

# Overview of Korean Test code for Combine Harvesters

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# 1 SCOPE

- Test procedure and requirements for **self-propelled head feeding** type and **whole feeding** type combine harvesters



Head feeding type  
for rice



Whole feeding type  
for Soybean, barley, Rapeseed

# 2 TERMINOLOGY

- Terminology regarding **Grain loss** and **damaged grain** e.t.c. is defined

- Verifying the mechanism, dimensions, materials and accessories of the combine harvester.

Specifications	
Dimensions	Length w/o header to auger end, mm
	Height in transport, mm
	Weight with tires, kg
Engine	Rated power, kW
	Maximum power, kW
	Number of cylinders
	Piston displacement, L
	Rated speed, rpm
Header	Header widths, m
	Cut frequency, strokes/min
Feeding System	Number of chains
	Slat design
	Reverser drive type
	Torque-sensing drive available
	Housing lateral float available

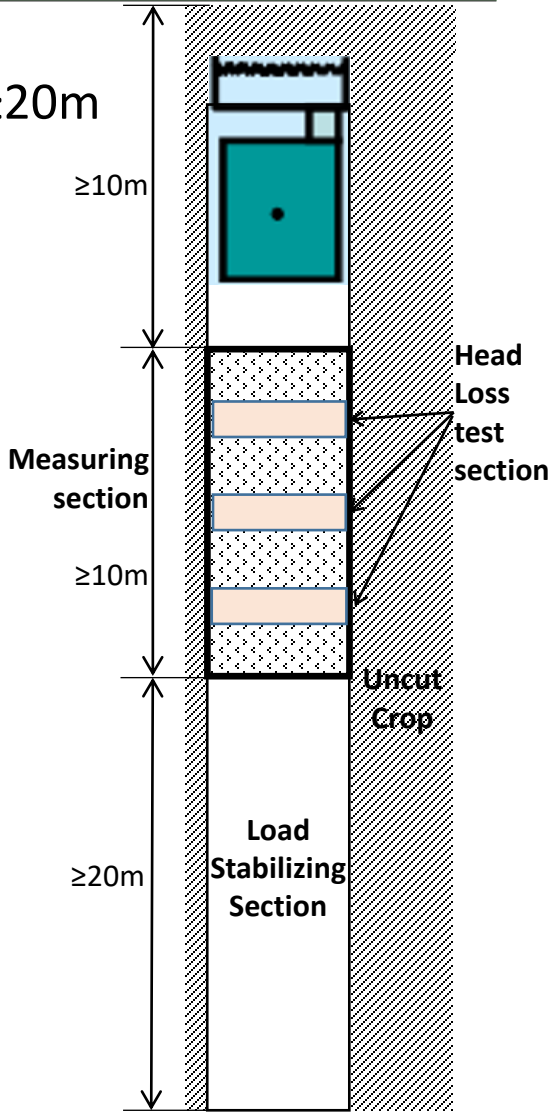
Threshing & Separating System	Number of threshing cylinders
	Cylinder width, mm
	Cylinder speed rpm, diameter
	Cylinder speed control
	Concave wrap angle, °
	Concave area, m <sup>2</sup>
	Beater speed rpm, diameter
	Separating cylinder width, mm
	Separating cylinder diameter, mm
	Total separating area, m <sup>2</sup>
Separating Straw Walkers	Number of straw walkers
	Number of walker steps
	Straw walker length, m
	Straw walker area, m <sup>2</sup>

Cleaning System	Leveling system
	Total sieve area, m <sup>2</sup>
	Total cleaning area, m <sup>2</sup>
	Fan type
	Fan speed, rpm
Grain Handling System	Tailing elevator type
	Clean grain elevator type
	Grain tank capacity, L
	Tank unloading rate, L/s
	Unloading auger length, m
St'd unloading height, m	
Crop Residue Disposal	Straw chopper
	Straw spreader
	Chaff spreader
	Quick switches
	chopping/swathing

Power Train	Drive type/number of gears
	Ground speed, km/h
	Transport speed, km/h
	Brakes, turning against
	Brakes parking
Steering	Final drive type
	Tread width, adjustable axle, mm
	Tread width, rear wheel assistance, mm
	Standard steering type
	Turning radius, mm
Tires	Drive tire size
	Steering tire size
Cab	Operator seat suspension
	Instructor/passenger seat
	Control, position
	Monitor
	Heating, Automatic air conditioning

	Conditions	Check and Report
Crop	<ul style="list-style-type: none"> <li>▪ <b>Good condition</b> (uniform, normal MOG:G ratio, free of disease·weeds, standing, matured, moisture content of rice <math>\geq</math> 20% w.b.)</li> </ul>	Variety, maturity, disease, plant height, <b>Max·min ground height of grain</b> , moisture content of grain, grain weight per stem, populations (row·hill distance, rice stems/hill, plants/m <sup>2</sup> ), stem angle, pre-cut loss, others
Field	<ul style="list-style-type: none"> <li>▪ <b>Fairly</b> flat and no serious surface irregularities</li> </ul>	Flatness, surface regularity, dryness, soil hardness, weeds, others
Atmosphere	<ul style="list-style-type: none"> <li>▪ Preferable and stable</li> </ul>	Temperature, humidity, wind
Machine	<ul style="list-style-type: none"> <li>▪ <b>Optimum setting</b></li> <li>▪ Adjustment of the threshing, separating, clean mechanisms shall be permitted only between test series</li> </ul>	Selected forward range/gear, adjustment position of each part, others
Operator	<ul style="list-style-type: none"> <li>▪ <b>Well-experienced</b></li> <li>▪ Adequate time for adjusting</li> </ul>	Operator and guider, and their roles

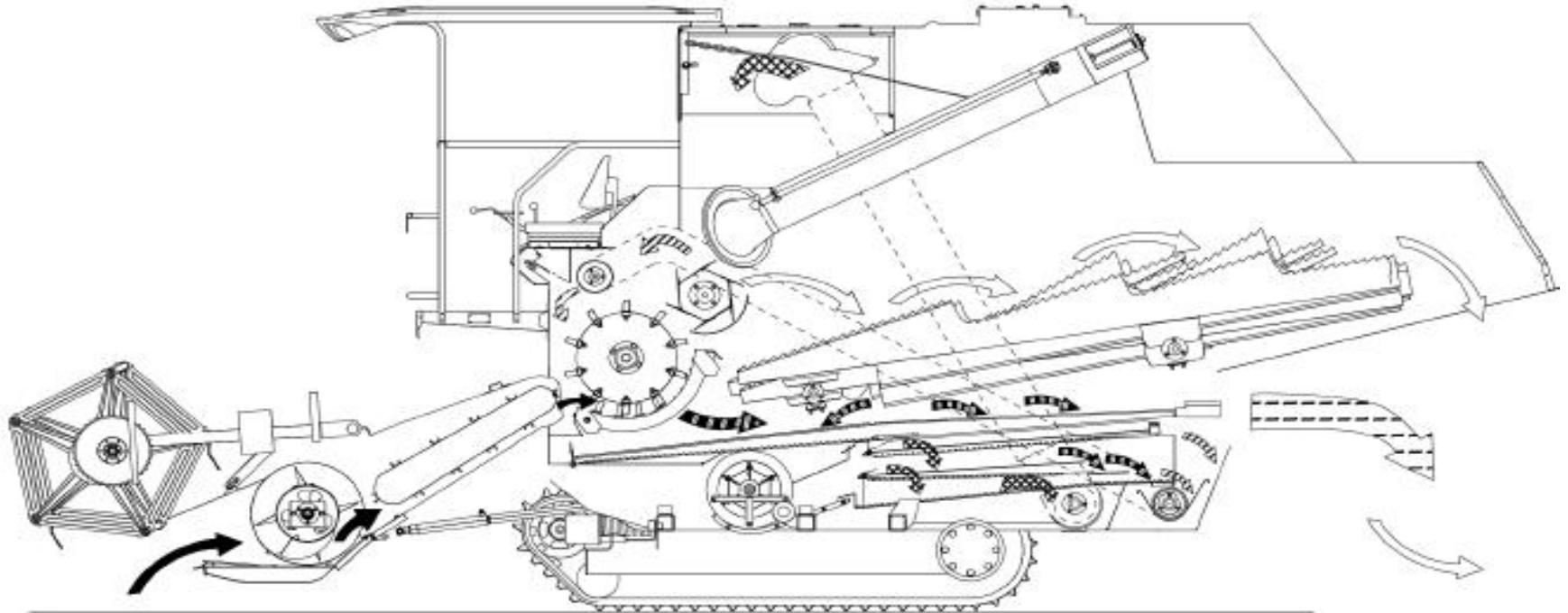
- Conditions for Grain loss, purity, damage test






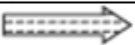
Combine operation	Test Field
<ul style="list-style-type: none"> <li>3 test series per ground speed levels: Min(0.4m/s), Mid, Max</li> <li>Replicate at least 3 test runs for each 3 test series, respectively</li> </ul>	<ul style="list-style-type: none"> <li>Length of test run               <ul style="list-style-type: none"> <li>Load stabilizing section: <math>\geq 20\text{m}</math></li> <li>Measuring section: <math>\geq 10\text{m}</math></li> <li>After catch : <math>\geq 10\text{m}</math></li> </ul> </li> <li>Harvest <b>full working width</b></li> </ul> 



# 5 QUALITY OF WORK

- A typical **materials flow** in Combine harvester



	Harvested crop		Grain		Straw
	Grain, chaff and short straw		Returns		Chaff

< Source: Combine Harvesters, Petre Miu >



- Before harvesting,  
remove pre-harvest losses in the head loss test section for measuring header loss
- When harvesting,

**Operator**

- Drive ground speed constantly, stubble height  $\leq 10\text{cm}$

**Speed checker**

- Measure the ground speed





**Supervisor**

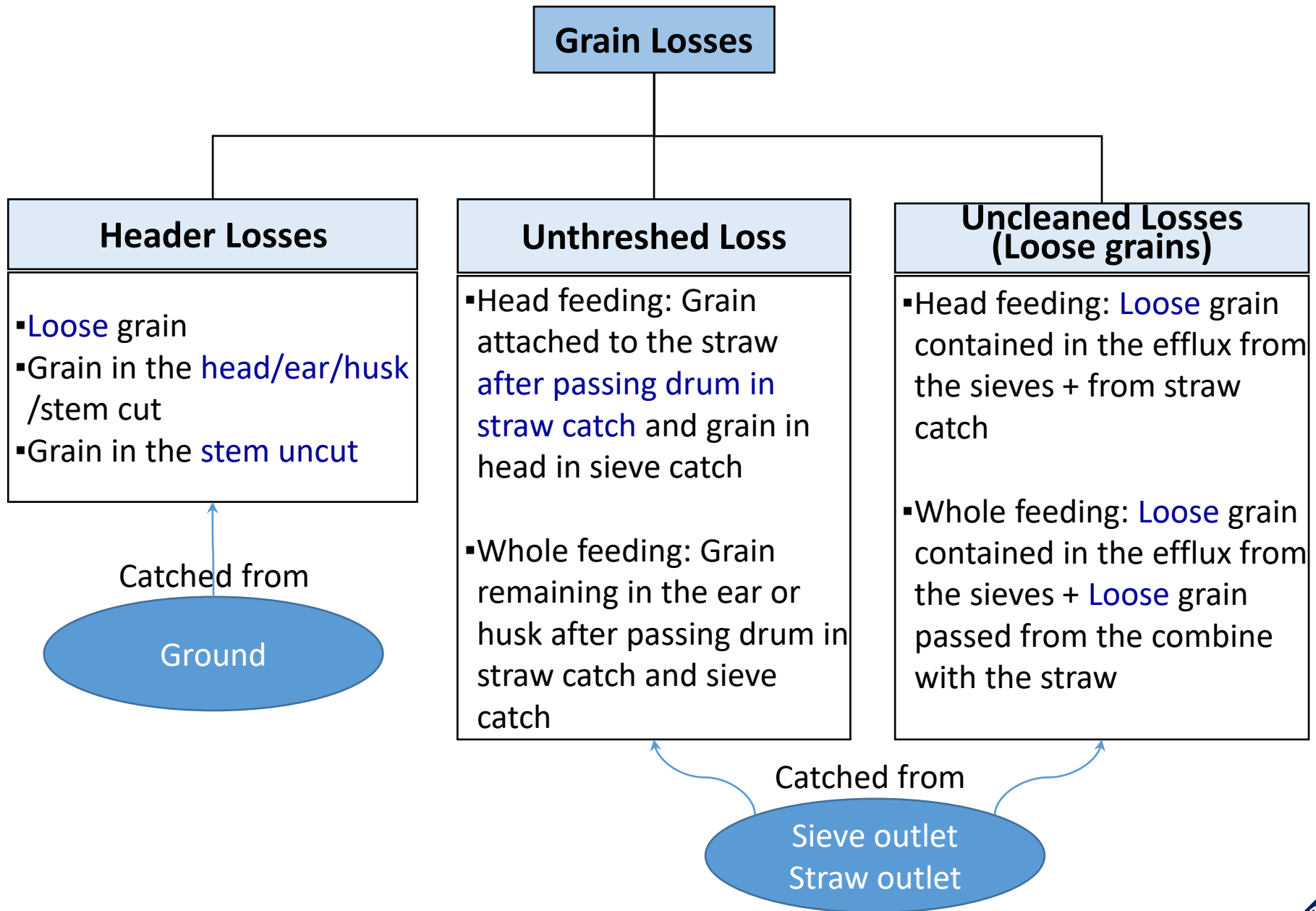
- Check all machine behavior
- Safety First control.

**Dust man**

- Catch whole efflux continuously without interruption
- Catch straw outlet, sieve outlet separately

### ● Head Losses, Cleaning and Separating the Losses in the catches

Head Losses	Losses in sieve catch	Losses in straw catch
<ul style="list-style-type: none"> <li>▪ <b>Gather</b> grains in 3 each loss test area(W x L1m)                             <ul style="list-style-type: none"> <li>- loose grains</li> <li>- grains in the <b>head/husk /stem cut</b></li> <li>- grains in the stem <b>uncut</b></li> </ul> </li> <li>▪ <b>Convert</b> to total head losses of the measuring section by multiplying the area ratio</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>Gather</b> the loose grains from the sieve catch</li> <li>▪ <b>Separate</b> <ul style="list-style-type: none"> <li>-Rice,Barley: grains in <b>head</b></li> <li>-Bean: grains in the <b>husk</b></li> </ul> </li> </ul> 	<ul style="list-style-type: none"> <li>▪ <b>Gather</b> the loose grains from the straw catch</li> <li>▪ <b>Separate</b> <ul style="list-style-type: none"> <li>- Rice: grain attached to the straw <b>after passing drum</b></li> <li>- Soybean : grain remaining in the <b>husk</b></li> <li>- Barley : grain remaining in the <b>head</b></li> </ul> </li> </ul> 
		



## Estimation of the Total weight of grains and Grain losses

- **Total weight of grains from measured section consists of;**
  - Estimated weight of grains **unloaded** harvested from **the measurement section**, excluding impurities, calculated by multiplying the area ratio
  - Weight of **head** losses grain
  - Weight of **unthreshed** losses grain
  - Weight of **uncleaned** losses grain

- **Total Loss,% = Head losses + Unthreshed losses + Uncleaned losses**

$$\text{- Head losses, \%} = \frac{\text{Weight of head loss grains}}{\text{Total weight of grains from the measurement section}} \times 100$$

$$\text{- Unthreshed losses, \%} = \frac{\text{Weight of unthreshed loss grains}}{\text{Total weight of grains from the measurement section}} \times 100$$

$$\text{- Uncleaned losses, \%} = \frac{\text{Weight of uncleaned loss grains}}{\text{Total weight of grains from the measurement section}} \times 100$$

The Total Loss shall be less than: rice 2%, barley 2%, soybean 3%.



## Collecting harvested grains and sampling for analysis



- **Unload** the harvest from whole test run (pre-section + measuring section + post-section)

- Measure the unloaded **weight**
- Measure the **moisture content** of the grain
- **Sample**  $\geq 300\text{g}$  for grain analysis

- **Sort** the sample
  - **Damaged grains** : broken + crushed + dehulled rice
  - **Impurities**: broken straw, leaves, e.t.c.

- **Damaged grain or impurities, % =  $100 \times \frac{\text{Weight of damaged grain or impurities}}{\text{Total weight of sample including damaged grain and impurities}}$**

- Damaged grain shall be less than rice 1%, barley 1%, soybean 2%
- Rubbish shall be less than rice 1%, barley 1%, soybean 3%

- **Purpose**

To test field **work rate**, mean ground speed, **machine behavior**, fuel consumption, e.t.c. in **continuous** harvesting.

- **Test conditions**

- The combine should be operated at speed which can attain **the best work rate**.
- The size of field shall be larger than 20a(80m x 25m)

- **Procedure for rating the combine**

1) When harvesting, work rate, and machine behavior, e.t.c. shall be tested.

$$\text{Rate of work(a/h)} = \frac{\text{Area covered(a)}}{\text{Work time(min)}} \times 60$$

\*work time =cutting +turning +unloading time(excluding moving time for unloading)

$$\text{Grain harvesting rate(t/h)} = \frac{\text{Total weight of harvested grain unloaded(t)}}{\text{Work time(min)}} \times 60$$

- 2) **Ground speed** at the minimum of three tests between 20 m distance.
- 3) **Fuel consumption** measured by filling and weighing method
- 4) **Stubble height** shall be less than 10 cm
- 5) **Machine behaviors** shall be observed
- 6) **Damaged grain** shall be analyzed as in the quality of work test.

### Performance Requirements

- 1) Height of stubble of barley and soybean shall be less than 10cm,
- 2) Damage grain shall be less than: barley 1%, soybean 2%
- 3) No malfunction shall be observed.



- **Adaptability for the laid rice**

- in 4 directions of lateral **left**, lateral **right**, **forward**, **backward** direction
- in each 4 laid area larger than 10m x 10m

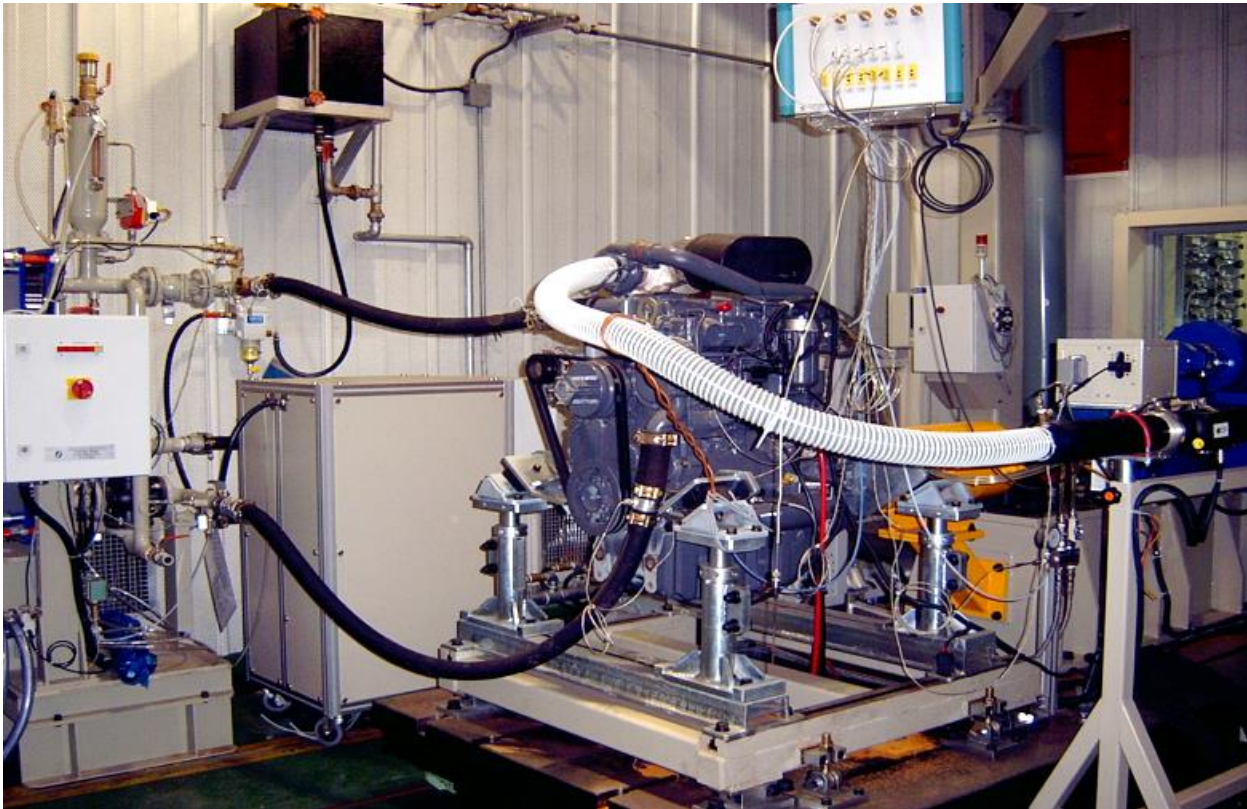


# 8 ENGINE PERFORMANCE

- **K.O.A.T. engine test method.**

- Tests the **crankshaft output power** with its fuel consumption.
- Tests max. power test, full load and varying speed, and part load at varying load.

\* Engine rated power output above 19kW requires **Stage V emission** certificate.



## ● Convenience test

- Ease of **access** to driving position
- Accessibility and ease of **operation of controls**
- Ease of **adjustment** and routine **maintenance**
- **Cleaning** out combine
- Accessibility and number of grease points
- Others

## ● Noise level test at the driving position

- Measurement when **harvesting in maximum ground speed**
- **Microphone** shall be face forward, **position** of center:
  - 250 mm to the side of the median plane of the seat
  - 700 mm above, 100 mm forward of the seat index point.

## ● Safety mechanism

- The **cutter bar** shall not be operated without the operation of threshing parts.
- For head feeding type, **emergency stop** shall be located **near the threshing input part**.

## ● Safety devices

- **Automatical power cuts off** the cutting part when clogged with rice straw, etc.
- For lifting part, mechanical **supports** or hydraulic **locking devices** shall be provided to prevent inadvertent lowering

## ● Warnings : grain **tank full**, flow of materials **clogged**, backward moving

## ● Lateral Stability : Left/right side **overturning angle** shall be **above 30°** on the tilt table

## ● Others :

- Observing of the **grain level** shall be possible from outside the grain tank.
- On the vehicle chassis, year of manufacture shall be marked according to 'ISO 3779:2018 **Vehicle identification number**'.



A photograph of a field of golden wheat under a blue sky with wispy clouds. The wheat stalks are in the foreground, and the sky is in the background. The text "Thank you very much for your attention !" is overlaid in the center of the image.

**Thank you very much  
for your attention !**