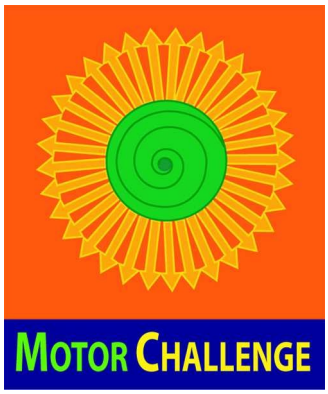
EUROPEAN COMMISSION
DIRECTORATE-GENERAL ENERGY AND TRANSPORT

New Energies & Demand Management
Promotion of Renewable Energy Sources & Demand Management

Brussels, 1 January 2003

THE EUROPEAN MOTOR CHALLENGE PROGRAMME

Compressed Air Systems Module



Contents

1.Introduction to the CAS Module document

This document is subsidiary to the Motor Challenge Programme (MCP) "Partner Guidelines". It defines what an MCP Partner Action Plan should cover, if the Partner company's commitment includes Compressed Air Systems (CAS)[1]. In particular, it explains what a Partner does for each of the following steps of participation in the Motor Challenge:

- **Inventory** of CAS components and system functioning
- **Assessment** of the applicability of possible energy savings measures
- **Action Plan**, presented to the Commission, which defines what the Partner has decided to do to reduce operating costs by improving energy efficiency
- **Annual report** of progress on the Action Plan.

Note that documents relating to the Inventory and the Assessment are in house, confidential documents, while the Action Plan and Annual Report are reported to the Commission.

2.Inventory of CAS components and system functioning

As a first step towards identifying applicable energy savings measures, an MCP Partner should establish an **Inventory** of CAS system components and major system operating parameters. The Inventory is established in 3 phases.

A. Basic system description

This consists of consulting company records or carrying out simple measurements, in order to assemble the following data.

1. Equipment list and layout : type and size of compressors, main uses of compressed air, age of system components
2. End use pressure (point of use, minimum)
3. More than one pressure required?
4. Pressure at compressor
5. Pressure after air treatment equipment
6. Operating hours/year
7. Demand profile: estimated variation during day/week
8. Air quality required
9. Is system shut off when not needed?
10. Size of receiver (or receivers)

In many organisations, most or all of this data could be assembled by in house staff.

[1] Refer to the "Partner Guidelines" for an explanation of terms such as "Partner", "Action Plan" and "commitment".

B. Documentation and measurement of system operating parameters

Documenting or measuring the following elements is desirable for all systems, and essential for large systems (over 200 kW). Collection of this data could be carried out by qualified in house engineering staff, or by a third party, such as an MCP endorser.

11. Total amount of leaks including condensate traps (by simple bleed down test, or by installing flow meter)
12. Intake air temperature in relation to ambient air temperature
13. Pressure before lubricator
14. Load / unload differential
15. Type and functioning of system control and individual compressor controls
16. Power consumption: total for the production site; part for CAS
17. Is whole ring main being used? Are there shutoffs for unused portions?
18. Is there water in the distribution network at point of use?
19. Do all end use items shut off properly?
20. For large systems, a data logger and appropriate input devices should be used (probably installed for the assessment period only) to measure: pressure, temperature, flow, power/current and relative humidity. For smaller systems, use best available data: establish compressor on/off load periods, power consumption, and pressure at compressor delivery and main consumption point.

C. Global indicators of system performance

On the basis of the data collected, the following global indicators of compressed air system performance can be calculated or estimated.

Annual costs:	Capital		Maintenance		Energy	
Annual operating hours			Avg. flow (Nm^3/hour)		Air quality	
Compressed air use compared to goods produced (000 Nm^3/Q-Prod.) (1)						
Indicative overall unit compressed air cost (Euros/000 Nm^3)						

(1) Q-Production is some relevant indicator of the volume of goods produced at the production site, expressed, for instance, in tonnes, yards, pieces, …

Note that for many systems (particularly smaller ones under 200 kW) the potential savings would not justify the complex and costly data collection necessary to establish precise figures. In such cases, the assessment could be based on appropriate rules of thumb, for instance:

- annualised capital costs (amortisation, major upgrades, etc.) might be estimated at 7% of current replacement cost of entire system;
- maintenance might be 4% to 5% of current replacement cost;
- energy costs might be estimated from nominal power and operating hours.

3.Assessment of energy saving technical measures

Energy savings are possible in:
- Production and treatment of compressed air
- Compressed air networks
- End use devices
- Overall system design and operation.

Of course, the applicability of particular measures, and the extent to which they might save money, depend upon the size and specific nature of your operation. Only an assessment of the system and of your company's needs can determine which measures are both applicable and profitable. This could be done by a qualified compressed air service provider (who might be an MCP Endorser) or by qualified in-house engineering staff.

The assessment conclusions will identify the measures which are applicable to your system, and will include an estimate of the savings, the cost of the measure, as well as the payback time. Assessment results are confidential in house data, not reported to the Commission.

The following tables show the potentially significant energy savings measures which might be applicable to your system. In each table, the measures are presented beginning with those that have a large potential impact and are the easiest to implement.

Table 1: *Production of compressed air*

Optimise utilisation of system: adjustment of controls and pressure regulation, turn off when not in use
Optimise system air pressure *This is a function of end use devices*
Lower intake air temperature by moving air intake (while ensuring optimal intake filtering)
Modify or improve compressor control system
Optimise downstream filter changing (as function of pressure drop, …)
Filter and dry air to minimum system requirements (possibly install local filters/dryers for specific needs)
Recover and use waste heat
Increase main receiver size
Install adjustable speed drive
Consider a multi pressure system, or use local pressure boosters
Replace motors with high efficiency motors
Replace compressor(s) with newer or better adapted machine(s), having a lower specific energy consumption, adapted to system needs

Table 2: Distribution network

Institute a regular leak check programme. Reduce air leaks: low leakage fittings, high quality quick connectors, …
Divide system into zones, with appropriate pressure control or shut off valves. Close unused lines
Use "no air loss" condensate traps
Install supplemental receivers close to variable loads
Improve network: layout (create ring network, ...), pipe size

Table 3: End use devices

Eliminate inappropriate uses of compressed air
Repair or replace leaking devices
Shut off air when a machine is not operating
Verify need for (and optimise) device specific pressure regulators, filters, dryers.

The assessment should, for each of the measures in tables 1, 2 and 3, evaluate applicability and profitability. This might take a form similar to the following table.

Table 4: Assessment results

Energy saving measures	Specific proposed action	(1)Estimated annual energy savings	Change in annual O&M costs (2)	Additional investment cost (2)	Estimated payback time (months)
Production of compressed air					
Optimise utilisation of system					
…					
Distribution network					
Reduce air leaks					
…					
End use devices					
Eliminate inappropriate uses of compressed air					
…					

Legend
(1) When energy savings cannot be precisely measured (as is often the case), they can be estimated from the assessment results and generally accepted technical coefficients.
(2) Investment and O&M costs are estimates of changes in costs, with respect to what would have been spent without Partner commitment to the Motor Challenge. This may be, for instance: additional investment for higher performance equipment; increase/decrease in maintenance costs; associated savings from better quality or reliability, etc.

4.Action Plan

Your company's Action Plan, as proposed in the form below, should indicate:
- for the measures you have decided to implement: time scale for implementation;
- for the measures you have decided not to implement: the reasons.

The Action Plan is presented to the Commission. After approval, your organisation will be recognised as an MCP Partner.

Energy Savings Measures	Feasibility (1)	Specific Actions (2)	% Covered (3)	Time table (4)	(MWh/year)Expected savings (5)
Production of compressed air					
Optimise utilisation of system					
Optimise system air pressure					
Lower intake air temperature					
Modify or improve compressor control system					
Optimise downstream filter changing					
Filter and dry air to minimum system requirements					
Recover and use waste heat					
Increase main receiver size					
Install adjustable speed drive					
Consider a multi pressure system					
Replace motors with high efficiency motors					
Replace compressor(s) with newer or better adapted machine(s)					
Distribution network					
Reduce air leaks					
Divide system into zones					

Use "no air loss" condensate traps					
Install supplemental receivers					
Improve network: layout, pipe size					
End use devices					
Eliminate inappropriate uses of compressed air					
Repair or replace leaking devices					
Verify need for (and optimise) device specific pressure regulators, filters, dryers.					

Legend:
(1) **Feasibility.** Indicate obstacles to application by one or more of the following codes:
NA Not applicable for technical reasons
NP Not profitable
NC Not considered, because evaluation would be too expensive
If this field is left blank, the measure is considered to be both applicable and profitable.

(2) **Specific Actions.** Several specific actions may be adopted to implement one energy saving measure. For instance, buying a leak detector, and replacing low quality quick disconnects might be actions corresponding to the "Reduce air leaks" measure.

(3) **% Covered.** If the Partner's proposed commitment covers several CAS systems, this column should be used to indicate the proportion of the systems for which the specific actions will be implemented. This can be evaluated according to the most convenient indicator: number of systems; power; energy consumption. Specify the indicator used, as by: "%"; "%kW", %kWh"

(4) **Time table.** The time scale at which the action will be implemented. This might be a specific period or date, or might depend on some other action, for instance "When compressor is replaced", or "When paint shop is refurbished".

(5) **Expected savings** in MWh/year. This will often be an estimate, based on generally accepted practice.

5.Annual Report

The Annual Report to the Commission specifies progress made in carrying out the Action Plan, and will comment on any new or amended initiatives. The following reporting form should be used with progressive updating on an annual basis. The two left hand columns are copied from the Partner's Action Plan as approved by the Commission.

Approved Action Plan		Annual report for year 20xx
Actions decided upon to implement energy savings measures	Agreed upon time scale for action	Progress on action, as percentage achieved, and comments where appropriate (1)
Production of compressed air		
Action 1		
Action 2		
…		

Distribution network		
…		
End use devices		
…		

(1) The percentage achieved could refer to an indicator such as the proportion of systems in the scope of the Action Plan for which the specific action has been completed.

Partners may find it useful to produce parts of the following Synthesis of the results of commitment to the Motor Challenge. They are invited (but not required) to submit the Synthesis to the Commission.

Annual report synthesis		
	Since commitment	This year
Percentage of actions in Action Plan completed		
Estimated total investment for Plan (000 EUR) (1)		
Estimated change in non energy O&M costs (000 EUR) (1)		
Estimated energy savings (MWh) (1)		
Compressed air use compared to goods produced (000 Nm^3/Q-Prod.) (2)		
Indicative overall unit compressed air cost (Euros/000 Nm^3)		

(1) See above, legend for Table 4: Assessment results

(2) Q-Production is some relevant indicator of the volume of goods produced at the production site, expressed, for instance, in tonnes, yards, pieces, …