

THE ENGINEERING EQUIPMENT AND MATERIALS USERS' ASSOCIATION

Industrial Cooling Tower Fans and Fin Fans

Guide for Design, Maintenance and Operation

PUBLICATION 215

Edition 1

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ENGINEERING EQUIPMENT AND MATERIALS USERS' ASSOCIATION

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1. Introduction

This Guide addresses the best design, maintenance and operation of mechanical draught cooling tower fans and fin fans used in air cooled heat exchangers. If fans are neglected until they fail, there is often extensive damage to the housing and danger of pieces of blade being thrown out. As well as causing damage to plant, this type of failure presents an unacceptable risk to the safety of personnel. It is clearly desirable to define and adopt appropriate maintenance procedures.

The purpose of this Publication is to set out appropriate maintenance practices. It provides a framework for the maintenance routines and gives details of what is required.

2. Scope

The scope of this Guide covers mechanical draught cooling tower fans and fin fans as used in industrial air cooled heat exchangers. It excludes small fractional-kilowatt drives provided as part of proprietary equipment, e.g. analysers, laboratory equipment, heating and ventilating systems. The Guide does not cover the structural or pressure equipment aspects of the equipment, other than those that directly impinge on the safe operation of the fan.

The Guide frequently recommends 'best practice'. This term is used in the sense adopted by the GB Health & Safety Executive as being a recommendation beyond that which is simply required to meet regulations. For a definition of 'best practice' and 'good practice' see Chapter 4.

3. Guidance

3.1 Description of Mechanical Draught Cooling Towers

Figure 1 shows a typical industrial mechanical draught cooling tower fan *in situ*. Appendix 1 gives further details of a typical cooling tower fan assembly arrangement.



Figure 1 Typical industrial mechanical draught cooling tower fan

3.1.1 Motor and Drive Shaft

Each cooling tower cell has an electric motor mounted just outside the fan chamber with a horizontal drive shaft taking power to the central fan gearbox. On small towers, a single-piece hollow steel shaft (up to 2.5 m (8 ft) long) may be used. On larger towers, former practice was that intermediate bearings were installed on multi-piece shafts. The intermediate bearings can be a significant source of problems and so best practice is to use a single-piece carbon fibre shaft.

3.1.2 Central Gearbox

The central gearbox is of a worm and wheel design, which reduces the motor drive speed down to the fan speed. The fan hub is mounted directly onto the output shaft of the gearbox. The gearbox is typically oil lubricated, with the oil level maintained via an oil pot mounted outside the flume and connected to the gearbox by a small bore pipe. A gearbox vent line may also be provided, venting adjacent to the oiler. In some cases, external oilers are not used and the oil is added direct to the gearbox when it is off-line. Gearboxes can also be connected

to a pure mist or purge mist lubrication system in order to help prevent moisture from entering the gearbox. The lubrication of the gears themselves is either by splash lubrication from the sump, or in some cases an internal oil pump provides pressurised lubrication.

Given the harsh conditions that the gearbox has to operate in, regular inspections are required. Best practice is to put an access walkway from the outside of the flume to the central gearbox. Use of fibreglass open mesh decking and a wooden structure does not affect the air flow in the cooling cell.

3.1.3 Fan Blade Materials

3.1.3.1 GRP Blades

GRP blades have been in use for many years and are now recommended for new applications. They offer higher efficiency than aluminium blades, do not suffer from corrosion and have given good service. The blades typically have plain ends and are clamped into the hub with aluminium mounting locks secured by means of U-bolts.

3.1.3.2 Solid Aluminium Blades

Cast aluminium blades are typically manufactured in LM4 alloy. Blades up to about 4.3 m (14 ft) diameter are screwed into the hubs with a very fine thread. The female hub threads are split and clamped onto the blade stubs after setting the blade angles. Longer blades have plain ends which are clamped into rubber mounting bushes. These blades are heavy and fatigue failures near the hub have occurred whilst in service. In some cases, blade failures have been caused when the blade has caught the fan cowl. If a single blade failure occurs, other blades often fail due to the out-of-balance condition. On some occasions, blades have been ejected into neighbouring cells causing further failures or ejected from the cooling tower/fin fan altogether with the consequent risk to personnel.

3.1.3.3 Hollow Aluminium Blades

Cooling tower blades can be made from interlocking hollow aluminium sections bolted to an aluminium spar that reinforces the blade near the central hub. In one known application, these blades suffered significant corrosion after two years in service, which then lead to fatigue cracks and blade failure. This design of blade is not recommended for cooling tower service.

3.1.3.4 Wooden Blades

Wooden blades were supplied historically, but are not normally used in modern designs.

3.1.4 Guarding

The flume effectively provides the guard for the cooling tower cell, besides the small guard at the drive motor. Guarding design should where possible retain the fan blades in the event of their failure. Given the variety of fan blade and cooling tower arrangements, complete containment cannot be certain, but where practical guarding options that contain the fan blades are available, best practice is to use these.