

# Minesweeper Rules

## Object

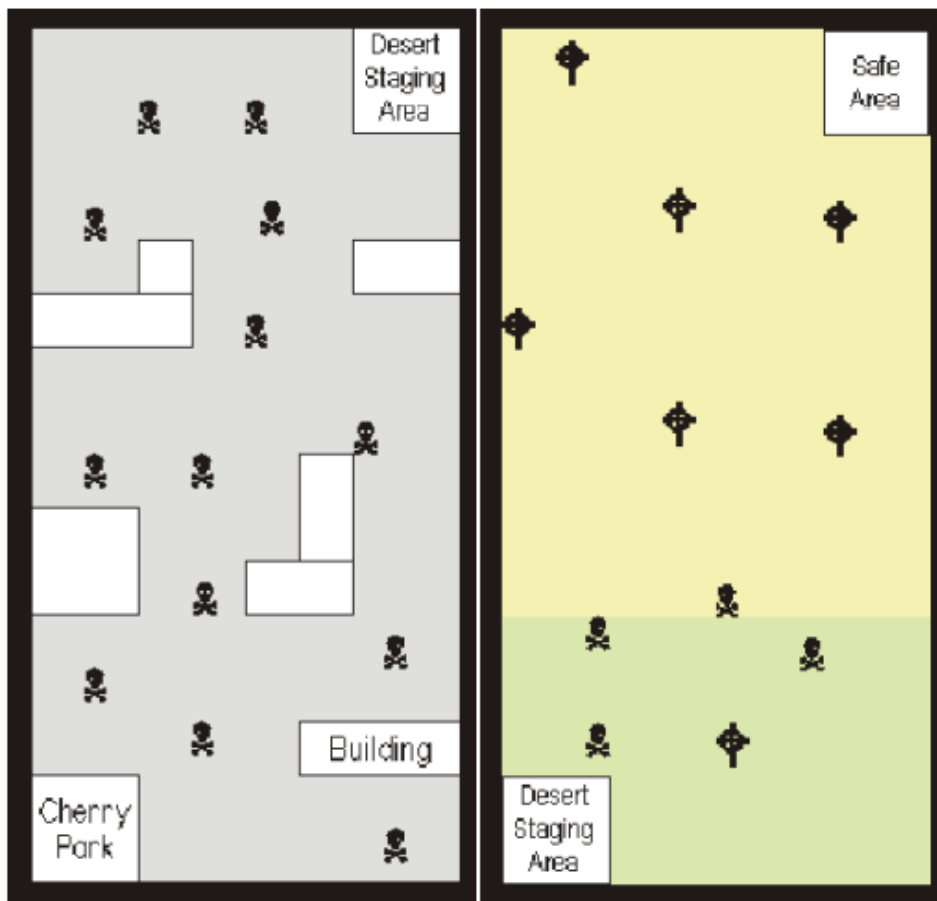
The object is for your minesweeper robot to remove unexploded bombs (UXB's) in Bellum City, and then to travel through the deadly Wgasa Desert (pronounced Wa-ga-sa), and flag all mines (preferably without setting the mines off, if you don't mind).

## Arenas

There are two arenas, Bellum City and the deadly Wgasa Desert. Each arena shall consist of a 4' x 8' sheet of unfinished plywood, with 1.5" x 3.5" walls on the perimeter. The robot is required to attempt both surfaces (the city stage first).

You will deploy your robot in the launch area, a 30 x 30 cm square in the southwest corner of the arena, and proceed to its destination, a 30 x 30 cm square, in the northeast corner.

The actual arena layout will not be announced until Game day, but would look something like this:



# WCRG 2012 MINESWEEPER REV0

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## Bellum City

Bellum City has a plywood surface only. The City has some obstacles such as buildings, stones, brick, and other objects which may be found on the ground (the smaller objects may be up to 4mm in size). The gaps between the buildings are at least 30 cm. The buildings are at least 10 cm high. The buildings are at least 30 cm x 30 cm in size, and are made from 12 mm particle board.

## Wgasa Desert

The deadly Wgasa Desert is another story! It begins as "grass" (a fine nap carpet), but quickly degenerates to a sandy surface, with small dunes ranging in size up to 2". The dunes are made of sand and loose material.

## Mission

You will have 3 minutes to complete each stage of the mission. Once your robot arrives at the destination area in the northeast corner, that stage is concluded (i.e. your robot may not enter and leave the destination area). So your mission ends as soon as you enter the destination area.

### Stage 1 - City Mission

Your robot will be landed in Cherry Park in the southeast corner of Bellum City. Your robot must leave Cherry Park, navigate through the city, and rendezvous at the Desert Staging Area. While en route, it must collect as many unexploded bombs (UXB's) as it can, and deliver them to the Desert Staging Area.

Reconnaissance reports that the pavement is in fair condition, with minor irregularities due to military action. Minimize any further damage to city buildings (that means don't knock them over or move them from their foundation!). It is also reported that there are 15 UXB's to be collected.

If you wish to supply a homing beacon, it can be air-dropped at the Desert Staging Area.

### Stage 2 - Minefield Mission

Your robot should detect and flag all the mines it can find without detonating them (that's WITHOUT detonating them!). Rendezvous at the Safe Area on the northeast side of the minefield, and deliver the UXB's after flagging all the mines. Your robot is allowed to sweep the mine field without attempting to flag the mines, (but for a lower score, as flagging the mines gives a lot of points).

Reconnaissance indicates that the ground conditions vary from grass in the south to predominately sand dunes of varying depths, with some small boulders and other natural hazards in the North (don't forget your sand equipment!). It was also reported that there are 8 mines to flag, and 8 UXB's to collect.

The robot must flag each mine in any non-destructive and non-permanent way you choose (e.g. a flag or ball, but not paint). The marker must fit inside a 45mm cube. At least part of the marker must lie within a circle with a radius of 50mm from the center of the mine. A judge may disqualify any marker if, in his opinion, it was not placed deliberately on a mine (if a flag is placed more than 50mm from a mine, deliberately or not, it will lose 10 points as shown under Scoring).

After the city stage, you will have 3 minutes to prepare your robot for the desert stage. You may reprogram or reconfigure your robot for the desert. You may detach pieces and leave them at the

# WCRG 2012 MINESWEEPER REV0

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Desert Staging Area, but you may not add any pieces (i.e. all pieces of the robot must be carried through the city by the robot). If you wish to supply a homing beacon it can be air-dropped at the Safe Area.

## Intelligence Reports

### Unexploded Bombs (UXB's)

The UXB's consist of the magnetic "flasher lights" found in many novelty stores, and at the Robot Games in 2003. Each UXB has a neodymium iron boron magnet, with a strength of approximately 2.2 Mega Gauss Oersted's (MGOe), 3/8" dia. x 1/10" thick, attached to the bottom of the UXB. Each UXB is 7/16" in diameter x 1/2" tall, and weighs 5.4 grams. Each UXB also has two light emitting diodes (LED's) flashing alternately at 2.5 Hz, and at a brightness of 20 Millicandelas (mcd).



Be careful! These babies are more deadly than they look.

### Landmines

The mines consist of a 9V battery with a 38.5 kHz infrared (IR) transmitter LED. The frequency of the mines will be adjusted to match the response of the popular PNA4602M (38 KHz IR Detector), from Panasonic. The PNA4602M contains all the circuitry needed to decode IR remote signals used by most consumer electronics devices (stereos, TVs, VCRs etc.). The IR signal is constantly on, modulated at 38.5 kHz, so it will trigger the output of the sensor when a mine is getting close. The mines will also have a spring loaded vertical trip wire which will trigger when the mine is touched. The wire will extend up 4 cm from the surface of the sand (3 cm from the top surface of the mine). The IR LED will be on the circuit board (not on the trip wire).



PNA4602M (38 KHz IR Detector)



Typical Land Mine

There will be 8 land mines in the Wgasa Desert. These mines may be placed loosely on the surface or buried just beneath the surface with the transmitting IR LED exposed.

## Robot Specifications

Your robot must fit entirely inside the launch area (30 x 30 cm) at the start of the match, but may expand once the match begins.

The robot must be fully autonomous. However, the operator may place a stationary homing beacon (bright light, IR, radio, etc.) on or behind the destination area, before the beginning of the match. Once placed the beacon may not be touched.

**Your robot must be safe, and must comply with the “General Rules for All Robots”.**

## Scoring

The following point system will be used to score the missions:

### Points

- 10 - Per foot of distance covered to the destination area in the northeast corner. Maximum 70 points.
- 20 - For arriving at the destination area.
- 25 - For each mine flagged.
- 10 - For each UXB collected by the robot and still held at the end of the time limit, whether the robot makes it to the destination area or not (0 points if the robot drops the UXB somewhere outside the destination area and does not pick it up again).

### Penalties

- 25 For each mine detonated.
- 10 For each flag that is dropped more than 50mm away from any mine.
- 25 For each building knocked over or moved from its foundations.
- 25 For each human intervention. The robot may be lifted and rotated, but not moved from its current location.
- 20 For use of an unmodified kit.

### Bonus Points

- 50 - For completing the desert stage without tripping any mines.
- 100 - For flagging all the mines and not putting any extra flags down.
- 25 - For collecting all the UXB's.
- 1 - For every 5 seconds the robot arrives at the destination before 2 minutes (120 seconds), for each stage.
- 50 - For a walker completing the course.
- 50 - If your robot carries a system to attempt to mark the mines.

## Prizes

A robot must score at least 25 points to be eligible for a prize.