft designator (Me-109, Fw-190, He-177) follows one of the above, it denotes that the facility is devoted to that type of aircraft. “A/Iasy Me-110” denotes an assembly plant for Messerschmitt 110s.

- Alum/P: aluminum plant
- Armaments: artillery, machine guns, small arms, and associated production
- Barracks: barracks and associated military bases
- Bearings: Axis ball-bearing production
- Canal: canal struck by bombing or mining
- Carpetbagger: Eighth Air Force special operations missions in support of resistance movements in occupied territory
- C/C: communications center; town serving as a support center for enemy military operations
- Chem/P: heavy-industrial chemical plants and associated production
- Coking/P: coking plants associated with steel, but also used in producing benzene oil
- Dam: dam struck by bombing
- Explosives: explosives manufacturing plants
- Fleet: surface warships or invasion barges of the German and Italian navies
- F/Y: rail freight yard (15th Air Force only)
- Hutted camps: suspected temporary military housing
- Hy: highway
- Hy/BR: highway bridge
- Hy/Choke: highway choke point suitable for bombing
- Hy/Via: highway viaduct
- I/A: industrial area, industrial section of city or town
- Leaflets: Allied leaflet dropping on European targets
- Loco Wks: construction, maintenance, and repair facilities specializing in locomotives
- M/Y: marshaling yard
- MCG/A: military and civilian government area, administrative center of Berlin (only)
- Metal/Wks: specialized metal working, such as engine castings
- Mining: RAF mining operations
- NB: Noball, American code word for bombing V-1 associated targets
- NB/Cons: V-1 related construction
- NB/LrgSiteCons: construction at “large” launching sites
- NB/SkiCons: construction on Ski Site launchers
- NB/V-Site: operational V-Site
- O: oil industry
- O/R: oil refinery

O/St: oil storage
 O/Ben: synthetic oil (benzene)
 O/Sy: synthetic oil (Fischer-Tropsch or Bergius)
 Omitted: city-area attack on occupied country (Bomber Command only)
 Ord/D: ordnance depot
 Ord/D tanks: AFV depot
 Ord/D artillery: artillery park
 P/A: port area, docks, shipping, warehousing, etc.
 Power Station: usually a key electric generating facility
 RR: railroad targets
 RR/Junc: railroad junction, usually with accompanying facilities
 RR/Br: railroad bridge
 RR/Choke: railroad choke point, suitable for bombing
 RR/Fac: repair and maintenance facilities associated with a marshaling yard
 RR/Via: railroad viaduct
 RR/Shops: railroad maintenance and repair facilities
 RR/Sta: railroad passenger station
 Red Stocking: Eighth Air Force intelligence support operations into Germany
 Special operations: missions in support of resistance movements and Allied clandestine and intelligence activities
 Steel: steel works, associated mills, and collocated industry (forges, presses, etc.)
 T & M: transportation and morale (Bomber Command strikes on German transportation and workers' housing in 1941)
 T/O: target of opportunity
 T/T: tactical targets, usually frontline enemy troops
 T/T (M/Y): M/Y struck to support army operations
 T/T (City): city area struck to support army operations
 T/T Coastal Installations: Axis coastal defenses, usually gun batteries
 T/T Defended Localities: fortified villages forming part of enemy front line
 T/T Strong Points: casemated forts
 UB: German submarines (U-boats)
 UB/Yards: shipyards building U-boats
 UB/Pens: massive hardened concrete shelters for U-boats
 UB/Base: U-boat support facility without pens

Column **F**: sighting (see "General Information" at end of key)

Aphrodite: AAF radio-controlled, war-weary aircraft filled with explosives
 Azon: AAF radio-controlled bomb tail allowing only lateral control after release
 Gee: ground-controlled radio beam useful for aerial navigation but short-ranged
 Gee (N): night ground-controlled radio beam; could not reach beyond the Ruhr (from England); susceptible to jamming
 GH: a ground-air two-way radio beam system, capable of controlling more aircraft than Oboe
 GH (N): night two-way radio beam not altitude dependent as was Oboe
 H₂S: aircraft-carried centimetric wavelength bombing device; could detect built-up areas through all cloud cover
 H₂S (N): night H₂S radar, good returns over water and coast, detectable by Germans

H₂X: American-built H₂S; accuracy improved with amount of visual sighting on bomb run
H₂X (N): night H₂X
LL: low-level (under 8,000 ft.) sighting and bomb release; very accurate; costly in aircraft
Loran: much-improved Gee; 10-mile error at 1,000 miles
N LL: night, low-level sighting and bomb release
MH: American combination of "H" (air-to-ground station plot) and H₂X
N ML: night, mid-level (8,000 to 15,000 ft.) sighting and bomb release
Oboe: ground-controlled radar bombing; temperamental but highly accurate; could control only a limited number of aircraft
Oboe (N): night, ground-controlled radar bombing; jamming and range limitations
TV: experimental bomb using TV guidance
Vis: visual sighting
Vis (N): night visual sighting
Vis (L): daylight leaflet dropping
Vis (NL): night leaflet dropping
Vis (MN): night mining
Vis/DR: visual release using dead reckoning navigation or estimated time of arrival (ETA); highly inaccurate
Vis/DR (N): night dead reckoning or ETA bomb release; highly inaccurate
Vis (S): daylight supply operations and/or supply drops
Vis (SO): daylight special operations
Vis (NSO): night special operations

Column **G** (Atk): The number of aircraft reported to have actually attacked the target; not the total number of aircraft dispatched or taking off to attack the target.

Column **H** (Lost): The AAF counted all lost aircraft and their bomb loads as part of the force attacking the target. The RAF reported all lost aircraft and bomb loads as having failed to reach the target until the fall of 1943, when it switched to the American practice. This figure includes only bombers lost in combat, not aircraft that crashed on take-off, landing, or collision, or were lost to weather or written off as unusable after their return.

Column **I** (H.E.): high-explosive bombs reported released over the target in short tons

Column **J** (I.B.): incendiary bombs reported released over the target in short tons

Column **K** (Frag): fragmentation bombs reported released over the target in short tons

Column **L** (Total): bomb tonnage in short tons of all types reported released over the target

Column **M** (Msn): Eighth Air Force mission number or Bomber Command night raid report number assigned to a specific attack. If no numbered mission is listed, then raid is designated as daylight “D” or night “N” attack mission.

Column **N** (Area): gives letter code for type of area or city bombing or denotes special bombing operations:

- A: “area-like” raids; flown by the US Eighth and Fifteenth Air Forces, 100 or more heavy bombers, bomb mix of at least 20 percent incendiaries, and sighted by H₂X
- C: city-area bombing; ordered or authorized by directive or numbered air force
- F: missions flown as part of Operation Frantic (US shuttle-bombing missions to the USSR)
- H: night harassment raids flown by RAF against German and Italian cities
- HP: HALPRO mission flown by Americans against Ploesti
- O: opportunity city-area bombing, conducted by individual formations and crews following initiative granted by AAF or RAF policy
- R: city-area bombing requested by friendly ground forces or partisans

General Information

Column **E** (Target Struck): This category requires detailed explanation. The RAF and the AAF followed distinctly different practices in allowing aircraft to deviate from the intended target. With few exceptions, RAF Bomber Command’s aircraft always struck at least in the vicinity of their planned target, or withheld their bombs. Large numbers of Bomber Command aircraft did not divert to an alternate target during night raids. In the case of Bomber Command, the “target struck” is virtually always the primary target it set out to hit. The Americans adopted much different tactics. Their strategic bombers, from whatever numbered air force, almost always left base with one or two or more alternative targets. If, as it too often happened, weather conditions or other circumstances prevented attack of the primary target, American bomber formations had the freedom to attack any of their alternatives, or even any target of opportunity that presented itself. Thus, the target struck by American bombers may have had little relation to the mission planners’ intended target.

Column **C** (Target Category): City also demands explanation. An attack on a city meant the deliberate use of area bombing techniques on an urban area with the primary intent of attacking the city’s population rather than its military targets, if any. Here again, the Americans and British followed separate although related paths. In July 1941, the British government instructed Bomber Command to bomb German cities for the purpose of lowering the morale of and de-housing the German labor force. Although Bomber Command gained additional duties as the war progressed, its commander, Air Chief Marshal Arthur T. Harris, continued to pursue the July 1941 directive, which the British govern-

ment did not rescind until April 1945. Given the nature and tenor of the Bomber Command night reports, which cover all night missions for Harris' tenure, one must conclude that any RAF raid upon a city that did not cite a specific target as its goal was a city raid. I use that criterion in assigning city "targets struck" for Bomber Command. At the highest levels the AAF refused to acknowledge that it engaged in city bombing. However, the records of the US numbered air forces in Europe, in spite of the policy discouraging the designating of specific bombing as city, contain numerous examples of urban strikes. The author takes the AAF at its word. If an AAF, group, wing, air division, or numbered air force report (the author has personally examined all the available mission folders for each air force) designates a raid as a city or town strike, it is counted as such. This method has unearthed many unacknowledged city attacks.

American city bombing entails further caveats. The Eighth Air Force's most comprehensive target summary, prepared in May 1945, does not acknowledge a single instance of city bombing by American aircraft. It systematically changed city raids theretofore carried on Eighth Air Force books to other target categories, usually industrial areas (I/A). All raids on Berlin became raids on the military and civilian government area (MCG/A). These missions were left "as is" rather than arbitrarily changed back to city raids. However, for Eighth Air Force raids, the reader should check column **N** for a city bombing type designation. If the city has such a notation, then the reader should be aware that the men who flew the mission filed official reports describing it as a city raid. The author included only raids in which AAF reports specifically listed a city, town, or village (and no specific military target therein) as a city target. He excluded many combat reports that described identical damage but professed to have been aimed at a bridge or rail yard.

Bomber Command monthly summaries also contain an interesting official discrepancy. Although Bomber Command can account for the target of every ton of bombs dropped on Germany proper, for bombs dropped on German-occupied countries, it sometimes lists no target. After puzzling over this and taking note of Bomber Command's treatment of bombing French towns on the nights of 5 and 6 June 1944, the author concluded that as a matter of policy, Bomber Command did not acknowledge attacks on city areas in occupied Europe. When a Bomber Command target is listed as omitted, it refers to this specific policy.

In the course of compiling this chronology, three distinct classifications of city raids emerged: *command*, *opportunity*, and *requested*. A *command* city raid usually consisted of a force of several hundred bombers, specifically ordered by a higher headquarters, usually at the air force level, to attack a city area or a city, either as the primary, secondary, or alternative target. This often depended on the weather encountered. For example, marshaling yards in Vienna might be the primary target if weather offered visual bombing opportunities. If clouds prevented visual sighting of targets, which forced the bombers to revert to the extremely inaccurate radar bombing device (H₂X), orders specified attacking the city of Vienna as a secondary target. Command raids have the full sanction of AAF authorities. Given Harris' directive on morale bombing and Bomber Command's practice of carrying through to its primary targets (not to mention the designations of targets contained in its own records) virtually all Bomber Command city raids were command raids. An *opportunity* city raid could consist of anywhere from hundreds to as few as one bomber. In some cases a formation of bombers would arrive over its *target*, let's say the I. G. Farben chemical plant at Ludwigshafen, and find it cloud covered. Rather than search for the designated secondary target, the formation might well bomb through the clouds. On other occasions weather, opposition, or faulty navigation

might scatter a large formation, sending wings, groups, squadrons, and even individual aircraft throughout Germany (the AAF had a strict policy of not seeking targets of opportunity in countries occupied by the Axis) looking for holes in the clouds and worthwhile targets for their bombs. This roving brief to attack German targets sometimes resulted in the misidentification of targets and the unintentional bombing of Switzerland and occupied countries. Although the crews followed approved AAF policy in seeking targets of opportunity, they had to bear some responsibility for the specific targets they selected. *Requested* city bombing was by far the least common form of such bombing. For the Fifteenth Air Force it consisted of 27 missions, none larger than 42 bombers, in Yugoslavia. From May to November 1944, at the direct request of Marshal Tito's partisan forces, US bomb groups struck towns and villages, such as Bihac and Banja Luka, said to house German forces. Eighth Air Force and Bomber Command raids on French towns on the night before D-day, ordered by SHAEF and AEAFF, and Bomber Command raids on German cities in the fall of 1944 and winter of 1945, requested by 21st Army Group and SHAEF, also fall into this category.

Column **F** (Sighting): The method of bomb sighting, in conjunction with such variables as weather (wind, cloud cover, temperature, etc.), nature of the opposition, and ballistic properties of ordnance, determines bombing accuracy. Limitations in bomb sighting methodology also directly affect operations and tactics. The Butt Report of August 1941, which revealed the abysmal accuracy of Bomber Command's attempts to hit individual strategic targets in Germany, led to the July 1941 directive that Bomber Command switch to morale bombing. On the other hand, Bomber Command's highly accurate bombing of French rail targets in the spring of 1944 (plus its defeat in the Battle of Berlin), led to its assuming the largest portion of the transportation plan bombing. Likewise, the Eighth Air Force persisted in its doctrine of daylight precision bombing, which excluded city bombing by definition, as long as it possessed only the Norden visual bombsight. When the H₂S and H₂X radar bombing devices arrived (along with its defeat in battles at Schweinfurt) in the fall of 1943, the Eighth took advantage of its new capability by launching a series of daylight city bombing raids over completely cloud-obscured targets.

The AAF and the RAF used distinctly different methods of sightings for air attacks. Unlike the AAF, Bomber Command did not fly in formation—a highly dangerous procedure at night. Rather, each British bomber, following a predetermined course, flew separately to its target. This produced a strung out mass of aircraft, appropriately called the bomber stream. Because the difficulties of night navigation interfered with attempts to mass the bomber force over a particular target or aiming point, Bomber Command soon developed methods for marking the target with an assortment of aerial and ground flares that would lead the main force of bombers to the objective. Night operations also reduced the ability to locate targets of opportunity and, perhaps, encouraged aircrews to continue to the target. As the marking system grew and the Pathfinder force developed, it incorporated airborne controllers and numerous “backer-uppers” who would keep flares burning throughout the attack or correct for misplaced flares. The main force, according to its instructions, would sight and bomb on sky flares, ground flares, if visibility permitted, or the glow of flares through the clouds. Although many of the main-force bombers had H₂S equipment as well as the capability to plot Gee fixes, all of which they needed to navigate to the target area, the sighting method of the Pathfinder force, plus the uncontrollable variables, ultimately determined the accuracy of any given raid. Therefore, the Bomber Command sighting method cited in this chronology is that

used by the Pathfinders, not the main force. Eventually RAF marking became so well organized and sophisticated that, by September 1944, its night bombing exceeded the accuracy of AAF day bombing.

In addition to H₂S's poor return over built-up areas, the emissions coming from it were almost a fatal flaw for the bombers. The Germans developed two methods of tracking its emissions. The first, the Naxos radar receiver, equipped individual night fighters and submarines (tracked by air-to-surface radar). It had a range of 30 miles and came into operation in January 1944. It greatly reduced the interception problem of the night fighter pilots, allowing them to infiltrate the bomber stream, but not to identify individual aircraft. Bomber Command concluded that an individual aircraft carrying H₂S was in no greater danger than one unequipped with the device. It did not impose a partial H₂S silence until the autumn of 1944. By the end of conflict almost 1,500 night fighters had Naxos installations. Given the cranky nature of the H₂S equipment, standard procedure called for almost constant monitoring of its status. If the bombers used it for navigation, it would remain on continuously. Second, the Germans developed a ground-based detection device known as Curfew and deployed it throughout western Germany. Curfew had the capability of detecting H₂S transmissions from bombers parked in their English bases and could plot the bomber stream from takeoff to landing.¹ The Germans also used it to protect their synthetic oil plants by detecting the H₂X on attacking American bombers and then using that information for ranging and directing antiaircraft artillery.²

RAF 205 Group also employed Pathfinders and some radar aids. However, because of the little effective opposition it encountered, that force consistently flew at far lower altitudes (under 10,000 ft. but often under 8,000 ft.) than any other strategic bombing force. This gave it higher accuracy and more visual sighting than other commands.

Daylight presented the AAF a far different problem. Although the RAF deployed Gee in the spring of 1942 and H₂S a year later, the Eighth Air Force did not receive its four H₂S sets until late September 1943, and a dozen H₂X sets arrived only in early November 1943. It had no additional sets until spring 1944. The Fifteenth Air Force did not receive H₂X until late April 1944. The heavy bombers of the Ninth and 12th Air Forces never employed radar- or ground-controlled bombing techniques. No radar-controlled bombing meant total reliance on visual sighting and left the bombardiers at the mercy of the cloud and haze conditions over their target. Of the Eighth Air Force's first 103 missions (August 17, 1942 through September 26, 1943), all dispatched without radar, weather over the target forced the recall or substantially interfered with bombing for 22 of them. In addition, forecasts of unsuitable weather over targets either led to the dispatch of missions against lesser priority targets or failure to send out any mission at all. The advent of H₂S/H₂X in the Eighth revolutionized its sighting, targeting, and operations.

The radar-bombing devices (the AAF never called them radar bombsights) greatly increased the operations tempo by allowing bombing through overcast. As long as weather over the bases permitted takeoff and landing and conditions along the route and over the target allowed formation flying, the AAF could strike its selected target. Of course, H₂X's poor resolution over land and large cities did not permit it to sight pinpoint or precision targets. Even synthetic oil plants covering a square mile of ground did not present satisfactory images on the radarscope. However, H₂X could pick up a built-up area (city), and a well-trained operator might be able to orient himself to select a large aiming point, the choke point in a marshaling yard, for bomb release. For maximum accuracy the H₂X required a lengthy bombing run. Both the H₂X operator and the bombardier at the visual sight, who fed the H₂X operator's instructions into the sight, cooperated throughout the bomb run. On many occasions patches in the clouds, or a last-

minute clearing of clouds, would allow the bombardier to make much more precise visual corrections and achieve far greater accuracy.

Radar also furthered a trend in sighting used by formations already underway in the Eighth. During its first year of operations, bomb damage assessment photos revealed problems with the concentration of bombs on target. In a group formation, if all bombardiers, all of different skill levels, individually performed all the corrections for range, deflection, and so forth, the bomb pattern tended to become diffuse and therefore less damaging to the target. The movement of individual aircraft as they danced to each bombardier's corrections simultaneously increased the danger of collision within the formation and spread out the formation. To achieve a concentrated bomb pattern and a reasonably tight formation, the Eighth began to designate their most proficient bombardiers as squadron and group leads. They would head the formation and make all bomb-sight adjustments, including drift and rate. The aircraft following would maintain formation on the leader, while their bombardiers adjusted for rate (range) only. When the lead bombardier toggled his bombs, the rest of the formation would also release. In early 1944 radar aircraft began to lead large formations (two groups or more), all of which dropped on the lead bomber. The Americans continued the practice of dropping on the lead bombardier, even in visual conditions, until the end of the war. After September 1944 Bomber Command, in at least some instances, adopted a modified version of this practice for its large daylight raids.

Columns **I** (H.E.), **J** (I.B.), **K** (Frag), and **L** (Total): Tonnage is given in short tons (2,000 lbs.). British tonnage has been converted from long tons to short tons (B x 2,240/2,000: A). "A pound is a pound, the world round," but a ton isn't necessarily a ton. The RAF did not routinely use fragmentation bombs, and when it did it appears to have used weapons supplied by the AAF.

Column **M** (Mission): Eighth Air Force mission numbers and Bomber Command night raid report numbers are supplied to give precise identification to the referenced raids. Night and day references are to aid the reader in determining when during the 24 hours of the day a raid occurred.

Terminology

"Omitted," "not given," and blank cells (no text in the column) have specific meanings. *Omitted* was used by Bomber Command to conceal collateral damage or city bombing committed in an occupied country. *Not given* means that the author of this work could not determine the item (sighting, target, etc.) from available documentation. A blank cell signifies that the author could find no documentation or only very fragmentary information on this item. A worksheet entry containing an asterisk denotes a citation (in cell format) to a document or to an unusual circumstance applying to that worksheet cell entry. Worksheet notes are found in the section of the text directly following the end of the corresponding monthly worksheet. The bulk of the worksheet citations refer to the official documentation designating a raid as a city-area raid.

Notes

1. Charles Webster and Noble Frankland, *The Strategic Air Offensive against Germany, 1939–1945* (London: HMSO, 1961), IV, 13.
2. Roger Freeman, *The Mighty Eighth War Diary* (London: Jane's Publishing, 1981), 362.